International Conference on

Recent Developments and Applications in Materials Science and Engineering

RDAMSE 2025

30th – 31st January, 2025

In association with

Indian Photobiology Society,
Jadavpur University, Kolkata
&
Sripat Singh College, Murshidabad

Book of Abstract

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Organized by: Department of Basic Science & Humanities,
Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (SurTech), (Autonomous Institution), Dum Dum, Kolkata

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Messages

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JIS GROUP
Educational Initiatives

Sardar Taranjit Singh
Managing Director, JIS Group

Message

It is my distinct pleasure to announce you to the International Conference on "Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025)." This event is not just a gathering of scholars and experts but a significant step toward addressing the challenges that our world faces in areas such as sustainability, renewable energy, healthcare, and manufacturing. Materials science is a critical pillar of modern innovation, and it is through such discussions that we create new possibilities for a better tomorrow.

As the Managing Director of JIS Group, I have always emphasized the importance of collaboration between industry and academia. This conference exemplifies that vision by bringing together thought leaders from across the globe to share ideas and solutions. I encourage all participants to actively engage in the sessions and discussions to enhance your understanding and make valuable connections.

The future of materials science lies in how we apply our research to solve real-world problems. Let this conference serve as a platform to inspire new collaborations and partnerships. I am confident that the knowledge shared here will not only advance your research but also help shape the future of materials science in meaningful ways.

I extend my warmest wishes to each of you for an enriching and successful experience at RDAMSE 2025.

Best Regards,

Taranjit Singh

Sardar Taranjit Singh
Managing Director, JIS Group

Sardar Simarpreet Singh
Director, JIS Group

Message

It is with great pleasure that I announce you to the International Conference on "Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025)." Materials science is a rapidly evolving field that influences numerous industries, including aerospace, healthcare, electronics, and environmental protection. This conference provides a wonderful opportunity for us to come together and share our latest research, innovations, and ideas that are transforming the world around us.

As a director of JIS Group, I strongly believe in the power of collaboration and knowledge sharing to drive innovation. RDAMSE 2025 brings together experts, students, and professionals from diverse backgrounds, all of whom share a common goal: to advance the field of materials science and engineering. I encourage all of you to take full advantage of the sessions, networking opportunities, and discussions that are being offered.

The discussions and interactions here have the potential to spark new ideas, inspire future research, and foster collaborative partnerships that can lead to significant breakthroughs in materials science. I am excited to see how this conference will contribute to shaping the future of this important field.

I wish you all an insightful and successful experience at RDAMSE 2025.

Warm regards,

Sardar Simarpreet Singh
Director, JIS Group

যাদবপুর বিশ্ববিদ্যালয়

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OFFICE OF THE VICE-CHANCELLOR : AUROBINDO BHAVAN ANNEXE

Date: January 28, 2025

MESSAGE

It gives me immense pleasure to extend my heartfelt greetings to the organizers, participants, and attendees of the International Conference on Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025), organized by the Department of Basic Science & Humanities, Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (Sur Tech), JIS Group, in collaboration with the Indian Photobiology Society, Jadavpur University.

In this rapidly advancing world, materials science and engineering play a pivotal role in addressing the challenges of sustainable development. Conferences like RDAMSE 2025 are vital platforms for bringing together scholars, researchers, and professionals to share cutting-edge ideas, foster collaborations, and develop innovative solutions to global challenges. It is heartening to know that this conference focuses on Sustainable Development Goals (SDG) 6, 7, and 13, emphasizing clean water, affordable energy, and climate action.

Jadavpur University has always been committed to advancing research, fostering innovation, and promoting industry-academia collaborations. I am pleased to see that this conference aligns with our shared vision of bridging the gap between academic research and real-world applications. The collaboration with esteemed journals such as ChemistrySelect (Wiley) and Engineered Science underscores the conference's high academic standards and the global relevance of its contributions.

I commend the efforts of the organizers for creating a multidisciplinary forum that unites experts, students, and industry professionals, fostering an exchange of ideas that will undoubtedly lead to impactful outcomes. I am confident that the proceedings of RDAMSE 2025 will pave the way for novel advancements and inspire young minds to contribute to a sustainable future.

I wish the conference grand success and encourage all participants to make the most of this enriching opportunity. Let us continue to work collectively to address global challenges and create a better world.

Warm regards,

Bhaskar Gupta

Residence : 19C/1 Kalibari Lane Kolkata 700032, West Bengal, India
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Prof. Tanusri Saha-Dasgupta

APS fellow, FTWAS, FNA, FASc, FNASc, J.C. Bose National Fellow

Director
S. N. Bose National Centre for Basic Sciences
Under Department of Science and Technology, Govt. of India

Message

It gives me immense pleasure to extend my heartfelt greetings to the organizers, participants, and attendees of the International Conference on Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025), organized by the Department of Basic Science & Humanities, Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (Sur Tech), JIS Group, in collaboration with the Indian Photobiology Society, Jadavpur University and Sripat Singh College, Murshidabad.

In today's rapidly evolving world, materials science and engineering hold a central role in tackling the pressing challenges of sustainable development. Events like RDAMSE 2025 serve as invaluable platforms, bringing together scholars, researchers, and professionals to exchange cutting-edge ideas, foster collaborations, and develop innovative solutions to address global issues effectively.

It is truly commendable that RDAMSE 2025 emphasizes Sustainable Development Goals (SDG) 6, 7, and 13, focusing on clean water, affordable energy, and climate action—areas critical to ensuring a sustainable future.

S.N. Bose National Centre for Basic Sciences (SNBNCBS) has consistently demonstrated its commitment to advancing research, fostering innovation, and bridging the gap between academia and industry. The alignment of this conference with such a vision is both timely and significant. The collaboration with esteemed journals like ChemistrySelect (Wiley) and

Engineered Science further reinforces the conference's academic rigor and its relevance to global scientific advancements.

I applaud the efforts of the organizers in establishing a multidisciplinary forum that brings together experts, students, and industry leaders. This exchange of ideas promises to yield impactful outcomes and inspire the next generation of researchers to rise to the challenge of creating a more sustainable world.

I extend my best wishes for the grand success of RDAMSE 2025 and encourage all participants to engage actively, learn, and collaborate during this enriching event. Together, let us contribute to addressing global challenges and shaping a brighter, more **sustainable future.**

Warm regards,

JIS INSTITUTE OF ADVANCED STUDIES & RESEARCH, KOLKATA
(An Autonomous Institute under JIS University)

JIS UNIVERSITY

Prof. Ajoy Kumar Ray (Padma Shri)
Director
Former Professor, IIT Kharagpur
Former Director, IIEST Shibpur

Message

I am delighted to know that Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex, Dum Dum Kolkata, a premier institute of the JIS Group, has organized the International Conference on Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025). It is well recognized that materials science is advancing rapidly, making a significant impact across various facets of human life. From healthcare and environmental sustainability to diverse industrial applications, materials science continues to shape and enhance our daily existence, and I am confident it will sustain this remarkable trajectory.

Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex provides an exceptional interdisciplinary platform for scholars, scientists, researchers, and engineers to discuss the multifaceted applications of materials science. The conference addresses critical areas such as ensuring access to clean and potable water, promoting clean air and a sustainable environment, and driving advancements in healthcare, industries, transportation, telecommunications, and more.

I am certain that the participants of this conference will gain valuable insights and contribute to a transformative field that promises to revolutionize every aspect of our future. I wholeheartedly congratulate the organizing team for hosting such a significant event and wish the conference lasting success and meaningful outcomes for all attendees.

INDIAN PHOTOBIOLOGY SOCIETY

(Regd. No. : S/10422)

(Affiliated to the Association Internationale de Photobiologie)

Department of Chemistry, Jadavpur University, Kolkata 700 032

President: Prof. Ashok Kumar Mishra Secretary: Prof. Chittaranjan Sinha

www.ipbsindia.in/ <indianphotobiology@gmail.com>

Message from the President, Indian Photobiology Society

It is indeed a matter of great pleasure and satisfaction that Department of Basic Science & Humanities, Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (Sur Tech), JIS Group, Dum Dum, Kolkata, is organizing an international conference on "***Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025)***" in collaboration with the Indian Photobiology Society (IPS) on January 30th and 31st, 2025.

Research on Materials Science has been steadily growing over the last few decades. The slope of this growth has been fairly steep currently, as is seen from the increasing number of new journals in this area. This conference has been designed to provide a multidisciplinary platform for sharing novel ideas, developments, and challenges in the field of materials science. Development of Materials Science and Engineering linked to 'Sustainable Development Goals' is also a note-worthy theme of this conference. The Institute has indeed chosen a theme of strong current relevance.

I have also noted that the Institute is collaborating with 'Chemistry Select' (Wiley), an SCI-indexed journal, and 'Engineered Science', a Scopus-indexed journal, for publishing selected papers. They are also planning publication of extended abstracts in an ISBN-indexed Conference Proceedings Book of Abstracts. I am sure this facilitation will encourage researchers to participate in the conference.

I sincerely thank the Institute and the Organizing Committee for this noble endeavour and wish them all success.

I convey my very best wishes for the grand success of this international event.

Ashok Mishra

(Ashok Kumar Mishra)

INDIAN PHOTOBIOLOGY SOCIETY

(Regd. No. : S/10422)

(Affiliated to the Association Internationale de Photobiologie)

Department of Chemistry, Jadavpur University, Kolkata 700 032.

President : Prof. Nitin Chattopadhyay Secretary: Prof. Chittaranjan Sinha

www.ipbsindia.in/ <indianphotobiology@gmail.com>

11/01/2025

MESSAGE

It is indeed an honor that Indian Photobiology Society is associated as a partner in the International Conference on "**Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025)** on **January 30th and 31st, 2025**" organized by *Dr. Sudhir Chandra Sur Institute of Technology & Sports Complex, Dum Dum, West Bengal*. A group of internationally acclaimed scientists will demonstrate their research results in view of the salvation of the suffering humanity and to motivate the future generation for the betterment and sustainability of the society. It is needless to say that a strategic change in information system and technological revolution towards exploration of energy saving, drug design, transportation, materials for daily use towards achieving sustainability etc. has extended average life in the globe. Today's challenge is energy conservation, environmental protection, to feed the masses and providing amenities along with protection of every living and non-living part of the world. It is clear that further development and understanding of the low-cost environmentally benign materials, are needed to improve the quality of life.

The Indian Photobiology Society (Regd. No.: S/10422A; www.ipbsindia.in/), one of the oldest interdisciplinary organisation in the country inclusive Physics, Chemistry, Biology, Medicine, Pharmacy, Environment and Engineering & Technology. The Society started in 1964 under the leadership of Prof. Krishna Kamini Rohatgi-Mukherjee as Secretary in Jadavpur University and Dr. B. P. Mukherjee, D. Sc., Director of Chittaranjan National Cancer Institute, Kolkata & Former Director of CDRI, Lucknow, as the founder President and is working more than sixty years through different scientific activities like Conferences, Seminars, Symposia, Students Competition, Young Scientists Program; Publication of IPS News Letter, IPS instituted Lifetime Achievement Awards, Endowment Awards, Fifteen Memorial Awards to promote scientific activities. In addition, collaborative scientific program with Colleges, Universities, Research institutes are continuing for last couple of years. Monthly IPS Science Talk, one such interesting activity of the Society, is running every month last Saturday at evening. The Society has Life Membership and Students Membership facilities. Application forms are available in the IPS Website, www.ipbsindia.in/.

I am indeed happy that different units of Dr. Sudhir Chandra Sur Institute of Technology & Sports Complex have massively united to make the program success and have promised to reach the future generation with modern science and technology. It is indeed worth to mention that the Engineered Science Publishers and Wiley are extended their collaboration to publish research articles in their peer reviewed journals.

I hope all of you join actively to make this endeavor in success.

Happy Healthy Prosperous New Year 2025!

(Prof. Chittaranjan Sinha PhD, FAScT, FESS, FICS, FRSC)

Secretary, Indian Photobiology Society

Dean, Faculty Council of Science & Professor, Department of Chemistry, Jadavpur University

SRIPAT SINGH COLLEGE

[NAAC ACCREDITED]
P.O. Jiaganj, Dist. Murshidabad, West Bengal, PIN 742 123
e-mail: sscollege2009@gmail.com

Sripat Singh College Joins Hands with RDAMSE 2025 for Academic Collaboration

It is a privilege for Sripat Singh College, Murshidabad, to collaborate with the Department of Basic Science & Humanities, Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (Autonomous Institution), JIS Group, Kolkata, for the International Conference on Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025), scheduled for January 30–31, 2025.

This prestigious international conference, organized in association with the Indian Photobiology Society, Jadavpur University, aims to provide a multidisciplinary platform for discussions on cutting-edge innovations, recent advancements, and challenges in materials science. The focus will be on addressing critical Sustainable Development Goals reinforcing the commitment to sustainability and scientific progress.

Sripat Singh College is proud to be an integral part of this endeavour, fostering knowledge-sharing and research-driven collaborations. We look forward to engaging with eminent scholars, industry experts, and young researchers to drive meaningful discussions and innovations in the field of materials science.

I wish this conference a grand success.

Dr. Kamal Krishna Sarkar

Principal
Sripat Singh College
Jiaganj, Murshidabad

On behalf of SurTech Research Innovation Centre, we extend our heartfelt best wishes to the RDAMSE (Recent Developments in Advanced Materials Science and Engineering) conference. It is with great enthusiasm that we commend the organizers, participants, and attendees for their commitment to advancing research and development in this critical and dynamic field.

The RDAMSE conference stands as a prestigious platform that brings together some of the brightest minds in academia, research, and industry. It provides an unparalleled opportunity to showcase ground-breaking innovations, share knowledge, and collaborate on solutions to some of the most pressing challenges in advanced materials science and engineering. Conferences like RDAMSE are not just gatherings; they are milestones in the journey of scientific exploration and technological evolution.

At SurTech Research Innovation Centre, we firmly believe that materials science and engineering are at the heart of the technological advancements shaping our future. From renewable energy technologies and sustainable manufacturing processes to next-generation electronic devices and biomedical applications, this domain continues to revolutionize the way we live, work, and interact with the world around us.

The themes of RDAMSE resonate deeply with our mission to drive innovation and foster interdisciplinary collaboration. As research and innovation hubs, we share a common goal to develop solutions that are not only cutting-edge but also sustainable and inclusive. The insights and ideas shared at RDAMSE have the potential to spark new avenues of research, inspire young scientists, and create partnerships that could transform industries globally.

We applaud the efforts of the RDAMSE organizing committee for curating such a high-quality event. It is the dedication of these individuals that ensures an environment conducive to meaningful dialogue, productive networking, and impactful discoveries. To the researchers and innovators presenting their work, we express our admiration for your contributions to the field. Your ideas and efforts form the backbone of scientific progress and technological breakthroughs.

As the RDAMSE conference unfolds, we hope it becomes a beacon of inspiration for all participants. May it lead to thought-provoking discussions, valuable collaborations, and a shared commitment to pushing the boundaries of what is possible? The challenges of our time demand solutions that are innovative, sustainable, and scalable, and events like RDAMSE are vital to achieving these outcomes.

In closing, we once again extend our best wishes for the success of the RDAMSE conference. May it achieve all its objectives, inspire progress, and leave an indelible mark on the field of advanced materials science and engineering. SurTech Research Innovation Centre is proud to support and celebrate this remarkable endeavour.

From,

Mr. Sobhan Chakraborty (Project Head)

Mr. Suvendu Mondal (Programme Head)

Prof. (Dr.) Saradindu Panda
Principal –
Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex
(SurTech), (Autonomous Institution), Dum Dum, Kolkata

Message

I am pleased to announce that SurTech is organizing the International Conference on "Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025)." This conference marks a significant milestone in the field of materials science, as it brings together top researchers and professionals who are at the forefront of innovation. Over the next few days, we will have the opportunity to explore the most cutting-edge developments that are shaping industries such as nanotechnology, energy, and healthcare.

As the principal of DSCSITSC, I am deeply committed to the idea that academic research and industry applications must go hand in hand to drive real-world change. This conference offers a unique chance to bridge the gap between theory and practice, creating opportunities for collaborative research and development that can lead to the next wave of innovations in materials science.

The contributions you make during this conference, whether through presentations, discussions, or networking, are integral to the growth of the field. I encourage you to take full advantage of this gathering, to learn from one another, and to form connections that will continue long after the conference has ended.

I am confident that the knowledge shared here will not only enhance your professional expertise but also inspire new ideas that will influence the future of materials science and engineering.

Prof. (Dr.) Saradindu Panda
Principal –
Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex
(SurTech), (Autonomous Institution), Dum Dum, Kolkata

Mr. Anirbit Sengupt
Deputy Registrar
Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex
(SurTech), (Autonomous Institution), Dum Dum, Kolkata

Message

On behalf of Dr. Sudhir Chandra Sur Institute of Technology & Sports Complex, it is my great pleasure to organize the International Conference on Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025).

We are thrilled to host this important event, which brings together experts, practitioners, and students from across the globe to exchange knowledge, ideas, and experiences in the ever-evolving field of materials science. The conference provides a unique opportunity to explore the latest trends, breakthroughs, and applications that are shaping the future of engineering and technology.

As we stand at the crossroads of significant advancements in materials research, RDAMSE 2025 offers a platform to foster collaborations, share insights, and inspire new avenues for scientific inquiry. The interdisciplinary nature of materials science today is enabling remarkable progress in diverse sectors—from energy to healthcare, and from environmental sustainability to nanotechnology. Your participation in this event plays a crucial role in furthering these exciting developments.

We are honoured to have a distinguished group of speakers and attendees joining us, and I encourage you to engage in fruitful discussions, exchange knowledge, and form lasting professional connections. Together, let us make RDAMSE 2025 a memorable and impactful experience for all.

I wish you a successful and enriching conference!

Dr. Dipankar Das
Convenor, RDAMSE 2025
Head of Department, Basic Science and Humanities

Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex

(SurTech), (Autonomous Institution), Dum Dum, Kolkata

Message

It is with great pleasure and excitement that I welcome you to the International Conference on "Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025)." As the Convenor of this event, I am truly honored to be part of this vibrant gathering of scholars, researchers, and industry professionals who are passionate about driving advancements in the field of materials science.

Materials science is a pivotal area of study that influences numerous industries, ranging from energy solutions to healthcare, manufacturing, and environmental sustainability. This conference presents an incredible opportunity to share knowledge, explore cutting-edge innovations, and discuss how we can apply these discoveries to tackle global challenges. It is also a unique opportunity to forge new collaborations that will shape the future of this field.

At DSCSITSC, we believe in fostering an environment that encourages both academic inquiry and practical application. By bringing together experts and researchers from diverse backgrounds, this conference will undoubtedly provide insights and inspiration that will help push the boundaries of materials science. I encourage all of you to engage with the presenters, participate in thought-provoking discussions, and network with fellow participants to form partnerships that can lead to impactful future research.

The topics that will be covered during this event are critical to the continued advancement of industries across the world. From the latest developments in nanomaterials to sustainable solutions for energy storage, the knowledge exchanged here will be integral to the ongoing evolution of materials science.

I would like to extend my deepest gratitude to all of you for being part of RDAMSE 2025. I look forward to the discussions and the ideas that will emerge over the coming days. May this conference be a source of inspiration and an important milestone in your personal and professional journeys.

Best regards,

Dr. Biswajit Das
Co-Convenor, RDAMSE 2025
Department of Basic Science and Humanities

Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex

(SurTech), (Autonomous Institution), Dum Dum, Kolkata

Message

It is a privilege and honour to serve as the Co-Convenor of the International Conference on "Recent Developments and Applications in Materials Science and Engineering (RDAMSE 2025)." This conference marks a significant opportunity to exchange ideas, share groundbreaking research, and explore the latest innovations in the field of materials science. As someone who is deeply involved in both academic research and the practical applications of materials science, I am excited to see what will emerge from our collective conversations and discussions.

Materials science is not only about understanding the structure and properties of materials but also about finding practical solutions to challenges that affect industries and society at large. The advancements in this field have the potential to revolutionize how we approach energy, manufacturing, healthcare, and much more. This conference provides a unique opportunity for us to connect research with real-world applications, allowing us to shape the future of materials science for the benefit of global communities.

As Co-Convenor, I encourage all participants to make the most of the numerous opportunities to learn from experts, engage in discussions, and form collaborations that will continue long after the conference ends. The diverse backgrounds and expertise of the participants here will undoubtedly lead to exciting new perspectives and innovative ideas that have the power to reshape industries.

I am confident that RDAMSE 2025 will be an intellectually stimulating and productive event that will inspire you to continue pushing the boundaries of your research and professional development. Let us work together to build new partnerships, generate new knowledge, and advance materials science for the benefit of future generations.

I look forward to a successful and enriching conference experience for all of you.

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CONTENT

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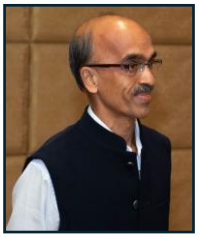
Ceramics for Space

Dr M. R. Ajith
Scientist G,

Indian Space Research Organisation, India



ABSTRACT

Ceramics are not as popular as their counterparts namely polymers or metals while coming to space applications. However they are still used in some very critical applications. The talk will cover in brief the various ceramics being used in ISRO's space applications and will focus on the development and supply of various ceramic systems undertaken in the Advanced Materials Group of VSSC. These include Thermal protection system for re-entry applications, ceramics for electric propulsion, electronic ceramics, glass and glass ceramics, silica aerogel, magnets etc. The talk will focus on the significant contribution of the group in making India self reliant in the area of Thermal Protection system for re-entry applications.

During every re-entry of a space flight, the challenge is to design an effective Thermal Protection System. The high heat load imposed on the vehicle surface has to be carefully handled or the structure will be destroyed.

Radiation is by far the most important approach because heat rejection is a function of absolute temperature to the forth power. This is the principle behind which the high temperature silica tiles have been employed in space shuttle, Space Capsule recovery Experiment (SRE) and Reusable launch Vehicle – Technology demonstrator (RLV-TD) and Re-usable launch Vehicle Orbital re-enbtry Vehicle (RLV-ORV).

The talk will review the history of TPS development for the Space Capsule Recovery Experiment (SRE) and RLV-TD through the indigenous development of silica tiles. Some light on the critical technologies namely Boron Nitride silica and thermionic materials developed for electric propulsion will also be highlighted.

BIOGRAPHY

Dr. M.R. Ajith is a distinguished scientist who joined the Vikram Sarabhai Space Centre (VSSC) in 1999 and has made significant contributions to India's space program. A key member of the Indian Space Research Organisation

(ISRO), Dr. Ajith was part of the team that received the prestigious International Academy Laurels for Team Achievement Award in 2007. This honor, awarded during the International Astronautical Congress on September 28, 2008, in Glasgow, UK, recognized their groundbreaking work in developing silica tiles for re-entry applications. The same contribution also earned him the ISRO Team Award for 2007.

In 2012, Dr. Ajith was again recognized with the ISRO Team Award for his role in the development of Alumina Cored Bricks for the Hypersonic Wind Tunnel project. Notably, he and his team were responsible for the development of the Thermal Protection System for the Reusable Launch Vehicle Technology Demonstrator (RLV-TD), which was successfully launched on May 23, 2016.

Dr. Ajith's expertise is further evidenced by his impressive portfolio of five patents and over 35 invited talks at national and international conferences. Currently, he serves as the Group Director of the Advanced Materials Group and the Associate Project Director for the Thermal Protection System for RLV-ORV, continuing to contribute to advanced materials and thermal protection systems for space applications.

Dr. Ajith’s career is a testament to his exceptional dedication and innovation in the field of aerospace materials and thermal protection systems.

Health Management of Oil-Filled Transformers-Why and How

Prof. (Dr.) Sivaji Chakravorti

FNA, FNAE, FNASc, FAScT, AvHumboldt Fellow

Professor, Electrical Engineering Department, Jadavpur University

Former Director, National Institute of Technology Calicut

ABSTRACT

Transformers are not only critical components but also very expensive power system equipment. Large number of power transformers, which have oil-paper as the insulation, have already crossed their design life, but are still working fine. The strategy for health management of transformers is therefore of immense economic importance to power utilities all over the globe. Such strategy depends on monitoring of health of the insulation. Health monitoring is best performed if it is non-invasive in nature and if it could identify the ageing status of the most vulnerable insulation, viz. paper. The contaminant that damages paper insulation most is moisture. Hence, a good health monitoring technique of transformer is the one that could estimate moisture content in paper insulation accurately, which requires a proper understanding of moisture dynamics within the transformer insulation.

BIOGRAPHY

Dr. Sivaji Chakravorti is Professor of Electrical Engineering at Jadavpur University, Kolkata. He was the Director of National Institute of Technology Calicut during 2015-2020. He worked as Humboldt Research Fellow at Technical University Munich and also at ABB Corporate Research, Ladenburg. He is recipient of Technical University Munich Ambassador Award. He is Fellow of the Indian National Science Academy, Fellow of the Indian National Academy of Engineering, Fellow of the National Academy of Sciences India and Distinguished Lecturer of IEEE PES. He is presently Vice-President of the Indian National Academy of Engineering, President of the West Bengal Academy of Science & Technology and was formerly Chairman of IEEE India Council and an Associate Editor of IEEE Transactions on Dielectrics & Electrical Insulation. He has published more than 275 research papers, authored three books and owns one US patent, four Indian patents and two software copyrights. His current fields of interest are condition monitoring of power equipment, numerical field computation and optimization of insulation system.

Recent Developments on Utilisation of Secondary Raw Materials in close Loop Materials Cycles

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Sustainable Development & Circular Economy Research Centre,

International Society of Waste Management,

Air and Water (ISWMAW) & Founder Advisor,

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ABSTRACT

Natural resource extraction and processing are part and parcel for the national and global developmental activities. At present the natural resource extraction has soared by almost 400% since 1970 due to industrialisation, urbanisation and population growth, according to a presentation of the five-yearly UN Global Resource Outlook. Each year, the world consumes more than 92b tonnes of materials – biomass (mostly food), metals, fossil fuels and minerals – and this figure is growing at the rate of 3.2% per year. The global extraction of raw materials is expected to increase by 60% by 2060, with calamitous consequences for the climate and the environment, according an unpublished UN analysis seen by The Guardian. The stripping of Earth's natural materials is already responsible for 60% of global heating impacts, including land use change, 40% of air pollution impact, and more than 90% of global water stress and land-related biodiversity loss.

[https://www.theguardian.com/environment/2024/jan/31/raw-materials-extraction-2060-unreport#:~:text=The%20global%20extraction%20 of%20raw,analysis%20seen%20by%20the%20Guardian].

Extractive industries are responsible for half of the world's carbon emissions and more than 80% of biodiversity loss, according to the most comprehensive environmental tally undertaken of mining and farming. While this is crucial for food, fuel and minerals, the study by UN Environment warns the increasing material weight of the world's economies is putting a more dangerous level of stress on the climate and natural life-support systems than previously thought [https://www.theguardian.com/environment/2019/mar/12/ resource-extraction-carbon-emissions-biodiversity-loss]. Resources are being extracted from the planet three times faster than in 1970, even though the

population has only doubled in that time, according to the Global Resources Outlook, which was released in Nairobi recently.

Significant interest has been seen in recent part to curb the use of fossil fuels in different nations while the installation and use of the renewable electricity generation by energy sources are increasing year by year. The extraction of natural resources has to be reduced while the use of renewables needs to be increased. The need of effective waste management and implementation of circular economy strategies are significant in today's global requirements. Technologists, Scientists, policy makers, industries, and other stakeholders have been trying to achieve the sustainable environment while a group are involved in damaging the environment by their power. The huge amount of wastes, the emission generated and damage to the mankind impacting significantly on the eco system from the war. It has to be stopped for the interest of the people and environment as a whole in a broader prospective having a paradigm shift from own interest. We are rapidly approaching dangerous tipping points for every aspect of human life, from our health and safety, our natural environment, our economies, to our property and infrastructure. We have to act for achieving.

epcd2 (Extract-Produce-Consume-Dispose-Deplete) in the concept of linear economy has been creating enormous adverse impact on the natural resources reserve. A few countries used to ship tons of waste to China and a few other countries every year making it a dump yard, while India and China recently ban these activities and no longer import discarded plastics, yarn, cotton, ash, waste wool, slag from steelmaking, or paper etc. Traditional disposal methods fail miserably to adequately and properly handle the increasing load. Waste dumped into our oceans is polluting the planet and harming marine, animal, and human life. Circular Economy is the way of life. We need to have the pathway to move forward for sustainable development. There are a number of initiatives, concepts, best practices, legislations which are the endeavour of coming out of the crisis and leave in less pollutes or no polluted globe. Following is a few of those.

- Sustainable development Goals 2030
- Circular Economy and 3Rs models,
- Zero waste models
- Pathways to waste prevention
- Pathways to Prioritising Waste
- Waste management business models
- Data and digitalisation to strengthen the waste management value chain
- Pathways to delivering societal change & adopting behavioural science
- Ensuring inclusion and representation
- Building national capacity
- Educate and involve the school children on waste management, Circular Economy & business models

Circular Economy has been defined by Prof. Sadhan Kumar Ghosh in his book, Circular Economy: Global Perspective, Springer, 2019 as, "Circular economy is a systems-level approach to economic development and a paradigm shift from the traditional concept of linear economy model of extract-produce-consume-dispose deplete (epcd2) to an elevated echelon of achieving zero waste by resource conservation through changed concept of design of production processes and materials selection for higher life cycle, conservation of all kinds of resources, material and/or energy recovery all through the processes, and at the end of the life cycle for a specific use of the product will be still fit to be utilised as the input materials to a new production process in the value chain with a close loop materials cycles that improves resource efficiency, resource productivity, benefit businesses and the society, creates employment opportunities and provides environmental sustainability". However, there are a few definitions given by experts. This is the time when the concept of circular economy and the waste management have to be injected among the school in the society.

Any materials in any product as it's intended use at the end life time should be used as a potential raw material in a second manufacturing process which reduce the extraction of natural resources, provided the materials should be made fit by some preprocessing for the second process. These materials are called the Secondary Raw Materials [SRM]. The International Organization for Standardization (ISO) as well as the Bureau of Indian Standards (BIS) and other national standard bodies in different countries have been working to develop a standard for SRM and their effective quality control and use. There are several production processes which use SRM, for examples, coprocessing of wastes and use of fly ash in cement manufacturing, paving block from steel slag, recycled plastic products, metal recycling for production of many recycled products, paper waste in paper production, waste textile for production of different items, energy recovery from waste in waste-to-energy plants and many more. The use of SRM not only reduce cost but also generates employment opportunity, economy, but helps developing a sustainable environment supporting SDGs, specifically focusses on SDG 1, 7, 8, and 12.

Educate and involve the school children on waste management, Circular Economy, using SRM & business models are one of the very important aspects in our life. The first of its kind, the mission, "Catch Them Young: Zero Waste and Circular Economy in Campus" conceptualized and started its operation in India very recently in which more than nearly 2,10,000 students and teachers from 157 schools in Andhra Pradesh, Meghalaya, Telangana and West Bengal have been working in the mission, CTY:ZW&CEC where bin culture was adopted for everyday practice of waste segregation, utilize waste (SRM) for making hand-crafted recycled products and organic fertilizer. Business model is established to sale recycled products where students find way of livelihood earning. In the mission school children at the formative stage are given practical understanding of circular economy protecting environment, waste littering, marine littering developing a business model to achieve sustainable development. This integrated approach involving school children in circular economy is unique model in the globe. The mission will soon be implemented in Indonesia, Nepal, Norway and Vietnam. The circular economy may help in reducing the extraction of natural resources by

using secondary raw materials (SRM) developing regenerative process, reduces process cost and cycle time while and enhances life cycles, generates employment, generates economy, leading to a sustainable development. We have to strengthen cultural adoption of circular economy among the in Schools Children in schools, encourage the MSMEs to adopt circular economy in their processes, encourage the municipal administration to practice circular.

Sadhan Kumar Ghosh, & Sannidhya Kumar Ghosh (2021), Circular Economy: Recent Trends in global Perspective, Ed Book, Springe Nature Inc., Singapore, https://doi.org/10.1007/978-981-16-0913-8

Keywords: School Children, Industry, Resource Utilisation, epcd2, waste utilisation,

BIOGRAPHY

Prof. Dr. Sadhan Kumar Ghosh is recognized among Top 2% Scientists in the World in 2024-year basis 2023 by Stanford University having collaboration in more than 45 countries. Based on his strong publication record, the impact of his work, and the notable quality of his scholarly contributions have placed him in the top 0.5% of all scholars by ScholarGPS. His rankings in which he has been awarded Top Scholar status based on his accomplishments over the totality of his career (lifetime) and/or over the prior five years: Top Scholar - Prior 5 Years ranks in the world: #16 in Waste management; #522 in Sustainability & #51,020 Overall (All Fields) and Top Scholar – Lifetime rank: #180 in Waste management; He received 3 patents in India and Bangladesh on "eco-friendly plastics recycling machine [Patent no.202532 Dt. 02/03/2007] and "Automatic High Speed Jute Ribboning Machine" [Patent no. 1005146 dt. 17/02/2014]. He has conceptualized and has been mentoring the mission, "***Catch Them Young: Zero Waste and Circular Economy in Campus***" which is a flagship mission in India and abroad in which more than 2,00,000 school students and teachers have been working with him in four states in India, Norway, and Indonesia targeting 20 million people to make aware on waste management by December 2025. For the first time the school children are induced to the concept of circular economy ever. He has been working in plastic waste management and recycling, SUP control in India, Nonrecyclable plastic waste to turn into Circular Economy opportunities in cement plants & waste to energy plants, supply chain sustainability of MSW, e-wastes, C&D wastes etc. Presently the Director General, Sustainable Dev. & Circular Economy Research Centre, ISWMAW, India and the Founder Advisor, Centre for Sustainable Development & Res. Efficiency Management, Jadavpur University, Kolkata, India. He is a renowned personality in the field on Waste Management, Circular Economy, Green Manufacturing, Supply Chain Management, Sustainable Development, Co-processing of Hazardous & Municipal Solid Waste, Plastics Waste management & recycling, E-waste management & recycling, management system standards (ISO) and TQM. He started his career in the multinational industries. He served as the Dean of Faculty of Engg. and Technology,

Head and Professor in mechanical engineering at Jadavpur University, India and the Director, CBWE, Ministry of Labour and Employment, Govt. of India. Prof Ghosh is the founder Chairman of the IconSWM; Founder & President of the International Society of Waste Management, Air and Water (ISWMAW) and the chairman of the Indian Congress on Quality, Environment, Energy and Safety Management Systems (ICQESMS). He is the Editor-in-Chief of the Journal of Solid Waste Technology & Management, and Associate Editor of Journal of Material Cycles and Waste Management. He wrote ten books, more than 55 edited volumes, more than 300 national and international articles and book chapters, delivered more than 1,000 keynote, plenary and invited lecture in several countries. He received several awards in India and foreign countries including the Distinguished Visiting Fellowship 2012 by the Royal Academy of Engineering, UK and The Boston Pledge & NABC 2006 Award for 'The most eco-friendly innovation" for conversion of plastics & Jute wastes to Wealth conferred by the North American Bengali Conference 2006, Houston, USA in the ESP/50K Business Plan Competition. He received three patents in India and Bangladesh on "ecofriendly plastics recycling machine and the process there of" [Patent no.202532 Dt. 02/03/2007] and "Automatic High Speed Jute Ribboning Machine" [Patent no. 1005146 dt. 17/02/2014]. He developed & established "Policy on AntiPlagiarism, Jadavpur University, 2019". In International arena, Prof. Ghosh international consultant/expert of the United Nations Centre for Regional Development (UNCRD)/DESA), Asian Productivity Organization (APO), Japan, China Productivity Council (CPC), Taiwan, The Institute for Global Environmental Strategies (IGES), & JAIF Japan and SACEP, Sri Lanka. He has been the Principal Investigator in nearly 27 international funded projects by EU, British Council, Erasmus, Royal Academy of Engg., SINTEF, Hungary Govt., IGES, Georgia Govt., etc and 25 national research projects, e.g., DST, DBT, National Jute Mission, CPCB, etc. He has been serving as the member of international steering committees and editorial boards and served as the Keynote/Plenary speaker in international conferences in several countries. He has initiated the movement for worldwide Sustainable Waste Management and research with partners in many countries through the *Consortium of Researchers in International Collaboration* (CRIC). He was the convener of ISO TC 61 WG2, member in the Indian mirror committee of ISO TC 323 - Circular Economy, ISO/TC 297 - Waste collection and transportation .Management and ISO TC 207- Environment Management. He was a lead assessor & trainer of ISO 9001, ISO 14001, OHSAS 18001, HACCP 22001. He is the Chair of 14th IconSWM-CE 2024. He is the Chair of 14th IconSWM-CE 2024. He is available to serve for any national or International Projects. Please Visit: https://www.youtube.com/@Prof.SadhanEditor/videos; He is available at: sadhankghosh9@gmail.com. For details. please visit : www.sadhankghosh.com ResearchGate: https://www.researchgate.net/profile/Sadhan-Ghosh and ORCID 0000-0002-9128-5202.

Nanotechnology and Sensing Solutions for Water and Air Pollution Remediation

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ABSTRACT

Nanotechnology has emerged as a transformative approach to address critical environmental challenges, particularly in water and air pollution remediation. Advanced nanoscale materials offer unique properties such as high surface area, reactivity, and selectivity, making them ideal for detecting and removing pollutants. Nanostructured sensors enable real-time monitoring of contaminants with exceptional sensitivity and precision, facilitating timely intervention. Additionally, nanomaterials such as carbon nanotubes, metal oxides, and photocatalysts effectively degrade or adsorb harmful substances, ensuring cleaner water and air. This work explores innovative nanotechnology-driven sensing and remediation strategies, highlighting their potential to mitigate pollution and promote sustainable environmental practices.

BIOGRAPHY

Professor Ajoy Kumar Ray is a distinguished academic and researcher currently serving as the Director of JIS Institute of Advanced Studies & Research. With a career spanning over four decades, he has significantly contributed to engineering and technology education, leading initiatives that foster innovation and excellence.

Before his current role, Professor Ray served as the Vice Chancellor of Bengal Engineering and Science University (BESU), Shibpur, from 2009. He had previously led the School of Medical Science and Technology at IIT Kharagpur and was a Professor in the Department of Electronics and Electrical Communication Engineering there. A graduate of Bengal Engineering College, Shibpur, he earned his master's and doctoral degrees from IIT Kharagpur, where he began teaching in 1980.

A notable milestone in his career was receiving the Padma Shri in 2017, India’s prestigious civilian award, for his instrumental role in transforming BESU into the Indian Institute of Engineering Science and Technology (IIEST). Professor Ray’s research includes 17 projects funded by various global organizations, and he has co-invented six U.S. patents with Intel and filed three more with Texas Instruments. He has published over 90 research papers and authored five books, making significant contributions to image processing, video coding, and medical diagnostics,

particularly in areas like brain activity monitoring and breast cancer detection.

Professor Ray's research focuses on advanced algorithms for medical image analysis, signal processing, and diagnostics. He has improved image compression and video coding, enhanced data transmission, and applied artificial neural networks (ANN) and convolutional neural networks (CNN) for medical applications. His work has advanced digital pathology and EEG signal analysis, contributing to better healthcare technologies.

Beyond research, Professor Ray has shaped India's technical education landscape, participating in national committees and fostering industry-academic collaborations. His leadership and contributions have earned him international respect in the engineering community.

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Keynote Lectures

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Structural Dynamics in the Solid State: Insights from Solvate Removal and Mechanical Grinding

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ABSTRACT

Mechanochemistry, a rapidly advancing area of green chemistry, offers sustainable methodologies for synthesizing organic molecules, metal complexes, coordination polymers (CPs), and metal-organic frameworks (MOFs) in the solid state with minimal or no solvent. Mechanical grinding has not only enabled the formation of novel materials but has also facilitated the isolation of compounds unattainable through conventional solution-based methods.

While single-crystal X-ray crystallography remains a cornerstone for investigating solid-state structural transformations induced by thermal or photochemical stimuli, alternative approaches are essential when single crystals are unavailable. Techniques such as NMR spectroscopy have proven invaluable for monitoring [2+2] photocycloaddition reactions and other molecular movements in the solid-state.

This talk explores how mechanochemical grinding of solids induces structural transformations, often accompanied by the loss of solvates and single crystallinity. Through the lens of [2+2] photocycloaddition reactions, we examine pivotal changes including olefin pedal motions, molecular conformational shifts, compositional alterations through atmospheric water absorption, anisotropic volume expansion, rotational dynamics in helical coordination polymers, changes in dimensionality, solvent loss, and the catalytic influence of template molecules. These findings offer a deeper understanding of mechanochemical processes and their impact on solid-state molecular behavior.

BIOGRAPHY

Professor (Dr.) JJ Vittal after his BSc (University of Madras) and MSc (Madurai University) received PhD from Indian Institute of Science, Bangalore in 1982. After working as a postdoctoral research associate at the University

of Western Ontario, Canada, he managed the X-ray service facility. In 1997, JJ accepted a faculty position and moved to the National University of Singapore (NUS). He has been currently an Emeritus Professor at NUS since 2021. He held a World Class University Chair Professorship at the Gyeongsang National University, Jinju, South Korea (2009-2013). He co-authored 'Crystal Engineering – A Textbook' with Desiraju and Ramanan. He also edited two more books on Crystal Engineering. He is a Fellow of Royal Society of Chemistry, Singapore National Institute of Chemistry, Indian Chemical Society and International Association of Advanced Materials. JJ won various awards including Toronto International Invention & Innovation Competition in Canada (20023), Japanese Photochemistry Association Elsevier Lectureship Award (2023), Chemical Research Society of India Medal (2020), Indian Chemical Society G.V. Bakore Memorial Award (2019), Outstanding Chemist Award, NUS (2014), CRISP Award, NUS (2013), Outstanding Research Award, NUS (2011) and Outstanding Scientist Award, NUS (2007). His research profile was highlighted in Angewandte Author Profile (2014) and was an Erudite Scholar-in-Residence India (2011). A special virtual issue "Honoring Professor Jagadese J. Vittal and his Contributions to Functional Molecular Crystals", by the American Chemical Society journal Crystal Growth & Design appeared in 2024/2025. He was the founder and organizing committee member of Singapore National Crystal Growing Challenge (1997-2016). JJ published ~550 original papers, reviews and book chapters. Google Scholar Citations: ~28,700 citations and h-index, 83. According to the C-score (composite indicator for career-long impact) published in 2020, JJ ranks 57th (all citations) & 50th (self-citation excluded) out of 57422 researchers listed in the field of Inorganic Chemistry & Nuclear Chemistry, and overall, 12,920th out of 655,350 researchers (top 2%) listed in the database, ranked 53rd in Singapore, 19th at NUS and 2nd in the Department of Chemistry, NUS..

Development of Potential Strategies from Simple Ideas

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ABSTRACT

New entrants in the field of scientific research often possess a pre-conceived idea that contemporary quality research is possible only with sophisticated modern instruments. Hence, they become often depressed working in a relatively poor research laboratory lacking the easy accessibility of such costly instruments. The talk intends to stimulate the young researchers by giving some demonstrative examples to establish that the principal components of a quality research is one's brain and his/her thoughts, rationalizations and inquisitiveness, although sophisticated instruments help in this respect to a good extent. The talk will focus on three selected areas, all being very relevant in contemporary modern research, to demonstrate that a logical transformation of a societal observation and/or targeted extension of simple ideas or intuitions often can yield quality research. In many such cases one does not even require costly instruments.

The first example (published in JACS) simply transforms a societal observation into science, keeping in mind the role of a broker in making hand-shaking between a promising tenant and owner of an apartment/flat, which is otherwise next to impossible. This simple concept can enhance the sensing efficiency of a sensor by orders of magnitude without the need of sophisticated and costly instruments. Further extension of this simple philosophy has enabled a cationic sensor in solution to sense a cationic species, reported for the first time in science.

The second example simply uses the well-known Frens method to synthesize gold nanoparticle with a directed extension where one can synthesize gold nanoparticles of desired dimension. Confirmation of dimension of the product may be done simply from an absorption spectrophotometer, without the need of costly TEM, SEM etc.

The third segment of the talk deals with the two promising ways to get rid of drug-induced side effects, namely delivery of drugs efficiently to the target (targeted delivery) and to expel the adsorbed drugs from the body occasionally. Rationally chosen molecular aggregates like micelles, lipids, cyclodextrins etc. can serve the purpose. The philosophy of such actions simply rests on comparative binding of the drugs between the carrier and the target, or the cell membrane and the excreter.

BIOGRAPHY

Professor (Dr.) Nitin Chattopadhyay obtained his Bachelor and Master degrees from University of Calcutta and Ph.D. degree from Jadavpur University working in Indian Association for the Cultivation of Science. He got the D.Sc. degree from Jadavpur University in 2023. He joined the Department of Chemistry, Jadavpur University in 1991 where he has been a Professor since 2006. During his couple of post-docs he worked in Katholieke University of Leuven, Belgium and Coimbra University, Portugal. His areas of specialization encompass Photochemistry & Spectroscopy, Biophysical Chemistry, Surface Chemistry, Fluorescence Sensing, Polymer Photophysics, Photoacoustic Calorimetry etc. He is a well acclaimed teacher as well as researcher at the same time. In recognition of his scholastic teacher-ship he has been endowed with Shiksha Ratna Award from the Government of West Bengal (2019). His quality research is recognized globally. He has been a Fellow of Indian Academy of Sciences (FASc), National Academy of Sciences India (FNASc) and West Bengal Academy of Science and Technology (FAScT). He is a recipient of the Bronze Medal from Chemical Research Society of India. He has received Prof. R P Mitra Memorial Award (2024) from Delhi University, Satikanta Guha Foundation Lecture (2023) from Garden High School, Prof. S C Ameta Award (2019) from the Indian Chemical Society and Prof. S R Mohanty Memorial Award (2018) from the Orissa Chemical Society.

He has been in the Editorial Boards of a number of international journals like Biophysical Chemistry, Journal of Photochemistry Photobiology B: Biology, Heliyon, Frontiers in Molecular Biosciences, Journal of Luminescence, Journal of Colloid and Interface Science, Journal of Chemical Sciences. He served Journal of Luminescence as Associate Editor and is now an Associate Editor of Heliyon Chemistry. He has published 178 quality publications in reputed and refereed journals including Journal of American Chemical Society and Journal of Chemical Education. His h-index is 45 and i-10 index is 145. He has an excellent academic career all throughout. Prof. Chattopadhyay is a teacher and a scientist par excellence. His research has developed a good number of new and valuable strategies in chemical and biophysical areas. His research on enhancement of sensing ability of a fluorosensor by orders of magnitude simply introducing the novel use of micelles as mediators (JACS 2006) needs special mention. The strategy is powerful enough to enable a cationic sensor to sense a cationic species in aqueous medium, reported for the first time.

Advantages of Supramolecular Interactions for the Designing of Conductor to Superconductor

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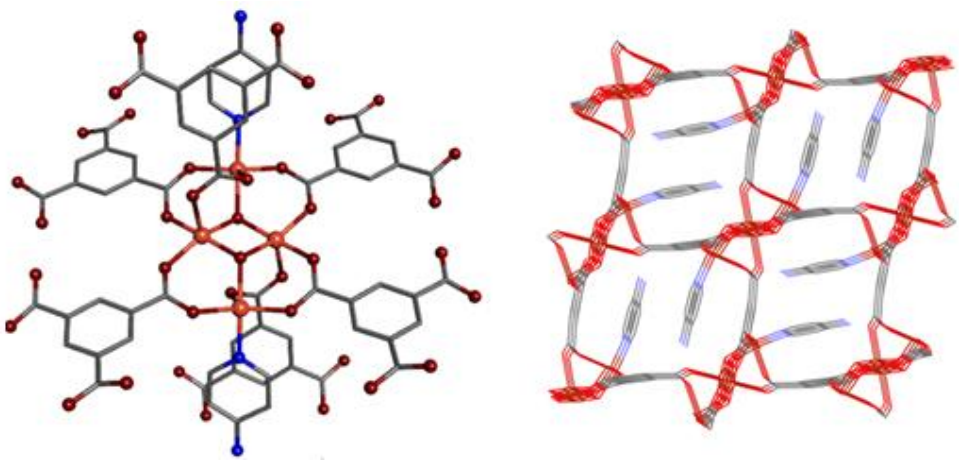
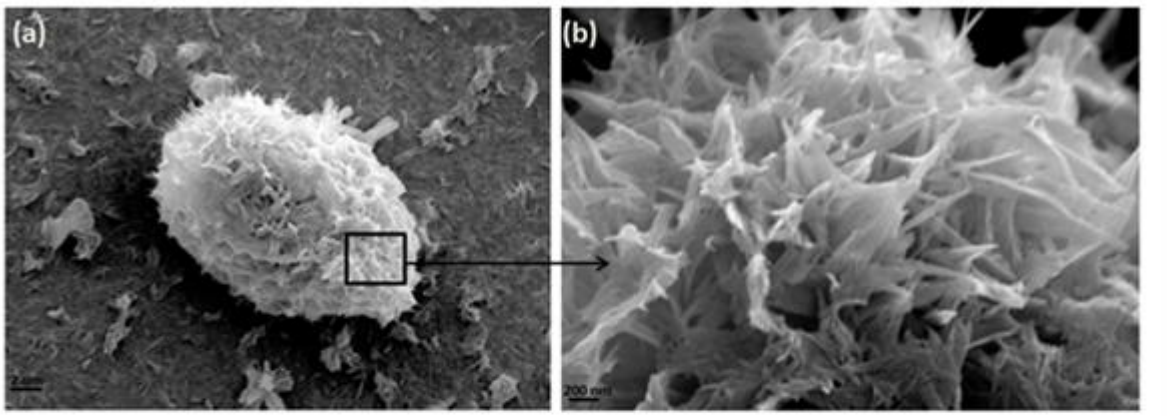
ABSTRACT

CPs/MOFs are appearing as brilliant materials and receive immense attention due to their structure and supramolecular interactions. Use of metal ions as knot and bridging organic ligands has created opportunities to prepare organic-inorganic hybrid materials. Several factors like nature of M^{n+}, organic linker, reaction condition etc. have been regulating the structure of crystalline coordination polymers along with the porosity, surface area, density etc. They have versatile applications[1-10] in gas separation, gas storage, ion sensing, ion separation, catalysis, luminescence, drug delivery, biomimicking,[4] and recently they are focusing on the photocatalytic and photoelectrocatalytic activities for CO_2 reduction,[3] water splitting, elimination of inorganic contaminants, and degradation of organic pollutants. Metal-organic frameworks, a dynamic family of functional materials, are also find use in electronic devices, batteries, insulators, powerbanks and superconductors, memory devices, optical superstructures, mechanical metamaterials etc. Supercapacitor MOFs are typically microporous and exhibit the



outstanding capacitive performance compared to other storage batteries such as, Li-ion, lead acid, and alkaline batteries. Hence new strategies are focused to enhance the electrochemical properties of MOF. We have designed and structurally characterize a Copper(II)-MOF of 1,3,5-benzene tricarboxylic acid (H_3BTC) and 4-Aminopyridine (4-APy) with nano-flower morphology. Magnetic study indicates the presence of a very weak antiferromagnetic coupling between the copper(II) ions. The experimental specific capacitance is 547 F g^{-1} at 2 mV s^{-1} scan rate. High performance supercapacitor behavior of Cu-MOF makes the material for energy storage application.



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BIOGRAPHY

Professor & Head, Department of Chemistry, Jadavpur University, Kolkata-700 032, India. Education from Calcutta University and Ph. D. degree from Indian Association for the Cultivation of Science, Kolkata (Jadavpur University), Joined as Lecturer in Chemistry, Burdwan University, 1992; with brief stay in Vidyasagar University (1994) returned

to Burdwan University and now in Jadavpur University since 2004. Published more than 480 original research articles in the national and international journals having h-index 50, citation 9360; awarded 54 Ph. D. degree and supervised more than 23 research projects from UGC, DST (New Delhi), State DST (Kolkata), CSIR, AICTE. Awarded Best Chemistry Teacher Award (2012) by Confederation of Indian Industries (CII) and AICTE. Elected Fellow of West Bengal Academy of Science & Technology (2018); Elected Fellow of Energy Science (2023); Elected Fellow of Royal Society of Chemistry (FRSC) (2023). Visited Taiwan, Japan, Singapore, Italy and received Centenary Lecture Award from Tokyo Institute of Science, Japan (2005). Organised large number of national and international conferences. Served as Editor, Inorganic & Analytical Chemistry Section of Journal of Indian Chemical Society (2010-2016); Chemistry-An Indian Journal (2010-); Sr-Editor, Journal of Spectroscopy & Dynamics (2014-); Associate Editor, Current Organocatalysis, Bentham Science (2018-; Associate Editor, Current Microwave Synthesis, Bentham Science (2018-). Honorary Secretary: Indian Chemical Society (2016-2022). Secretary, Indian Photobiology Society (2023-). He has been enlisted in top 2% Indian Scientists in the list of Stanford University in 2020, 2021, 2022, 2023 and 2024.

Engineered Polymer Nanoparticles for Cancer Drug Delivery

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ABSTRACT

The stability of a drug/gene inside nanocarriers at physiological environment and the release of the said drug/gene at specific tumor cells in a sustainable manner are the two most important factors that determine the efficiency of a smart targeted drug/gene delivery system. In order to bring stability to nanocarriers, we have employed several strategies to cross-link polymer nanoparticles which were found to de cross-link in presence of stimuli that are relevant to cancerous cells. For these, several random/block/star polymers were synthesized by controlled radical polymerization which formed self-assembled nanoparticles in aqueous medium at physiological condition. The polymers and the formed nanoparticles were well characterized by NMR, GPC, DLS, TEM/SEM/AFM and fluorescence experiments. For example, we have developed redoxresponsive and core cross-linked micellar nano-carriers using PEG-b-PLAHEMA diblock copolymers with tunable swelling properties for the delivery of drugs towards drug-sensitive MDA-MB-231 and drugresistant MDA-MB-231 (231R) cancer cells. We have designed and synthesized pH, redox and ATP responsive cationic cross-linked polymers having disulfide and reversible boronic ester linkages that contain folate groups that are known for their targeting capability towards cancer cells. These cationic polymers formed nano-sized polyplexes by effectively condensing DNA. These polyplexes have the ability towards selective release of the complexed DNA in acidic pH, ATP rich surroundings or presence of glutathione.

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BIOGRAPHY

Professor (Dr.) Dr. Dibakar Dhara is a renowned scientist and professor in the Department of Chemistry at the Indian Institute of Technology (IIT) Kharagpur, West Bengal, India. With a career dedicated to advancing polymer science and its biomedical applications, Dr. Dhara has made groundbreaking contributions to the field of engineered polymer nanoparticles for cancer drug delivery. His innovative research addresses two critical challenges: ensuring the stability of drugs or genes within nanocarriers in physiological environments and achieving sustainable and targeted release at specific tumor sites.

Dr. Dhara's work focuses on developing advanced polymer systems, including random, block, and star polymers synthesized through controlled radical polymerization. These polymers self-assemble into nanoparticles under physiological conditions and are tailored for stimuli-responsive behaviors such as pH, redox conditions, and ATP levels. His redox-responsive and core cross-linked micellar nanocarriers, based on PEG-b-PLAHEMA diblock copolymers, have demonstrated remarkable efficiency in delivering drugs to both drug-sensitive and drug-resistant cancer cells. Additionally, his pH, redox, and ATP-responsive cationic cross-linked polymers, containing disulfide and reversible boronic ester linkages, offer targeted DNA delivery in environments characteristic of cancerous cells, such as acidic pH and glutathione-rich surroundings.

Dr. Dhara’s research achievements are extensively documented in high-impact scientific journals, including Journal of Colloid and Interface Science, ACS Applied Materials and Interfaces, Langmuir, Biomacromolecules, and ACS Macro Letters. His collaborative work has advanced the understanding and development of smart drug delivery systems, with a particular focus on addressing drug-resistant cancer cells.

In addition to his research, Dr. Dhara has been recognized for his contributions to science and academia. His accolades include awards and honors from prestigious institutions, highlighting his influence in polymer chemistry and biomedical research. He has been invited to share his insights at numerous conferences and symposia, further

cementing his reputation as a thought leader in his field.

Beyond his professional achievements, Dr. Dhara is committed to mentoring the next generation of scientists and fostering innovation through collaborative research. His contributions extend to the development of innovative materials with wide-ranging applications in medicine and industry.

Dr. Dhara's pioneering efforts in polymer science and drug delivery systems continue to inspire the scientific community. His work holds the promise of transformative advancements in cancer treatment, addressing one of the most pressing challenges in modern healthcare.

Helical Molecular Structure as a Key Molecular Design for the Photolumienscence of Rare Earth Complexes

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ABSTRACT

A series of helicate rare earth complexes with hexadentate-bipyridine derivatives exhibits high stability with bright luminescence even in acetonitrile because of their polarity and the chelate effect. Molecular distortion and various derivations induce the intended luminescence and characteristic molecular conformation, which depend on atmosphere or media. It would be a supportive case to design novel units of rare earth components for luminescence. Here, the fundamental luminescence properties and approval dimension manipulation of these helical rare earth complexes will be presented. Also, it was also found the series of helical structure was suitable for the theoretical chemistry fields of rare earth complexes to evaluate the energy transfer processes or structural optimization.

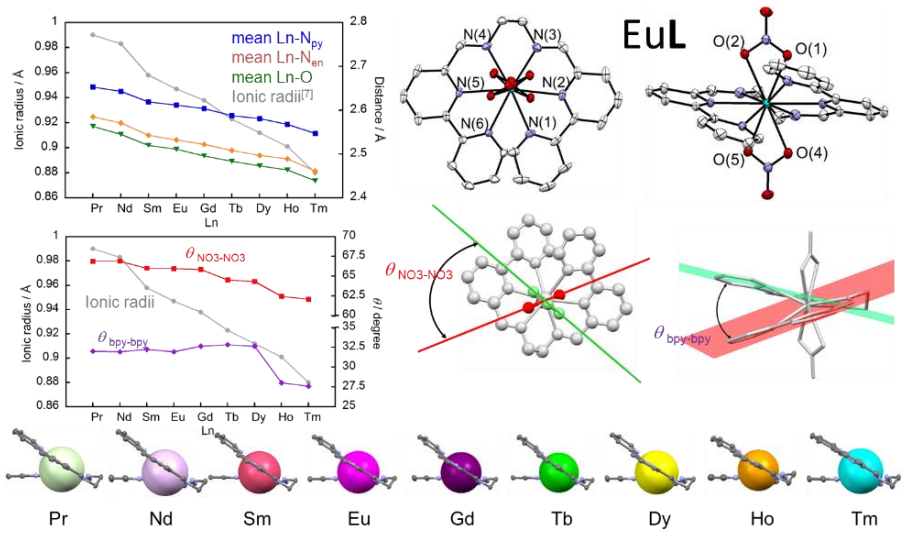

Fig. Helical molecular structure of LnL with a series of Ln ions.

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BIOGRAPHY

Professor (Dr.) Miki Hasegawa, born in Tokyo in 1970, is a renowned scientist in the field of coordination chemistry and photonic materials. She has built an illustrious career through her contributions to academic research, education, and international collaborations. Dr. Hasegawa's passion for science is complemented by her diverse interests, including collecting periodic tables, skiing, tea ceremonies, and Japanese flower arrangements in the Ohara style.

Dr. Hasegawa completed her undergraduate and graduate studies at Aoyama Gakuin University, earning her Doctor of Science degree in 1998 under the mentorship of Prof. Toshihiko Hoshi. She began her academic career at Aoyama Gakuin University, serving as a Research Professor (1998-2002), Associate Professor (2002-2010), and currently as a full Professor since 2011.

Her dedication to advancing chemical sciences has led her to hold visiting positions at prestigious institutions, including the Technical University of Vienna and the University of Tokyo. She has also collaborated extensively with the Institute for Molecular Science, further broadening her academic and research horizons.

Dr. Hasegawa's research focuses on the electronic and photophysical properties of coordination compounds, rare-earth elements, and photonic materials. Her work has earned her numerous accolades, including the Japan Rare Earth Society's Encouragement Award (Adachi Award) in 2011 and the inaugural SPring-8 Exploratory Research Award in 2009.

As a highly sought-after speaker, Dr. Hasegawa has delivered invited lectures at international conferences across the globe, including in the United States, China, Thailand, and Europe. She has also been actively involved in organizing international symposia, fostering global collaboration in the chemical sciences.

Beyond research, Dr. Hasegawa is passionate about inspiring future generations of scientists. She has conducted public lectures, workshops, and outreach programs, engaging with students from junior high school to graduate levels. She has also contributed to gender equality initiatives, serving as a mentor and role model for aspiring female

scientists.

Dr. Hasegawa's contributions to science extend to her numerous publications in high-impact journals. Her studies on lanthanide complexes, photoluminescence in rare-earth compounds, and innovative materials for energy systems have significantly advanced understanding in her field.

In addition to her professional achievements, Dr. Hasegawa is a dedicated educator, regularly teaching courses and delivering special lectures at institutions such as Keio University and Ochanomizu University. Her multifaceted career exemplifies a commitment to scientific discovery, education, and international cooperation.

Dr. Hasegawa continues to inspire the scientific community with her innovative research and unwavering dedication to mentoring the next generation of chemists.

Developing efficient electrocatalysts for green energy applications

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ABSTRACT

To mitigate the limitations of fossil fuel and its adverse environmental impact, extensive use of alternative energy is urgently necessary. Advancement of nanotechnology both at the materials and device level is showing bright prospects in this field of research. Because of its high calorific value and no post-burning harmful byproduct, hydrogen is thought to be the most important energy carrier in today's world. Generation of green hydrogen from water splitting by appropriate nanocatalysts is one of the most important energy technologies.

Electrocatalysts play crucial role in the process of green hydrogen production from water electrolysis. The preferred parameters of electrocatalysts should be such that the electrolysis happens at a very low overpotential, should have long term stability under large current flowing and should be cost effective. Recent findings indicate many important breakthroughs in terms of understanding the catalysis mechanism and also developing appropriate nanostructures for efficient catalysis. In this lecture, creation, optimization and mechanism of some of the developed electrocatalysts will be presented [1-6]. Current technological limitations and present challenges will be highlighted.

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BIOGRAPHY

Professor (Dr.) Kalyan Kumar Chattopadhyay, presently serving as a Professor in the Department of Physics of Jadavpur University is a well-known scientist and accomplished researcher. With a prolific career spanning 35 years in research and 31 years in teaching, Prof. Chattopadhyay has made significant contributions to the field of Nanoscience and Technology. His commitment to education is evident through extensive teaching experience at both the postgraduate and undergraduate levels, covering a range of subjects from condensed matter physics to advanced electrodynamics, Nanoscience and Nanotechnology etc.

As the former Director of the School of Materials Science & Nanotechnology (2012 – 2019), and the Head of the Department of Physics (2022-2024), Prof. Chattopadhyay played a key role in coordinating the Nanoscience and Technology program as one of the thrust areas of research under the 'University with Potential for Excellence' program of Jadavpur University. His global exposure includes postdoctoral fellowships and visiting professorships at various prestigious institutions such as the National Institute of Materials Science (NIMS), Japan; the Hanyang University, South Korea and the Ulster University, UK etc.

Prof. Chattopadhyay's research prowess is evidenced by his current 'h' index of 65, total citations exceeding 15900, and supervision of 49 awarded Ph.D. students and 85 M.Tech theses. His publication record includes over 430 research papers, four authored books and four patents. Notably, he has completed ten major research projects as the Principal Investigator and is recognized in the Stanford University's list of the world's top 2% scientists for the consecutive three years 2021,2022 and 2023.

Academic honours and recognition include Dr. Meghnad Saha Gold Medal from the Asiatic Society (2015), the Materials Research Society Medal (2015), the American Chemical Society Membership Award (2015), Prof. J.N. Mukherjee memorial award from the Indian Chemical Society (2021), the Shiksharatna award from the Government of West Bengal (2023) etc. As a recognition of his contribution he was elected as a fellow of the West Bengal Academy of Science and Technology (WAST-2015) and the National Academy of Sciences (NASI 2023), India.

Porphyrin Organization Towards Molecule-Based Functional Nanomaterials

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ABSTRACT

Because molecules are nano-scale entities and the smallest functional units, they can be used as building blocks for nano-scale functional materials and devices. Porphyrins are a class of compounds that display strong absorption in the UV-visible region, play key roles in excited-state energy and electron transfer processes, and can exhibit catalytic properties by incorporating various metal ions into their central cavity. As a result, porphyrin assemblies have attracted significant attention for their potential applications in light-harvesting/charge separation models, host-guest chemistry, sensors, catalysis, and molecular-scale devices, where multiple porphyrin molecules work synergistically [1]. We have explored various aspects of porphyrins as platforms of energy and electron transfer processes and their switching in response to external stimuli. Both covalent as well as noncovalent approaches have been adopted to construct molecular assemblies containing porphyrin units. While covalent approaches yield robust assemblies, the synthesis of elaborate structures is often challenging. On the other hand, the noncovalent approaches, relying on hydrogen bonding and coordination bonds, allows us to construct multi-porphyrin assemblies. In some of the studies, we introduced a coordination site into the porphyrin framework, designed to bind with the porphyrin's central metal ion. For example, zinc chlorophyll derivatives (porphyrin analogues) appended with a pyridyl moiety self-assemble into a tetrameric structure [2], whereas another assembly features a porphyrin trimer [3]. These systems, with an additional electron donor or acceptor, serve as models for the initial steps of photosynthesis. In a related approach, we recently introduced bipyridine moieties around the porphyrin framework, which form a stable dimer upon coordination with zinc ions [4]. Our ongoing research aims to further explore the potential of these porphyrin supramolecules as hosts and catalysts.

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BIOGRAPHY

Professor (Dr.) Joe Otsuki is a Professor in the Department of Chemistry at the College of Science and Technology, Nihon University. He earned his Doctor of Engineering degree from the University of Tokyo in 1991. Following this, he served as a researcher at the Institute of Industrial Science, University of Tokyo, from 1991 to 1999, and as a post-doctoral fellow at Université Louis Pasteur, France, in 1994. Since 1999, he has been a faculty member at Nihon University.

Prof. Otsuki has received numerous prestigious awards throughout his career, including recognition as a Top Peer Reviewer in Chemistry and Cross-Field by Publons in 2019, the Solar Energy Journal Best Papers Award from Elsevier in the same year, and the Publons Peer Review Award in 2018. He was also honored with the ISPAC Lecture Award in 2017 and the Outstanding Reviewer Award for Materials Chemistry Frontiers by the Royal Society of Chemistry in 2016. Earlier in his career, he received the Research Award from the College of Science and Technology at Nihon University in 2003 and the Special Lecture by Young Generation Award from The Chemical Society of Japan in 1998.

With a strong academic background and extensive contributions to the field of chemistry, Prof. Otsuki is highly regarded for his research and commitment to advancing scientific knowledge.

Chain-folding Regulated Hierarchical Assembly of Polyurethanes and Functional Materials

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ABSTRACT

Despite a rapid growth in cationic host defence peptide (CHDP)-mimicking synthetic polymers, the importance of the secondary structure of such synthetic systems, similar to CHDPs, has not been understood well in context of bacterial membrane perturbation. Recently we have investigated a series of cationic amphiphilic alternating polyurethanes (PUs) for antibacterial activity with specific focus on the effect of the chain-folding on the antibacterial activity. Some of them contain linear flexible hydrocarbons (F-PUs), while others contain cyclic rigid hydrocarbons (R-PUs) in the segmented polymer backbone. F-PUs exhibit intra-chain H-bonding driven pleated structure, followed by hierarchical assembly, producing cationic polymersome in water. In sharp contrast, R-PUs, deprived of the chain-folding possibility due to the rigid linker, exhibit immiscibility-driven aggregation producing spherical nanoparticles. F-PUs exhibit exemplary antibacterial activity with exceptionally low minimum inhibitory concentration (MIC), while R-PUs do not show even moderate activity.1 Beyond planktonic bacteria, F-PUs also exhibit extraordinary biofilm eradication efficiency. Likewise, we have recently shown sulfated F-PUs show excellent antiviral activity while their rigid analogues fail to exhibit any antiviral effects.2 Similar foldable PUs with pendant naphthalene-diimide (NDI) moiety in hydrocarbon solvent show pleated structure with the NDI units organized at the periphery.3 In presence of pyrene (Py), NDI-Py charge transfer interaction promotes formation of elongated nanotubular structure with stable room-temperature ferroelectricity4 and highly promising piezoresponse. This presentation will focus on the chain-folding regulated self-assembly of different polyurethane derivatives in water or hydrocarbon and implications in applications such as antibacterial/ antiviral material or organic optoelectronics.

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BIOGRAPHY

Professor (Dr.) Suhrit Ghosh was born in 1976 in India. After completion of the undergraduate education (Chemistry major) in the Presidency College (now University), Kolkata, he was admitted in the integrated PhD program (Chemical Science) at IISc, Bangalore in 1997. He received the MS degree (Chemistry) in 2000 and continued for PhD till 2005 under the supervision of Professor S. Ramakrishnan. Then he moved to the group of Professor S. Thayumanavan at the University of Massachusetts, Amherst, USA, for postdoctoral studies (2005-2007). Subsequently he worked as a Humboldt postdoctoral fellow (2007-2008) with Professor Frank Würthner at the University of Würzburg, Germany. In 2008 he joined IACS, Kolkata, India, as an Assistant Professor where he currently holds the position of Senior Professor in the School of Applied and Interdisciplinary Sciences (SAIS). He was selected as an Associate of the Indian Academy of Sciences (2009-2012). He is the recipients of the B. M. Birla Science Prize (2014), SwarnaJayanti Fellowship (2015), K. Kishore Memorial Award (2016) from the Society of Polymer Science in India (SPSI), Bronze medal (2017), CNR Rao National Prize for Chemical Sciences (2023) from the CRSI and Santappa Award (2023) from SPSI. He is an elected Fellow of the Indian Academy of Sciences (admitted in 2022). He served as a member of the Editorial Advisory Board of the journal Macromolecules during 2021-2024. Research interest of his group includes supramolecular polymerization of donor-acceptor π-systems, H-bonding driven assembly of amphiphilic π-systems/ macromolecules and biologically relevant stimuli responsive aggregation of amphiphilic polymers (polydisulfides, polyurethanes). He has co-authored in > 140 papers in reputed international journals. Sixteen students have already completed PhD under his supervision. At IACS, he has been serving as the Dean, Academic since 2021 and recently entrusted with the additional responsibility of the Dean, Administration & Finance. Prior to that, he served as the Chair, SAIS (2018-2021) and Head, Polymer Science Unit (2015-2018) at IACS, Kolkata.

Natural Language Processing and Generation for Machine Understanding

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ABSTRACT

Natural language processing (NLP) is a subfield of computer science and artificial intelligence (AI) that uses machine learning to enable computers to understand and communicate with human language. The meaning of NLP is Natural Language Processing (NLP) which is a fascinating and rapidly evolving field that intersects computer science, artificial intelligence, and linguistics. NLP focuses on the interaction between computers and human language, enabling machines to understand, interpret, and generate human language in a way that is both meaningful and useful. With the increasing volume of text data generated every day, from social media posts to research articles, NLP has become an essential tool for extracting valuable insights and automating various tasks. LLM, various Transfer Learning models etc, are the techniques to solve the problems.

NLP powers many applications that use language, such as text translation, voice recognition, text summarization, text processing, WSD, MWE, text classification, text mining, natural language processing, sentiment analysis, opinion mining, social media profile analysis, stock prediction, summarization, Generative AI and ChatBot GPT. You may have used some of these applications yourself, such as voice-operated GPS systems, digital assistants, speech-to-text software, and customer service bots. NLP also helps businesses improve their efficiency, productivity, and performance by simplifying complex tasks that involve language.

BIOGRAPHY

Professor (Dr.) Diganta Saha is presently working as a Professor, Department of Computer Science & Engineering, Jadavpur University, Kolkata, West Bengal, India and has several years of teaching experience. He completed his Ph.D. in the year 2009 in Computer Science and Engineering, JU. Was visiting Faculty in OHIO State University,

USA during 2007.His research interests includes Machine Translation/ Language Engineering/ Mobile Database Management/ Text Processing/ Text Classification/ Text Mining/ Natural Language Processing/ Sentiment Analysis/ Opinion mining/ Social Media Profile Analysis/ Stock Prediction/ Summarization/ Generative AI/ ChatBot GPT. He has authored more than 120 publications (books, journals, conferences) related to his domain of work. Under his guidance, 5 students have been awarded PhD. Degree. Besides that, he is the reviewers of multiple journals and conferences, editor and advisory committee members of various editorial boards, Question paper setter, expert committee member of multiple selection committee, BoS and PhD committee member of various institutes.

Bio-mulching Sheets: Applications and Prospects

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ABSTRACT

Bioplastics are microbiologically degradable biomass, mostly made from renewable organic resources such as polysaccharides, lipids and proteins. The use of bioplastic reduces our dependency on fossil fuel based on conventional plastic and can solve the issue of ever-increasing burden of plastic waste in our nature as bioplastics are naturally biodegradable by microorganisms. We can find the diverse applications in various fields like pharmaceuticals, packaging, catering industry and in the field of agriculture, and horticulture, as well. Mulching is a farming process to cover the top soil around the root area of plant to create a favourable micro ecosystem that can promoting the healthy growth of the plant. Biodegradable Mulch Film is a film that can be utilized to prevent the heat from reaching the plant's roots for modifying soil temperature, limiting weed growth, preventing moisture loss and for improving crop yield. This kind of mulch film is an environmentally friendly alternative to traditional plastic mulch films. In ALONA, we are aiming to develop Bio-mulching sheets with an aim to reduce production cost and make a long-term social, economic as well as environmental impact.

BIOGRAPHY

Dr. Subhalakshmi Ghosh was a Ph.D. from Jadavpur University and a Post-doc from Bhabha Atomic Research Centre, Mumbai. In 2012, she joined Jadavpur University as DST- Young Scientist and continued her research from Department of Pharmaceutical Technology. Dr. Ghosh has more than 30 research publications in international peer reviewed journals, 4 book-chapters, 2 patents, and attended several national and international conferences in India and abroad.

Dr. Ghosh shifted herself from academia to the field of innovation and industrialization on 2023 and co-founded the biopharmaceutical company, Alona Life Sciences Pvt Ltd. She is presently the Director of Alona. She is also the visiting faculty of School of Natural Product Studies, Jadavpur University. Industry-expert member of the advisory committee of Department of Biotechnology, University of Engineering and Management. Board Member of Asian Council of Science Editors, UAE. And also associated as an Editor and Reviewer in a number of international science journals.

Dr. Subhalakshmi Ghosh received Mahatma Gandhi Gold Medal Award, Rashtriya Gaurav Award, and Dr. APJ Abdul Kalam Excellence Award, New Delhi, for her contribution in the field of Research and Medicine. In her entrepreneurial journey she was also selected for 'Rising Women' by American Centre, US Consulate, Kolkata, secured 2nd runner-up position in the Eastern Zone Kolkata Chapter, TiE Women Entrepreneur Global Pitch Programme. Further, she has received the Women Entrepreneurship Award and Fund Support by Atal Incubation Centre, NIPER, Guwahati, Govt of India

Natural Language Processing and Generation for Machine Understanding

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ABSTRACT

The rapid growth of deep learning has revolutionized various fields, but its computational intensity poses significant energy challenges. Training large-scale neural networks demands substantial electricity, contributing to carbon emissions and environmental degradation. This paper examines the energy consumption issues associated with deep learning and explores strategies to minimize its environmental impact. Techniques such as model pruning, quantization, efficient neural architectures, and leveraging renewable energy sources are discussed. Additionally, innovations like federated learning and edge AI can decentralize computation, further reducing energy usage. Emphasizing energy-efficient practices in deep learning is crucial for aligning AI advancements with global sustainability goals.

BIOGRAPHY

Professor (Dr.) Samiran Chattopadhyay, presently the Vice Chancellor of Techno India Univeristy, West Bengal, brings over three decades of expertise in teaching, research, and a unique blend of academic and industry experiences. A distinguished academician, he has served as a professor in the Department of IT at Jadavpur University, a visiting fellow at the University of Northumbria, and an adjunct professor at IIT Kharagpur. He has also contributed to NPTEL and worked in leading global firms like Motorola Inc., NEC Japan, and Interra Systems. A gold medalist in M.Tech from IIT Kharagpur, he earned his PhD from Jadavpur University. His research spans machine intelligence, wireless networks, and network security, with over 200 publications, including 70+ in high-impact journals. Beyond academics, he is a poet, essayist, and admirer of music and cinema. Committed to his work, Dr. Chattopadhyay loves to blend scholarly brilliance with artistic passion.

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Special Lectures

ISBN: 978-81-983133-3-1

Communicate collaborate and Construct

Dr. Subhabrata Mukhopadhyay

Deputy Editor, Wiley

ABSTRACT

This talk will feature Wiley as a publishing house, including their collaborations with various chemical societies to promote scientific outreach and enhance research activities. Briefly, the talk will focus on ethics in scientific publication and plagiarism. Artificial intelligence-based generative language learning programs are creating a prominent impact on the publication landscape. The scope of ethical use of AI tools in scientific peer-reviewed publications will be discussed in the talk. The presentation will cover Wiley's editorial model and the role of an editor.

BIOGRAPHY

Subhabrata is working with the with the Wiley global team from India as a deputy editor. His primary focus is on the journals, ChemCatChem, Chemistry- An Asian Journal, ChemNanoMat, and ChemPlusChem. Additionally, he assists in developing new editorial policies and projects. Subhabrata has a strong background in materials chemistry, with a PhD from the University of Hyderabad (2020), where he worked with Prof. Samar K Das. Before joining Wiley, Subhabrata was working at Research Institute of Sweden (RISE), as a scientist on probable scale-up of academic technologies to pilot scale. He also has postdoctoral experience at Ben Gurion University in Israel (2020-2022) and Uppsala University in Sweden (2022-2023), where he published several papers in reputed journals and received prestigious fellowships (Marie-Curie postdoctoral fellowship) for his research excellence.

Communicate collaborate and Construct

Dr. Raja Chakroborty

Assistant Editor, Wiley

BIOGRAPHY

Raja Chakraborty obtained his Ph.D. degree from the Indian Association for the Cultivation of Science, Kolkata, in 2023, with a research area primarily focused on experimental condensed matter physics. He joined Wiley as an assistant editor in 2024. He is working with journals like Advanced Energy Materials, Advanced Functional Materials, and ChemistrySelect for manuscript handling at this moment.

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Invited Lectures

ISBN: 978-81-983133-3-1

Facile Strategy of Producing Electrically Conducting Paste from a Unique Copper (II) Based Metal- Organic Complex

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ABSTRACT

Unique metal-organic precursor-based copper (Cu) conducting paste was developed for electrically conducting paste applications by a careful selection of suitable metal ion i.e. Cu (II) and compatible ligand systems. This particular Cu (II) ion-based metal-organic complex shows extraordinary aerial oxidation resistance capability as compared to the conventional Cu micro or nano-particles used to formulate this kind of cost-effective electrically conducting pastes. This innovative strategy of producing Cu based economic conducting paste certainly possesses several processing, storage and technological advantages over the traditional commercially available Cu based electrically conducting pastes, used in electronics industry. Undoubtedly, initial experimental evidences make this new category of electrically conducting paste an excellent alternative to traditional market available micro or nano particle-based expensive silver or economic copper paste.

BIOGRAPHY

Dr. Barun Das is an expert in the research domain of Advanced Materials and Nano-Science Research & Development; with more than 16 years of research experience in academia as well as industry. He is currently an Assistant Professor at the Centre for Interdisciplinary Sciences, JIS Institute of Advanced Studies & Research, Kolkata, since August 2023. Previously, he held various teaching positions at prominent institutions and served also as an R&D Scientist at Macdermid Alpha Electronic Solutions in Bangalore for almost 8 years. Dr. Das completed his M.S and Ph.D at the Indian Institute of Science (IISc), Bangalore, under the supervision of Prof. C.N.R Rao. His research focuses on Graphene, Noble Metal nanoparticles & different allied functional martials. During his research career in academia and industry, he has published several internal journals with an average citation of 150 per publication and also holds 5 patents as co-inventor. He is a lifetime member of the Indian Science Congress Association.

Integration of Virtual Power Plants for a New Generation Smart Grid in Electricity Market

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ABSTRACT

- Incorporation and significant rise of Renewable Energy Sources (RES) which are the need for Environmental Sustainability.
- A possible solution to alleviate this is to combine with conventional generators, known as mixed generation.
- Integration of Renewable sources which are intermittent and uncertain in nature needs support from conventional ones, which acts as flexibility.
- Smart grid technology provides models for the operation, consumption and generating assets in a virtual power plant (VPP).
- Negative effects of the uncertainty in the production of Renewable Energy Sources.
- Scheduling problem for the risk-neutral virtual power plant in electricity power market with Day-Ahead, Real-Time and Future markets.
- Uses only Deterministic Model and lack of Stochastic Programming Model that accounts for uncertainties.

BIOGRAPHY

Dr. Bishaljit Paul completed his ICSE (New Delhi) from St. Pauls school, Rourkela in 1984. He completed his CHSE, Odisha, Bhubaneshwar from Govt. College Rourkela, in 1986. He received his BE Degree in Electrical Engineering from REC Silchar, Assam (Assam University) in 1996.

Qualification:

- He is recipient of GATE2007 and QIP both in the year 2007.
- He completed his ME Degree in Power Systems from BESU, Shibpur, Howrah in the year 2009.

- He completed his PhD Degree from the Department of Electrical Engineering at IIEST Shibpur, Howrah in 2020.
- He is recipient of NPTEL certification awards in six electrical subjects with a Gold medal in one subject till date.

Award:

- He is recipient of Five(5) best papers awards at international conferences, and the recipient of Best Thesis Award as well as International Scientist Award from IET and VDGOOD society in 2020 and 2021 respectively.
- He has authored five books.
- He is also recipient of NiT Jewel Award in the year of 2024.
- He is also recognised as eminent educator of the year 2024 by All India Eminent Faculty Council by "Akhil Bharath Limited".
- He has been awarded with most prestigious A.K. Ghosh Memorial Medal from IE (I) as a Guest Lecture on 8th July 2022.
- He is also awarded within Top 100 Researchers in 2022-India from India Education Awards (IEA).
- He is the recipient of International Distinguished Researcher Award 2021-2022 from International Institute of Organized Research (I2OR) govt. registered with MSME.
- He is awarded with most prestigious Dr. A.P.J Abdul Kalam Samman Award-2022 for Excellence in Education from Society of Integrated Federation and Awards, registered from Telengana govt., Hyderabad on 15.10.22. He is also awarded with Gurukul Awards on 20th November 22, by J S university, Uttar pradesh & NITI Aayog, Govt of India.
- He has in his credit 35 papers which are published in IEEE conferences, International journals in Springer Nature.

He has a teaching experience of nearly twenty-five(25) years.

His research interests are Electricity Power Markets, Power Congestion Management Techniques, and Power System Optimization, Uncertainty Decision Making and Stochastic Programming.

Tuning Piezoelectric Responses Through Controlled Supramolecular Self-Assembly of Naphthalene Diimide Appended Peptide and Amino Acid Derivatives

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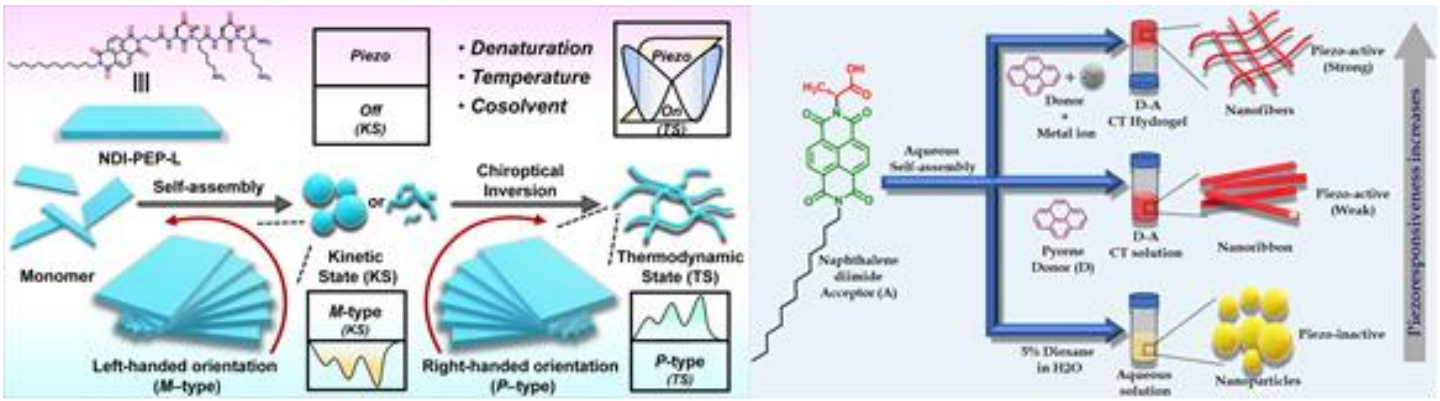
ABSTRACT

The ability to tailor piezoelectric properties in organic materials through supramolecular self-assembly opens new avenues for creating biocompatible and flexible electronic devices. Recently, we have investigated the self-assembly behavior of naphthalene diimide (NDI)-conjugated peptides and amino acids and its impact on their piezoelectric responses. By tuning the molecular arrangement within these systems, we demonstrate a dynamic modulation of piezoelectric properties, paving the way for innovative material design.

Using a combination of spectroscopic techniques (UV-Vis, PL, FTIR, NMR, CD) and atomic force microscopy (AFM), we explore the self-assembly of NDI-conjugated peptides. A key feature of our findings is the chiroptical switching between kinetically stable nanoparticles and thermodynamically stable nanofibers. This structural transformation is associated with a switchable piezoelectric effect, offering dynamic control over material properties (Scheme1 left panel).[1] In a separate study, we observed that NDI-conjugated amino acids form nanoparticles in aqueous solutions,[2] which exhibit no piezoelectric response. Interestingly, the incorporation of external guest molecules such as pyrene (a donor) transformed these nanostructures into 2D nanoribbons, driven by the formation of a charge transfer (CT) complex between NDI and pyrene, resulting in detectable piezoelectric responses. More strikingly, the further introduction of Zn^{2+} metal ions into the CT complex led to the transformation of the solution into a hydrogel with a crosslinked nanofibrillar structure. This structural change significantly enhanced the piezoelectric response, attributed to the unidirectional alignment of dipoles (Scheme1 right panel). These results demonstrate that by carefully manipulating both molecular interactions and the self-assembly environment, we can achieve a high degree of control over piezoelectric properties in NDI-conjugated systems.

These findings highlight the immense potential of supramolecular self-assembly in tuning the piezoelectric properties of NDI-appended peptide/amino acid-based materials. This strategy offers promising opportunities for the design of functional materials with applications in sensors, actuators, and energy-harvesting devices.



Scheme 1. Schematic representation of controlling piezoelectric responses of NDI-conjugated peptide (left panel) and amino acid (right panel)

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BIOGRAPHY

Dr. Goutam Ghosh received his Ph.D. in 2014 from the University of Calcutta, Kolkata, India. After completing his Ph.D, he joined the Indian Association for the Cultivation of Science (IACS), Kolkata, in 2015 as a postdoctoral researcher, where he focused on controlled supramolecular polymerization of π-systems and supramolecularly engineered polymers. Subsequently, in 2019, he moved to the University of Münster, Germany, as a postdoctoral research fellow, furthering his expertise in supramolecular chemistry. He received a highly prestigious “Ramanujan Fellowship” from SERB (now ANRF), Govt. of India in 2023. Currently, Dr. Ghosh holds the Ramanujan Faculty (Assistant Professor) position at the Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru. In 2024, he has been recognized as "The Rising Stars 2024" by The Society of Polymer Science, Japan. He has published many research articles, review articles, and book chapters in highly reputed international journals.

Current Research Focus: Dr. Ghosh's research primarily focuses on the controlled supramolecular polymerization of peptides, amphiphilic molecules, π-conjugated systems and polymers. His work explores their self-assembly behavior and their wide range of applications in fields such as materials science, biomedicine, and energy harvesting. Specifically, he investigates pathway complexity in supramolecular polymerization and the development of functional nanomaterials with tunable properties.

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Possible Application of Doped Zinc Oxide Nanostructures as Cold Electron Gun

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ABSTRACT

From the advent of material science and even before that cold field emission was considered to be a phenomenon of wonder where electron gets emitted from the material through the process of tunnelling against applied energy much lesser than work function of the material.

With the development of nanotechnology era when it was realized that material shape and size has a profound effect on their properties and especially cold emission can be substantially tuned by tuning the morphology of the material there was a boom in the field of cold electron gun development. In this consequence it will not be wrong to say that carbon and zinc oxide (ZnO) nanostructures are probably the two most well studied cold emitter.

Keeping this in mind this talk will address the cold emission characteristics of doped ZnO one dimensional structures and discuss its possible application as cold emission gun in different systems like display, electron microscope or X-ray tube.

This talk will also be supposed to touch the basic analysis method of cold field emission characteristics and in this consequence compare well-accepted Fowler-Nordheim analysis and old Millikan Lauritsen approach.

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BIOGRAPHY

Dr. Diptonil Banerjee is currently working as an associate professor in the department of physics, faculty of engineering, Teerthanker Mahaveer University since 2020. Dr. Banerjee, completed both his graduation and Masters in Physics from University of Calcutta in the year of 2005 and 2007 respectively. He did his PhD from Jadavpur University on Materials Science and Nanotechnology in the year of 2012. Presently Dr. Banerjee is working on mainly carbon-based nanotechnology and related applications. He has also started working on some oxide-based nanostructures as well. He is entrusted by the Department of Science and Technology (Gov't of India) with few projects of considerable budget.

Also, he is belonging to the editorial board members of different journals. Currently he has published around 100 research articles in different international journal of repute along with good many numbers of book chapters and authored a couple of books in the related field of nanoscience and technology entitled “Nano Science-Concepts and Fundamentals” and “Nanomaterial Induced Removal of Textile Dyes from Wastewater” from Bentham publisher. He is the owner of 2 patent and more than 25 conference articles.

He has supervised over 25 PG projects in both M.Sc. and M-Tech in the fields of physics and material Science and presently 5 scholars are pursuing PhD under his supervision along with 2 others already completed. In this journey he received the award of best supervisor of his college in consecutive 3 years. He has delivered numbers of invited talks in different national and international seminars/conference.

Presently Dr. Banerjee is having h index 24 and i10 index 50 with cumulative citation around 2000. Presently the main focus of his research is the indigenous development of electron gun for X-ray generator and electron microscope, a project he has received from DST Gov’t of India under Device Development Scheme along with IIT Delhi and INST Mohali.

Science and Innovation: Transforming Oral Cancer Treatment

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ABSTRACT

Photodynamic Therapy (PDT) is an advanced cancer treatment that uses a photosensitizer (PS), light, and oxygen to generate reactive oxygen species (ROS) for selectively destroying tumor cells. This presentation delves into the key aspects of PDT, beginning with an introduction to its principles and clinical significance. The mechanism of action is detailed, highlighting the activation of PS by specific light wavelengths, the transition to excited states, and subsequent ROS generation, which leads to localized tumor destruction.

The presentation further examines the parameters influencing PDT efficiency, including PS properties, light delivery, oxygen availability, and tumor microenvironment factors. While PDT offers significant advantages, it faces limitations such as poor PS selectivity, hypoxia in tumor tissues, and challenges in uniform light penetration.

To overcome these challenges, the latest methodologies are explored, such as integrating artificial intelligence (AI) for real-time monitoring and optimization, leveraging nanotechnology for improved PS delivery and targeting, and employing innovative oxygen enhancement strategies. The future scope emphasizes the convergence of AI, nanotechnology, and PDT to revolutionize cancer care, enabling personalized, precise, and highly effective treatments with minimal side effects.

This comprehensive overview underscores the transformative potential of PDT when coupled with cutting-edge advancements, paving the way for improved patient outcomes and broader clinical applications

BIOGRAPHY

Dr. Pravesh Singh is a distinguished educator and researcher specializing in Electronics and Communication Engineering. Currently a Professor in the Department of Electronics and Communication Engineering at KIET Group of Institutions, Ghaziabad, she holds a Ph.D. in Electronics and Communication Engineering, an M.Tech in VLSI Design, and a B.E. in Electronics and Communication. With over 18 years of teaching and research experience, she has excelled in roles ranging from Senior Lecturer to Associate Professor and Professor.

Dr. Singh has published 22 impactful research papers, primarily focused on solar materials and AI applications in healthcare, and holds multiple patents in healthcare AI, blockchain, and IoT innovations. She has successfully coordinated conferences, guided research projects, and earned recognition for academic excellence.

Proficient in tools such as MATLAB, IE3D, and Wien2k, Dr. Singh possesses expertise in signal systems and advanced communication technologies. A member of the Telemedicine Society of India, she also holds significant academic and administrative responsibilities at KIET. Her research contributions include serving as Co-Investigator for AI-driven projects in oral cancer screening and tobacco cessation, showcasing her commitment to advancing technology for societal benefit.

$CuBO_2$: The New Age Efficient p-type Delafossite

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ABSTRACT

In view of increasing demand for miniaturization of electronic devices, nanojunctions have been under focus of intense study since the last few decades.

With this, search for appropriate p-type semiconductors was also emphasized. Lead by the brilliant idea of chemical modulation of valance bands, fabrication of wide range of delaffosites were reported. Among such delafossites, Copper Boron Oxide is a novel material with its wonderful optical and electrical properties leading to numerous advance applications. $CuBO_2$ nanostructures were fabricated in form of nanoparticles, nano/micro fibres, nanocubes and also in thin films.

Fabrication of nanostructures of this p-type delaffosite wad realized after thorough optimization of parameters. Three major chemical routes were employed including sol-gel synthesis, molten salt method and hydrothermal technique.

Those nanostructures were incorporated in hybrid systems with graphene and ZnO to contribute in cold electron emission, photo induced water disinfection, photo response, efficient nanojunction formation and most recently in charge storage applications. Synthesis of $CuBO_2$ hybrids by incorporating impurity doping was also found to result in enhanced electrical properties. Simulation based theoretical study was employed to predict the electronic band positions and work function of $CuBO_2$.

This presentation will focus on all these aspects of synthesis and applications of this novel nanometerial along with important output parameters.

BIOGRAPHY

Dr. Nirmalya Sankar Das has been working in the field of solid-state physics and Nanotechnology since last 15 years. He started his academic career under scholastic environment of Ramakrishna Mission at Malda. After district level topper position in higher secondary he completed his graduation from Jadavpur University in 2005. Continuing his post graduation from Jadavpur University he started his research career in nanosience and technology in thin film

and nanoscience laboratory and received his doctorate degree from Jadavpur University in 2014. During his academic career, he has been awarded with prestigious fellowships like Research fellowship in science for meritorious students and post-doctoral fellowship from University with Potential for Excellence scheme.

He has published more than 100 research articles so far and authored 2 book chapters. He has written two books and contributed in a patent along with steel authority of India limited. He has supervised more than 15 students in their master degree thesis and currently supervising one PhD student. He is currently the academic coordinator at Techno International Batanagar, a unit of Techno India Group and the Head of the department of Basic Science and Humanities. He is also leading his institute as the examination coordinator.

Along with regular academic activities, he is also an artist contributing in different scientific graphic works and artistic projects.

Development of Arsenic Biofilter and Biofertilizer Using Isolated and Characterized Arsenic Hypertolerant, Plant Growth Promoting Strain of *Enterobacter sp*

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ABSTRACT

A strain of arsenic hypertolerant, plant growth promoting bacterium was isolated from the irrigation well water of Chakdah Block of Nadia District, West Bengal. Biochemical analysis of the bacterial strain followed by 16S rDNA sequencing, Phylogenetic analysis and Scanning electron microscopy identified the bacterium as *Enterobacter sp*. Sequencing and analysis of the bacterial genomic and plasmid DNA showed the presence of gene, gene clusters and operons responsible for arsenic hypertolerance, plant growth promotion, and further classified the bacterial strain as *Enterobacter sichuanensis* strain WCHECL1597. The bacterium showed unhindered growth at 1000 ppm of sodium arsenite, indicating towards assimilatory processes or dissimilatory processes. *Enterobacter sichuanensis* exhibited arsenic biotransformation potential (conversion of arsenite to arsenate), and arsenic bioremediation potential of 90.6 %, 85.0 % & 79.8 % at 1 ppm, 3 ppm & 5 ppm concentrations of arsenic, respectively. The bacterium showed maximum percentage of bioremediation within 24 hours of incubation at 37°C and pH-7.0. The design of an arsenic biofilter was proposed using the biomass of *Enterobacter sichuanensis* strain WCHECL1597 and a hybrid composite compound (β-cyclodextrin embedded Fe-oxide). Synthetic groundwater (with arsenic up to 10 ppm) was used to study the efficacy of the material (batch experiment). Results indicated arsenic removal up to 90% at a pH range of 7.0 - 8.5. The bacterium also showed plant growth promoting properties like nitrogen fixation, potassium and phosphate solubilization, and auxin (indole-acetic acid), siderophore, acetoin and ammonia production, under *in vitro* condition. Pot experiments and field application of this bacterial strain showed increase in plant height, dry weight of root & shoot, chlorophyll content, root length, fruit weight, fresh weight of chilli plant and branches per plant. We propose to patent the biofertilizer made from this bacterium for sustainable agriculture.

KEYWORDS: 16S rDNA sequencing; Genomic and plasmid DNA sequencing; Arsenic hyper-tolerant bacteria; Bioremediation; Biofilter; Plant growth promoting bacteria; Biofertilizer

BIOGRAPHY

Dr. Abhishek Basu is the Head of the Department of Molecular Biology and Biotechnology, Sripat Singh College and a Ph.D. supervisor affiliated to the University of Kalyani. Dr. Abhishek Basu did his graduation and post-graduation from Presidency College and Rajabazar Science College, respectively, and his Ph.D. from CSIR-Indian Institute of Chemical Biology (IICB) after qualifying research fellowships like CSIR-NET, UGC-NET, GATE and SET. Presently, Dr. Basu is guiding two Ph.D. students working on two projects sanctioned by West Bengal Department of Science and Technology & Biotechnology (WBDST & BT) on soil and water quality analysis, heavy metal bioremediation and designing of biofilter and biofertilizer. Dr. Basu has published more than 25 research articles and book chapters in reputed journals with internationally acclaimed publishers (Springer, Elsevier, Wiley periodicals, Biomed-central, Taylor & Francis, etc.). Dr. Basu has also given invited lectures in international conferences in India and abroad. The research group of Dr. Basu has filed two patents based on their current research and collaborated with internationally acclaimed scientists to translate their research from lab to land. Dr. Basu received many academic awards in his career. Dr. Basu is the Convener, Joint Convener and member of many committees in his institution and he also holds an M.B.A. in Financial Management.

Evolution of Aurivillius based Glass-Ceramics by Sol-Gel and Modified Solid State Process: Characterization & Properties

Dr. Soumya Mukherjee[1]

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ABSTRACT

Aurivillius based layered structure material are of prime interest in the domain of ferroelectrics, piezoelectrics, memory devices and others. Generally, represented by the formula Bi2Am-1BmO3m+3 has received more attention because of its unique crystal structure and the resultant anisotropic electric properties. One of the most important aurivillius based compound is Barium Bismuth Titanate which is glass-ceramic type. Barium bismuth titanate is one of the most widely used ferroelectric materials due to its high dielectric constant and low loss characteristics. As advanced miniaturization requires smaller circuit area, the multilayer ceramic capacitors (MLCCs) with higher efficiency are developed. The MLCCs films (thick or thin) usually require a sub-micron grain size of the ceramic. Conventionally, $BaBi_4Ti_4O_{15}$ powders are manufactured at high temperatures, by solid-state reaction or from chemically derived precursors. These methods produce large, non-uniform, and agglomerated particles that have to be milled and heat treated again to obtain the required particle size (0.5-1.5μm) to fabricate reliable MLCCs. Another possibility to obtain the required grain size could be by mechanical activation of raw materials during powder preparation process. The mechanical activation using high energy milling process is one of the most effective methods for obtaining highly dispersed powders. It results in a decrease of particle size that leads to the initiation of solid state reaction between the starting components at lower temperatures. In the present topics, modified solid state process and sol-gel is carried for synthesizing the compound. A comparison between two process will be discussed in terms of phase analysis, morphology and properties.

Keywords: Aurivillius, Glass-Ceramics, Phase, Bonding, Microstructure, Optical properties

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BIOGRAPHY

Dr. Soumya Mukherjee, joined the Department of Metallurgical Engineering of School of Mines and Metallurgy, Kazi Nazrul University, Asansol, India in 10th December, 2018 as an Assistant Professor. He obtained his PhD (Engineering) from Jadavpur University in 2015. He did his doctoral thesis work in the Department of Metallurgical & Materials Engineering. He has done his Master of Engineering in Industrial Metallurgy in 2010 from the Department of Metallurgical Engineering, Jadavpur University. He obtained Bachelor's Degree in Ceramic Technology from Government College of Engineering & Ceramic Technology (WBUT, India) in 2008 and subsequently obtained graduation in Mechanical Engineering from Institutions of Engineers (India) (Mechanical Engineering). In 2017 he got Chartered Engineering Certificate from Institute of Engineers (India). He had worked with Amity University Kolkata as an Assistant Professor in the Department of Mechanical & Automation Engineering for 3 & Half years along with prior service at Shroff S. R. Rotary Institute of Chemical Technology (Ankleshwar, Gujarat) as Assistant Professor in the Department of Chemical Technology (Ceramic & Glass) for 8 months. His domain of research interests include composite and nano-composite materials, advanced ceramics, nanomaterials, multiferroics, electronic materials, refractory materials, waste recycling and engineering, characterization techniques, mechanical properties of metals, manufacturing science and engineering (Welding, Casting, Advance Machining etc).

At present his teaching interest includes Characterization techniques, Physics of Materials, Industrial Management, Fuel, Furnaces & Refractories, Nanomaterials, Mechanical Engineering, Metal working, Transport phenomena and others. His past teaching interest includes Material Science, Metallurgy, Mechanics of Solids, Manufacturing Technology, Advance Ceramics, Thermodynamics, Heat and Mass Transfer, Non-Destructive Testing of materials and structures, Machines and Machine tools.

He has published about 77 peer-reviewed research papers in international/National peerreviewed journals, 30 Full papers in International/National conference proceedings, 5 Book Chapters, got 1 patent, presented 70 papers International Conference and 55 National conference papers till date. Till now he has attended 28 Faculty Development Programmes organized by NITTTR, Jadavpur University, NIT's, (Andhra Pradesh, MANIT Bhopal) MAKAUT, IIITDM Kaancheepuram, Ministry of Education (1 Month Orientation Programme) and UGC-HRDC. He has supervised 12 M.Tech Thesis and one PhD guidance in collaborative mode till date. In addition, 18 UG projects have been guided till date and 3 PhDs Scholars are working under his supervision. He is also the reviewer and Editorial board member of several International peer-reviewed journals at present. He has membership with several professional bodies like Institutions of engineers (India), Indian Institute of Metals, Indian Institute of Ceramics, International Association of Advanced Materials, Institute of Science, Education and Culture, (ISEC), Powder Metallury Associations of India(PMAI) and others. He has received INSA Visiting Scientist Programme 2021, 2023 and worked at CSIR-CGCRI, Jadavpur University in collaborative mode. He is the recipient of several

Awards from different organizations. He obtained prestigious DST TARE Fellowship and also Principal Investigator of a project funded by UGC-DAE, Indore. He have been the coordinator at his department's at both Kazi Nazrul University, Asansol and Amity University Kolkata for a total duration of 4 years, organizing also Short term training programme and workshop. He is actively involved in different scientific collaboration with different organizations.

H_2 Storage on Li decorated Triazole and Tetrazole Templates: An in-Silico Ivestigation

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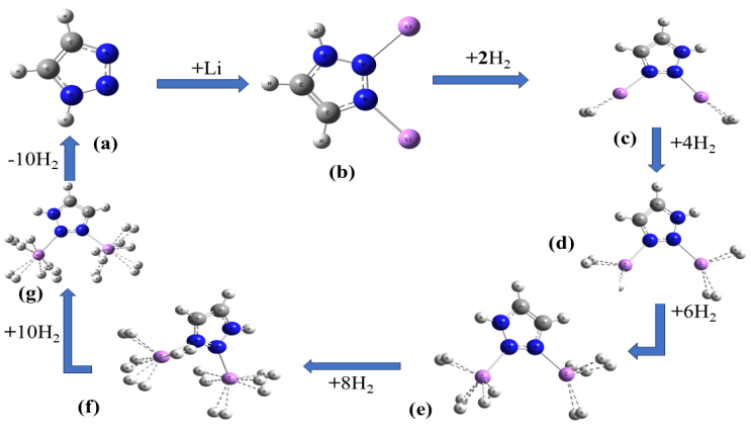
ABSTRACT

Hydrogen adsorption-desorption properties, and storage capacities of Li-functionalised triazole and tetrazole templates using dispersion-corrected density functional theory (DFT) were studied with molecular dynamic simulation. The Li^+ ion was found to bond linearly and strongly with the triazole and tetrazole ring via non-covalent interaction that has been confirmed by the EDA study. The host material, triazole/tetrazole-xLi^+(x=1,2) can adsorb up to 5$H_2$and 10 H_2 molecules respectively via a charge polarization mechanism with an average adsorption energy/H2 in between 0.1-0.8 eV/H_2, suggesting quasimolecular adsorption mechanism. Aromaticity is retained for all complexes even after gradual H_2 adsorption which implies the stability of the system. The gravimetric wt% of mono-lithiated triazole and tetrazole isomers are 11.76 and 11.49 respectively, while for bi-lithiated triazole and tetrazole isomers, the values are 19.6 and 19.23 respectively. The ADMP molecular dynamics simulations assured the reversibility of adsorbed H_2 above the desorption temperature (300K). Therefore, the Li-functionalized triazole and tetrazole can be considered as a thermodynamically efficient and potentially reversible H_2 storage material below room temperature.



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(1) https://doi.org/10.1016/j.comptc.2023.114362

(2) http://dx.doi.org/10.30919/esmm5f825

BIOGRAPHY

Dr. Gourisankar Roymahapatra, FICS, FIC, FRESI, is currently working as an Associate Professor of Chemistry at the School of Applied Science and Humanities, Haldia Institute of Technology (HIT) Haldia, India. He completed his Ph.D. from Jadavpur University, Kolkata (2014) with N-Heterocyclic Carbene Chemistry as a major field under the mentoring of Dr. Joydev Dinda of HIT Haldia, and Prof. Ambikesh Mahapatra of Jadavpur University. Before joining to Global Institute of Science and Technology (GIST Haldia), as a Lecturer in Chemistry in the year 2011, he worked at MCC PTA Chem. Corp. Pvt. Ltd India (MCPI), Haldia, (2003 ~ 2011) as a Senior Chemist. He joined HIT Haldia in 2015 as an Assistant Professor of Chemistry. His area of research interest includes NHC complexes, organometallics, catalysis, antibiotics, anti-carcinogenic, gas adsorption, super alkali, computational chemistry and DFT. For his contribution in research, he got the 'Distinguished Young Scientist Award in Chemistry -2014'; 'Bharat Gaurabh Award – 2018'; and 'Indian Chemical Society Research Excellent Award 2021'. Dr. Roymahapatra is a Life Fellow of the Indian Chemical Society (FICS), and a Life Fellow of the Institutes of Chemistry (India) (FIC), and Life Fellow of The Renewable Energy Society of India (FRESI). He is the elected Vice-president of Haldia Vigyan Parishad (HVP) from 2018-2024, and 2025-2026. He is the elected youngest Treasurer of Indian Photobiology Society (2023-24). He has published 125 international article, and 25 book chapters. Dr. Roymahaptra is the Jt. editor of 'Chemical Warta' - a chemistry newsletter, 'Education in Chemical Science and Technology' – a book series, published by the Indian Chemical Society. He is editorial board member and reviewer of several national and international journals. He was honoured by the Journal of the Indian Chemical Society as the 'Guest Editor' for the special issue in the honour of the Past President, Professor Dulal Chandra Mukherjee to celebrate his completion of 60 years as a chemistry teacher. He also edited the APC Ray special issue published by the international journal ES Material and Manufacturing, March-2023; contributor of ACS Axial on APC Ray, published on August 2023. Dr. C. V. Ramn University. Chttisgarh, has honoured him with Acharya P. C. Ray memorial Lecture Award – 2024.

Controlling of Hazardous and Toxic Radioisotopes of Atomic Reactor on Glass Material

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ABSTRACT

1. INTRODUCTION

The use of nuclear energy for future generation largely depends on the successive programmers and management of radioactive wastes which is generated at various stages of the nuclear fuel cycle. There are different levels of radioactive wastes that contain or are contaminated with radio nuclides at concentrations greater than a certain (permissible) level:1 low level waste (LLW), containing ~0.1 μCi/L(ii) intermediate level waste (ILW), between 0.1 and 0.4 μCi/L, (iii) high level waste (HLW), containing >0.4 μCi/L. Among all the sources nuclear power plant and atomic industries are the major sources of radioactive wastes.

The fission products with the usual fuel materials, viz. U, Pu and Th, contain ~35 elements with 200 different isotopes. Glass has ability to dissolve most of the elements of the periodic table. During preparation of the glass it imbibes all the elements present in the waste, so glass can be considered as a 'secular' matrix.

Iron phosphate glasses have high extent of chemical durability compared to silicate or borosilicate glasses. Addition of Fe_2O_3 in pure phosphate glass replaces the P–O–P bonds by more moisture resistant P–O–Fe bonds that lead to excellent chemical durability. The objective of the present work is to study spectroscopic properties of the LIP glasses with different modifier as well as their durability in different media. Lead-iron phosphate (LIP) glasses, mixed with high uranyl acetate loaded with simulated nuclear waste, were melted. Leaching study of these glasses up to 300 h was conducted under Soxhlet distillation condition with steam distilled water. Weight loss and residual activities by'radiotracer technique' were followed with respect to time of leaching.

2. MATERIALS AND METHODS

Preparation of Glass Batches and Melting Operation

Different wastes, supplied by Nuclear Recycle Group, BARC, Trombay, Mumbai, were used and their compositions were adopted in our work .The corresponding glass batches were malted

programmable muffle furnace in the range 750º-1000ºC for a soaking period of 60 min under ambient condition. For some of the LIP glasses(LIP8-LIP10) the batches were composed by taking uranyl acetate directly in to itself. The prepared glass was ground to powder and was subjected to Soxhlet distillation taking the powder in a net. It was then dried and α radiation emerging from it was counted by Geiger Muller counter to find its concentration in cps.

3. RESULTS AND DISCUSSION

Differential thermal analysis was used in the range 30 to 900 ^{0}C using α-Al_2O_3 as the reference. FTIR spectra were reordered using KBr plate .The mössber analysis were done UGC-DAE Consortium for Scientific Research .

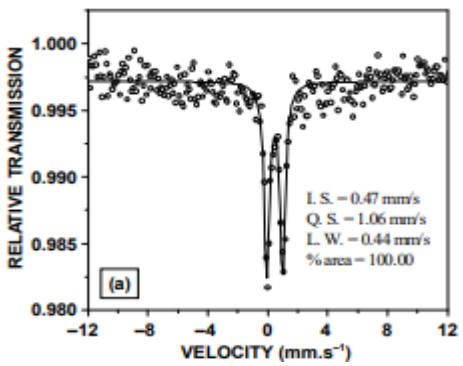
Glass formation was confirm from the powder XRD pattern. FTIR spectra Show stretches related two phosphate motions(P-O-P bending).

The Mössber spectra reveal the singularity of this study with respect to isomer shift .

$$IS = {}^2/_5 \Pi Z e^2 [\psi_{ex}{}^2 - \psi_{gr}{}^2][R_{ex}{}^2 - R_{gr}{}^2] \quad ..(1)$$

where Z is the atomic number, e is the electronic charge, ψ_{ex} and ψ_{gr} and ground states, respectively, R_{ex} and R_{gr} are the radii of Fe nucleus at the excited and ground state, respectively

The quadruple effect here is generated inherently and not applied externally. One sample MB spectrum is shown following figure -



From the leaching study it is evident that the resistance of LIP glasses to aqueous attack varies considerably with the pH of the lechate solution . The best chemical resistance is exhibited at neutral pH 7 and the corrosion of the LIP glasses increases slowly with increasing pH

4. CONCLUSION

Chemical and physical properties of lead iron phosphate glasses depend on the glass composition. P_2O_5 is assumed to be the glass former and PbO is added to reduce the viscosity and consequently the melting point. As per the Mössbauer spectra of Fe the IS value gets increased with increasing Fe_2O_3 content. With some exceptions LIP glasses are very much suitable for loading of nuclear waste in comparison to other from of glasses.

5. ACKNOWLEDGMENT

Time to time discussions with Late Dr J. Mukerji and Dr A. S. Sanyal, retired scientist CSIR-CGCRI, Kolkata is duly acknowledged. s. The financial assistance rendered by DSA (Chemistry) and DSA (Physics) through an UGC minor project are also acknowledged.

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BIOGRAPHY

Dr. Tanmoy Das, born on May 10, 1964, in Naihati, North 24 Parganas, West Bengal, is a distinguished academic and researcher in the field of Chemistry. Currently residing near Nawab Bari, K.A. Berh, Burdwan, he pursued his Honours degree in Chemistry at Vivekananda Mahavidyalaya, Burdwan, followed by an M.Sc in Chemistry with a specialization in Nuclear and Analytical Chemistry from the Department of Chemistry, University of Burdwan.

Dr. Das began his research journey as a Junior Research Fellow (JRF) at ISM, Dhanbad, and subsequently earned his Ph.D. under the guidance of the late Dr. J. Mukerji and Dr. A. S. Sanyal at the Central Glass & Ceramic

Research Institute (CGCRI), Jadavpur, Kolkata, sponsored by the Aeronautics Research and Development Board (ARDB). He also undertook a postdoctoral fellowship at CGCRI and a short-term PDF at the Indian Association for the Cultivation of Science (IACS), Jadavpur, Kolkata.

His professional career includes roles such as Junior Scientist at the Center for the Study of Man & Environment, Salt Lake, Kolkata, Lecturer at Bankura Unnayani Institute of Engineering (WBUT), and Assistant and Associate Professor in the Department of Chemistry, University of Burdwan. Dr. Das has contributed extensively to the academic community with 50 publications in national and international journals and 20 conference presentations. He has successfully guided six Ph.D. scholars.

Dr. Das has received several accolades, including the National Scholarship and the AIR-INDIA Statesman BOLT Teacher Award. Notably, he was involved in the "Development of AlON Dome of Missile" project sponsored by the Defence Research and Development Laboratory (DRDL), Ministry of Defence, Government of India.

Dr. Das can be reached at tdas@chem.buruniv.ac.in or on his mobile at 9434202422. His work exemplifies dedication to advancing Chemistry and its applications in defense and environmental studies.

Mechanical Energy Driven Piezocatalysis Activity for Environmental Remediation

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ABSTRACT

Piezocatalysis is a process that converts mechanical energy into chemical reactions that can be used to catalyze the breakdown of contaminants in water. Piezocatalysis, which turns mechanical energy into electrical energy through the polarization of piezoelectric materials, is considered as a promising method for environmental remediation and energy conversion. When piezocatalyst crystals are subjected to an external force, they produce surface polarization as a result of positive and negative charges being separated to opposite polar surfaces. These polar surfaces facilitate efficient charge transfer between catalyst material and organic chemicals, resulting in their rapid breakdown. Especially, operability under dark conditions as well as availability of abundant low-frequency vibration energy as a source of mechanical energy resource establishes piezocatalysis as a highly propitious technology over its peers. Moreover, the internal electric field generated by the piezoelectric material can effectively inhibit the photogenerated carriers' recombination, contributing to excellent catalytic performance. Development of highly efficienct piezoecatalytic technology that can harness natural driving forces will pave the way for its practical application in the field of environmental remediation.

BIOGRAPHY

Dr. Subhajit Saha has received his M. Tech. and Ph.D. (Engineering) degree from School of Materials Science and Nanotechnology, Jadavpur University, India. After that he conducted his postdoctoral research from Indian Association for the Cultivation of Science, Kolkata and National Tsing Hua University, Taiwan. Dr. Saha has also worked as a Senior UPE Fellow in Nanoscience and Technology program under UGC-UPE scheme at Jadavpur University. Currently, he is working as an Assistant Professor at Department of Renewable Energy Engineering, Maulana Abul Kalam Azad University of Technology, West Bengal. He is a Visiting Faculty of Department of Industrial Chemistry & Applied Chemistry, Ramakrishna Mission Vidyamandira, Belur Math, Howrah. His research interest includes Self-powered nanosensors, Environmental remediation and Energy-efficient lighting

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Oral Presentation

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Oral Presentation – OP-01

The Genetic Landscape and the Immune Pathways Network of Ankylosing Spondylitis

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INTRODUCTION

A class of immune-mediated conditions known as spondyloarthritis (SpA) affects the spine, entheses, and peripheral joints. Ankylosing spondylitis (AS) and non-radiographic axSpA (nr-axSpA) are two subtypes of axial spondyloarthritis (axSpA). AS, which is more frequent in men and has a prevalence of 0.07% to 0.32% worldwide, usually affects people between the ages of 15 and 30. It causes inflammation and structural damage to the sacroiliac joints and spine. Vertebral fractures, osteoporosis, and ankylosis can result from AS. Patients may also have extra-skeletal symptoms such cutaneous, gastrointestinal, and ocular involvement, as well as peripheral arthritis, dactylitis, and enthesitis in addition to axial inflammation.

MATERIALS AND METHODS:

The materials used for the study included DAVID for functional annotation, Cytoscape for node count analysis, and STRING for assessing the proximity of gene networks. The gene list was obtained from the GEO accession database, providing a comprehensive dataset for further study of gene interactions related to Ankylosing Spondylitis.

RESULT AND DISCUSSION:

Using the GEO accession database, the data were divided into subgroups: a) AS Female (AS F), b) AS Male (AS M), c) Control Female, and d) Control Male. A large dataset of genes, including upregulations and downregulations, was analysed. STRING was used to annotate closely connected genes responsible for AS, with ZFY identified as the seed gene, linking 10 nodes and 45 edges. Upregulation and downregulation of genes were calculated based on p-values, with genes showing a p-value of less than 0.05 considered as upregulated, and those with p-values greater than 0.05 classified as downregulated.

Gene	Pubmed Id	Species	David Gene Name	Regulation
VCY1B	353513	Homo sapiens	variable charge Y-linked 1B(VCY1B)	Down Reg.
STS	412	Homo sapiens	steroid sulfatase(STS)	Up Reg.
USP9Y	8287	Homo sapiens	ubiquitin-specific peptidase 9 Y-linked(USP9Y)	Down Reg.
TMSB4Y	9087	Homo sapiens	thymosin beta 4 Y-linked(TMSB4Y)	Down Reg.
RPS4Y1	6192	Homo sapiens	ribosomal protein S4 Y-linked 1(RPS4Y1)	Down Reg.
ZFY	7544	Homo sapiens	zinc finger protein Y-linked (ZFY)	Up Reg.
VCY	9084	Homo sapiens	variable charge Y-linked(VCY)	Down Reg.
XG	7499	Homo sapiens	Xg glycoprotein (Xg blood group)(XG)	Down Reg.

- VCY1B (Variable Charge Y-Linked 1B)- This gene, expressed only in male germ cells and part of the VCX/Y family, is linked to Spermatogenic Failure, Y-Linked 2 and Ichthyosis, X-Linked.
- STS (Steroid Sulfatase)-produces a sulfatase enzyme involved in breaking down 3-beta-hydroxysteroid sulfates, essential for cholesterol, estrogen, and androgen synthesis. Mutations are linked to X-linked Ichthyosis and Ichthyosis Vulgaris.
- USP9Y, a member of the peptidase C19 family, encodes a ubiquitin-specific protease. Mutations are linked

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to Spermatogenic Failure, Y-Linked 2, and Male Infertility.

- TMSB4Y, located on the Y chromosome, encodes an actin-sequestering protein immune to X inactivation. It is involved in ERK signaling and actin monomer binding pathways.
- RPS4Y1 encodes a ribosomal protein essential for protein synthesis, part of the 40S subunit. Haploinsufficiency is linked to Turner Syndrome and Hypogonadotropic Hypogonadism, with no functional difference between isoforms.
- ZFY encodes a zinc finger protein potentially acting as a transcription factor. It was previously considered a candidate for TDF, linked to Freemartinism and Campomelic Dysplasia.
- VCY, expressed only in male germ cells, encodes a positively charged protein with a nuclear localization signal. It is linked to Spermatogenic Failure, Y-Linked 2 and Ichthyosis, X-Linked.
- XG encodes the XG blood group antigen located at the pseudoautosomal boundary on the X chromosome. It is linked to Age-Related Macular Degeneration 1 and Ichthyosis

CONCLUSION:

The findings suggest that ZFY is a key seed gene closely connected to other genes linked to ankylosing spondylitis (AS), with the presence of these genes in the GEO dataset highlighting the connection. AS is more prevalent in males, who experience worse radiological outcomes. In contrast, females face longer diagnostic delays, exacerbating pain and worsening disease progression.

ACKNOWLEDGEMENT:

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Oral Presentation – OP-02

Image Captioning using Deep Learning Technique-A Novel Technique

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INTRODUCTION

Image captioning refers to the process of assigning natural language descriptions to images and has gained significant popularity recently because of application areas in accessibility, multimedia retrieval, and social media analysis. Traditional methods have especially tended to rely on architectures comprising CNNs for feature extraction and RNNs or LSTMs for sequence generation. Here, while these conventional approaches have achieved considerable success, really, they are still struggling with capturing the high-level contextual information and sometimes very fine visual details that are necessary for generating appropriate captions. In this work, we propose a hybrid architecture that combines the strengths of two of the most powerful CNNs, InceptionV3 and Xception in order to better capture the multi-scale visual features of an image. InceptionV3, being a deep architecture with auxiliary classifiers, generates strong high-level feature maps, and Xception, using depthwise separable convolutions, focuses on better extraction of fine-grained details. These are embedded into an LSTM-based sequence generator with attention where the model can selectively focus on the regions of images which are more informative during caption generation. Experiments conducted on the Pascal VOC 2012 dataset verify good performance against traditional methods while validating the strong potential for enhancing the accuracy as well as richness associated with image captioning tasks.

MATERIALS AND METHODS

This study employs a hybrid deep learning approach by integrating the InceptionV3 and Xception models combining into one single hybrid architecture and merging it with the BLIP transformer to enhance image captioning tasks. The methodology is divided into three key stages: feature extraction, hybrid model integration, and multimodal processing. Initially, InceptionV3 and Xception pretrained models, are utilized for feature extraction. Both models independently process input images to generate feature embeddings, leveraging their distinct architectural strengths. InceptionV3 focuses on multi-scale feature extraction using convolutional blocks, while Xception exploits depth wise separable convolutions for efficient learning. The extracted feature vectors are concatenated to form a unified representation, capturing comprehensive image features. This hybrid representation is further refined using a projection layer to align with the dimensional requirements of the BLIP transformer. The refined features are then integrated into the BLIP model by replacing its vision encoder with the hybrid backbone. The BLIP transformer combines these features with its text encoder, enabling joint vision-language representation learning facilitating the enhancement of captioning tasks. This methodology enhances the model's ability to process diverse visual information, improving the quality of image-text alignment while leveraging the strengths of both convolutional and transformer architectures (in Fig. 1).

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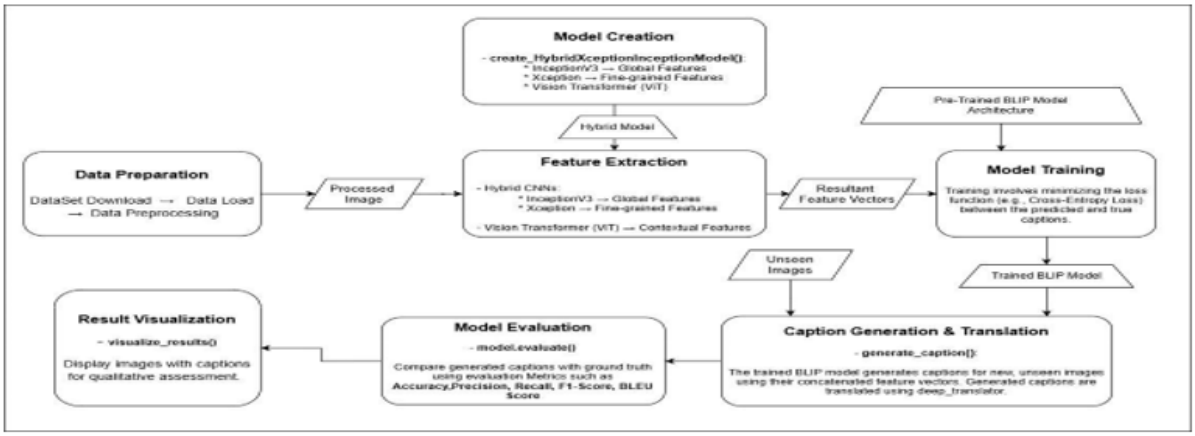
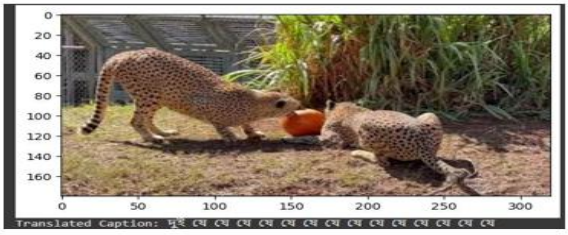


Figure 1. Block Diagram

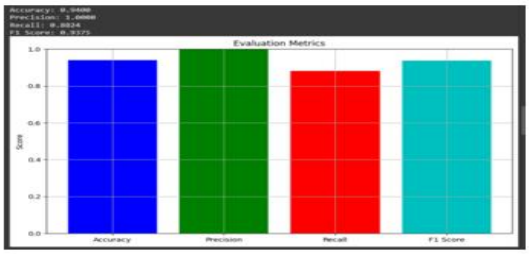
3.→RESULTS·AND·DISCUSSION¶

Figure·2.·Correct·Predictions¶

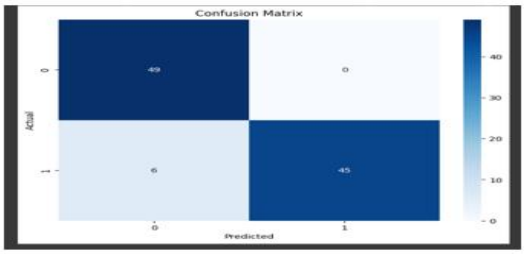


Figure·3.·Wrong·Predictions¶

¶



Figure·4.·Evaluation·Metrics



Figure·5.·Confusion·Matrix¶

CONCLUSION

The evaluation of the model on several standard metrics shows that it surpasses traditional single-architecture models in terms of performance (in Fig. 4 and Fig. 5). This hybrid approach paves the path for substantial enhancements in caption quality and diversity, revealing the efficacy of combining complementary architectures for complex visual-to-linguistic assignments.

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Oral Presentation – OP-03

Ultra-Responsive Methane Sensing by 2D ZnO Nanoparticle Based Mems Gas Sensor-an Artificial Intelligence Based Study

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INTRODUCTION

Methane (CH_4) gas is aggressively unstable and flammable when admixed with air, posing a risk of explosions, causing asphyxiation due to displacing oxygen in confined or poorly ventilated spaces.[1] Therefore, creating a dependable and affordable methane gas sensor is a critical question, in the environment and in coal mines to protect human lives. Metal oxides prove themselves as efficient methane gas sensing element, due to semiconducting nature. ZnO is a low cost and higher conducting metal oxide, preferably employed in CH_4, H_2 sensing as it is wide band gap (3.2 to 3.4 eV), electron dominated compound semiconductor, easily synthesized even at room temperature [1], high compatibility with silicon. Presently ZnO with its several morphology [1] are becoming prevalent in the ultra-responsive nano-dimensional gas sensors. Microheater-based micromachined silicon structures provides lots of advantages over traditional gas sensors, such as size-compactness, low power consumption, with cost-effective fabrication. They also provide high quality, excellent thermal efficiency, increased sensitivity, fast thermal response time, and long-term reliability. Although existing reports documented ZnO nanostructure based CH_4 sensing with MEMS based Si platform at lower operating temperature but the forecasting in CH_4 sensing is not reported comprehensively.[2] Artificial Intelligence (AI) based forecasting is a promising area of research now-a-days. In this present work, 2D ZnO nanoparticle based CH_4 sensor with Pd-Ag contact and DILVER P1 based MEMS platform is documented. The sensing mechanism, V-I characteristics, dynamic response, long term stability study were investigated at lower temperature range (150- 200^{o}C). The novelty of the present work is the successful implementation of Gradient Boosting Regression algorithm, to predict the CH_4 sensing where the performance of the model is measured by MSE(Mean Squared error) and R-squared value.

MATERIALS AND METHODS

Zinc Sulphate ($ZnSO_4$,$7H_2O$), Sodium Hydroxide (NaOH), Palladium Chloride ($PdCl_2$) were procured from Merck, India. All reagents were used without any further purification. P-type polished Si was purchased from Ultra nanotech Private Limited, Bengaluru, India. Google Collaboratory was used for development of our model as the platform is a free python platform and works fine in cloud architecture. The training data set comprises of operating temperature and CH_4 concentration as input whereas response magnitude (RM), response time(RT) are treated as output.

A. p-Si substrate Preparation
B. Synthesis of Nanocrystalline ZnO
C. Characterization- XRD, FESEM, FTIR, UV-Vis spectroscopy.
D. Fabrication of MEMS based nanocrystalline ZnO based CH4 gas sensor
E. Gas Sensing Measurement
F. ML model- Gradient Boosting Regression implementation

RESULTS AND DISCUSSION

The XRD pattern confirms the formation of wurtzite structured ZnO nanoparticle with grain size of 41.06 nm. FTIR study is also in good agreement with XRD result due to availaibility of hydroxyl group(O-H stretch, H-bonded) and Zn-O bond at 479 cm^{-1}. The Scanning ElectronMicroscopy revealed 2D flake like structure of the as prepared ZnO layer. FESEM study explores 2D flake like morphology of ZnO thin film consisting of hexagonal needle like structures with ~40-70 nm size and pores with average diameter of ~80nm. The film thickness is

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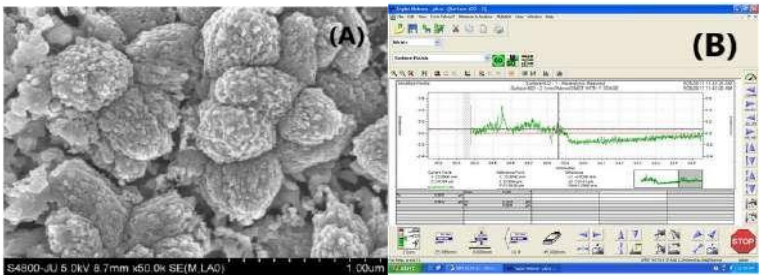
measured and it is found to be 250 nm. The UV-Vis spectra unshielded green defect (significant absorption peak at 561 nm) enriched ZnO nanostructure. The band gap energy was found to be 3.326eV.

Figure 1. (A) FESEM micrograph of as synthesized ZnO film, (B) ZnO film thickness profile.



The sensor starts sensing CH_4 @ 0.1 -1% with response time (RT) ~90-87s at 125^{o}C. The optimized operating temperature of the gas sensor is evolved as 200^{o}C as the RM becomes 88.48% for 1% CH_4 and RT was found to be 40s. The Pd-Ag (70%) contact exhibited excellent ohmic behavior. The sensor exhibited fairly stable resistance both for N_2 and for 1% CH_4 in N_2. The Gradient Boosting Regression model has depicted the prediction of CH_4 sensing in terms of MSE (0.7148) and R- squared value (0.9994). (from Table 1)

Table 1. Prediction performance of CH_4 sensing by Gradient Boosting Regression model

Temperature(x1)	Methane conc(x2)	Predicted magnitude(output)	Actual magnitude	Error
238.24	0.64	82.537	83.89	1.353
246.12	0.33	82.537	81.8819	-0.6551
166.35	0.33	74.2779	75.7608	1.4829
188.15	0.82	88.3453	86.9133	-1.432
130.23	0.07	44.4055	43.4314	-0.9741
224.86	0.22	85.2338	83.3102	-1.9236
189.33	0.43	85.5308	83.7936	-1.7372
211.41	0.5	86.5308	85.7576	-0.7732
228.9	0.44	82.537	84.011	1.474
226.18	0.05	79.3098	81.265	1.9552

CONCLUSION

Conclusively, the present investigation explored excellent and stable CH_4 sensing at low temperature by 2D flake like ZnO nanoparticle. The ML modelling has predicted the gas sensing with high level of regression.

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Oral Presentation – OP-04

An Information Therapeutic Approach to Analyzing the Impact of Meditation on Heart Rate Variability

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INTRODUCTION

Meditation has long been acknowledged for its psychological benefits, particularly its role in enhancing emotional regulation, reducing stress, and fostering mindfulness. However, in the past few decades, an increasing body of evidence has emerged linking meditation to physiological improvements, particularly in the domain of cardiovascular health. Among the most commonly used biomarkers to assess autonomic function and cardiovascular health are heart rate variability (HRV) and electrocardiogram (ECG) signals.The autonomic nervous system (ANS) regulates involuntary physiological processes, including heart rate and blood pressure, and is divided into two branches: the sympathetic and parasympathetic nervous systems.Heart rate variability (HRV), the variation in the time intervals between successive heartbeats, has become an important indicator of autonomic regulation. High HRV is typically associated with a well-balanced autonomic nervous system and good cardiovascular health, while low HRV has been linked to a range of cardiovascular and psychological disorders, including anxiety, depression, and increased mortality rates. Simultaneously, electrocardiogram (ECG) signals provide detailed information about the electrical activity of the heart, offering insights into heart rhythm, heart rate dynamics, and arrhythmic behaviors. Meditation has been shown to modulate autonomic function, influencing both HRV and ECG patterns. This paper seeks to develop a mathematical model to explore how meditation affects HRV and ECG dynamics by analyzing the time-domain and frequency-domain features of HRV and the morphological patterns of ECG signals.

MATERIALS AND METHODS

Physiologic systems generate fluctuations in their output signals that reflect the underlying dynamics. To discover such hidden information, we analyzed the repetitive appearance of certain basic patterns that are embedded in the complete signals. Consider an inter beat interval time series {x1, x2, x3,…. xn}, where xi is the ith interbit interval. We can classify each pair of successive inter beat intervals into one of the two states that represents a decrease in x,or increase in x. These two states are mapped to the symbols 0 & 1, respectively.

$$A_n=0, \text{ if } x_n <= x_{(n-1)} \; A_n=1, \text{ if } x_n > x_{(n-1)}$$

To evaluate the model's performance and how well it captures these changes, we introduce an Information-Based Similarity Index which quantifies the degree of similarity between the physiological states, capturing the information overlap between the pre- and post-meditation conditions in terms of HRV and ECG signal characteristics. Here, two different types of subjects are involved and each group has a different meditation technique Chi meditation and the Kundalini Yoga meditation. The process of meditation also differs significantly between these two groups.

In the process of Chi meditation, it is required to sit quietly and try to visualize the opening and closing of a perfect lotus in the stomach. On the other hand, the Kundalini Yoga meditation consists of sequence of breathing and chanting exercises, performed while seated in a cross-legged posture.

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RESULTS AND DISCUSSION

We noticed that the word size 4, word size 5, word size 6 and word size 7 are most suitable in our purpose. If the word size is too small, the number of data points become very small to represent a visual feature. On the other hand, if the word size is very high the results tend to lose their feature.

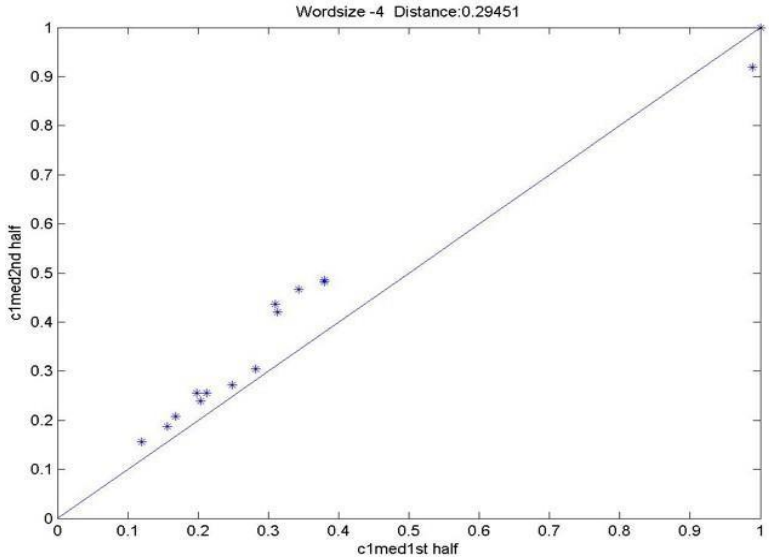

Figure 1. ***C1med 1st half Vs C1med 2nd half for word size=4***

CONCLUSION

This mathematical model provides a robust framework for understanding the physiological effects of meditation on heart rate variability and ECG dynamics. By simulating the interactions between the sympathetic and parasympathetic branches of the autonomic nervous system, we have been able to capture the significant changes in autonomic regulation and heart function that occur with meditation practice. These findings underscore the therapeutic potential of meditation as a tool for improving cardiovascular health and autonomic balance

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Oral Presentation – OP-05

A Highly Selective Benzyl Dihydrazone Based Bis- Schiff Base Chemosensor for Colorimetric Detection of Ni^{2+} Ion and *Turn-On* Fluorometric Detection of Ag^{+} Ion in Semi-Aqueous Medium

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ABSTRACT

A colorimetric and fluorometric *turn-on* probe **L**, has been synthesized and characterized by X-ray single crystal analysis, ^{1}H- NMR, ESI-MS, UV–vis spectra and elemental analysis. The probe **L**, functioned as dual ions sensor to detect important metal ions Ni^{2+} and Ag^{+} in 1:1 methanol–water (v/v) solution in the presence of other cations (Fe^{3+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, Hg^{2+}, Pb^{2+}, Mg^{2+}, Cr^{3+}, Al^{3+} and Fe^{2+} ions etc.) based on binding site-signalling approach, where both the benzyl dihydrazone moiety acts as binding sites for Ni^{2+} ions and carboxy-group acts as binding site in case for Ag^{+}. The binding stoichiometries of probe **L**, with the metal ions Ni^{2+} and Ag^{+} have been confirmed by Job's plot, ESI-mass spectral analysis and DFT studies. The colorometric detection limits reached upto 1.9 for Ni^{2+} and fluorometric detection limit upto 0.72 μM for Ag^{+} ions. The probe **L** has been successfully applied for the determination of Ni^{2+} and Ag^{+} ions in real water samples.

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Oral Presentation – OP-06

Highly Sensitive, Cost-effective, Flexible, and Wearable Pressure Sensors Based on Perforated Graphene and Tissue Paper for Several Real-life Applications

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ABSTRACT

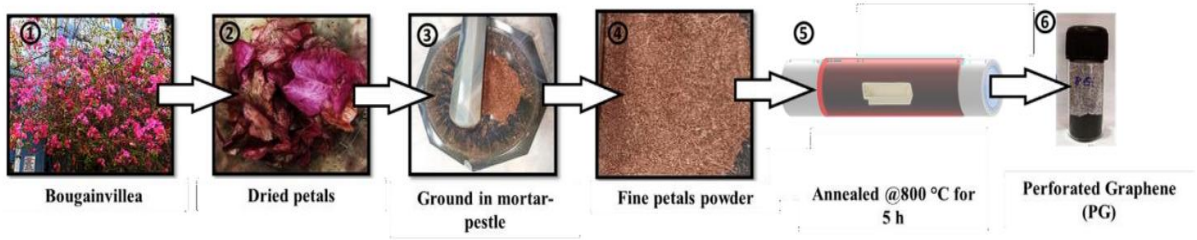
Flexible and wearable pressure sensors have gained significant attention due to their potential applications in healthcare monitoring and human-machine interactions. However, challenges such as complicated fabrication processes, high costs, and limitations in achieving both high sensitivity and a wide working range hinder their practical implementation. In this study, perforated graphene (PG)@tissue paper (TP) composites were utilized as the sensing material to address these issues. The optimized sensor demonstrated a high sensitivity of 38.61 kPa^{-1} (0-1 kPa), a low detection limit of 0.1 kPa, a wide working range (0.1-10 kPa), and excellent flexibility and stability. Additionally, a sensor array successfully identified spatial pressure distribution.

INTRODUCTION

In recent times, flexible and wearable pressure sensors have attracted great attention because of their potential applications in healthcare monitoring and human-machine interactions. [1] However, the complicated fabrication process and the high cost of sensing materials limit their widespread applications in real life. Also, pressure sensors should have an excellent sensitivity in a wide range for practical wearable applications. But traditional pressure sensors cannot achieve both a high sensitivity and a large working range simultaneously. [1, 2]

MATERIALS AND METHODS

In this work, perforated graphene (PG) is simply prepared via a one-step pyrolysis of a bio-waste material (dead



Figure·1.·Perforated·graphene·(PG-8)·is·simply·prepared·via·a·one-step·pyrolysis·of·a·bio-waste·material·(dead· Bougainvillea·flowers)·and·used·as·the·sensing·material·of·the·pressure·sensor.¶

Bougainvillea flowers) and used together with tissue paper (TP) as the sensing

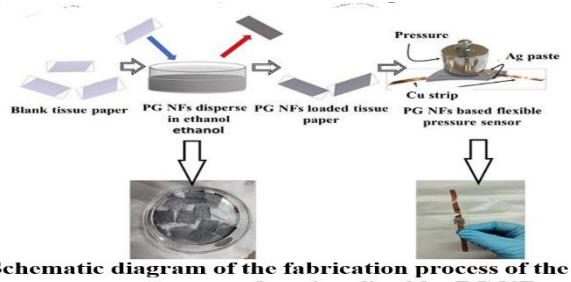


Figure 2. Schematic diagram of the fabrication process of the piezo-resistive pressure sensor functionalized by PG NFs.

material of the pressure sensor. Solutions of PG of different concentrations (1mg/ml, 3mg/ml, and 5mg/ml) are

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simply drop-casted on tissue paper matrices, then dried, and stacked together with different number of layers (2 layers, 3 layers, and 5 layers) to prepare the pressure-sensing devices.

RESULTS AND DISCUSSION

The sensing materials of the sensor are mainly perforated graphene (PG)@tissue paper (TP) composites. By optimizing the concentration and layer number, a high sensitivity of 38.61 kPa^{-1} in the range 0-1 kPa and a detection limit as low as 0.1 kPa is obtained. Additionally, the sensor exhibits fast response time, wide working range (0.1-10 kPa), good stability, excellent flexibility and biocompatibility. In addition, an array integrated with multiple PG@TP sensors has been designed to identify spatial pressure distribution and magnitude and several other experiments have been performed on the devices.

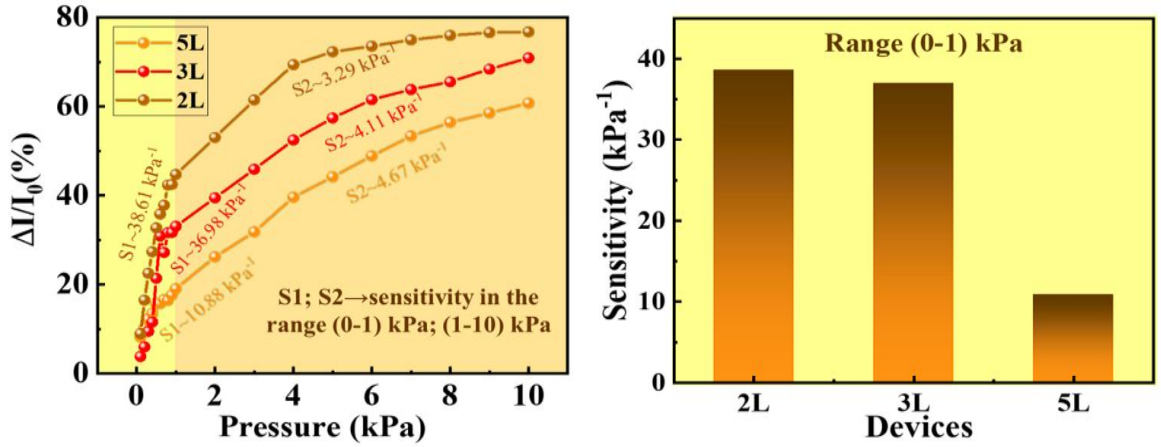

Figure 3. By optimizing the layer number, a high sensitivity of 38.61 kPa^{-1} in the range (0-1) kPa and a detection limit as low as 0.1 kPa is obtained for the best device (3mg/ml, 2-layer device).

CONCLUSION

Therefore, this study demonstrating a flexible pressure sensor with low cost, simple preparation, and superior performances, will open a pathway for the exploration of cost-effective pressure sensors in wearable devices. [3]

ACKNOWLEDGMENT

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Oral Presentation – OP-07

Mediqr - Integrated Patient And Doctor Management System

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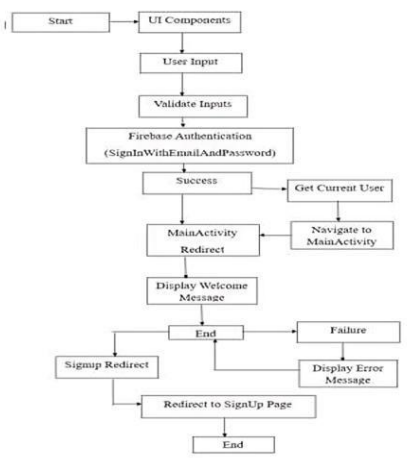
INTRODUCTION

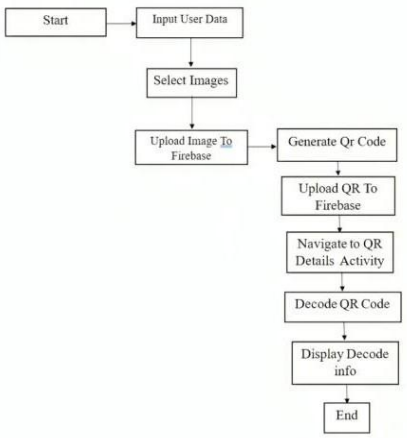
MediQR is a mobile app that enhances healthcare by using QR code technology to simplify medical information management and improve communication between patients and doctors. Users can securely register with details such as name, phone number, age, and blood group, and log in with email/password, including OTP and email verification for security.

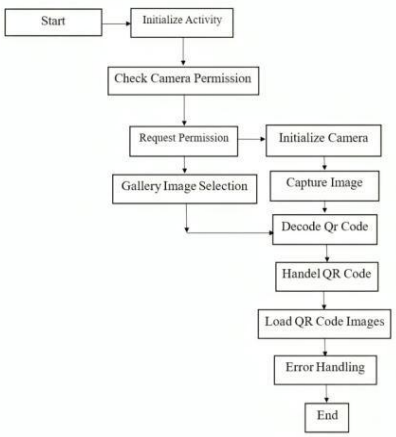
The app allows doctors to generate QR codes for prescriptions, while patients can upload medical data and test reports as QR codes for easy sharing. Location-based features help users find nearby doctors, hospitals, and medical shops, ensuring quick access to necessary healthcare services. MediQR's intuitive interface ensures a smooth user experience, making healthcare management more efficient, secure, and accessible.

MATERIALS AND METHODS

The app integrates secure user authentication and data management via Firebase, allowing users to log in with email and password, with an optional alternative that checks credentials directly from Firebase Realtime Database. It enables users to generate QR codes containing medical information and images, stored in Firebase Realtime Database and Storage. Users can scan QR codes using the camera or gallery, decoding them with ZXing's MultiFormatReader, and display extracted information or images from Firebase or web URLs. Additionally, location-based features help users find nearby doctors and hospitals, displaying essential details, while the Shop for Medicine feature enables patients to find nearby medical shops for easy access to medications. Key algorithms manage QR code generation, decoding, image loading, and camera operations, ensuring a smooth, user-friendly experience.







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RESULTS AND DISCUSSION

MediQR is an innovative mobile app designed to enhance healthcare by integrating advanced QR code technology with Firebase for secure medical data management. The app provides a seamless platform for patients and doctors to interact and exchange medical information efficiently. Users can register by entering their details such as name, age, role (Doctor/Patient), and contact information, with OTP and email verification ensuring secure access. The login system supports password recovery, making it user-friendly and accessible.Patients can input medical details, including name, age, gender, medical condition, and upload images to Firebase Storage. The app generates QR codes containing all the data, including a URL to the uploaded image, which can be scanned by doctors for a quick and comprehensive health overview. Doctors can also generate QR codes for prescriptions, which include patient details, diagnoses, and medication instructions.The QR scanning feature supports both live camera capture and gallery uploads, allowing users to decode QR codes and retrieve the stored data effortlessly. The app uses ZXing's MultiFormatReader for decoding and can display linked images by fetching them from Firebase Storage or external web URLs. Additionally, real-time feedback such as error messages or vibrations enhances the user experience during scanning.MediQR also incorporates location-based services to improve healthcare accessibility. Patients can search for and locate nearby doctors and hospitals, with essential details like distance, contact information, and available facilities provided. Moreover, the "Shop for Medicine" feature helps patients find nearby pharmacies, ensuring quick access to medications.With its intuitive and medical-themed interface, MediQR offers real-time feedback, flexible camera or gallery options for QR code scanning, and secure data storage and retrieval through Firebase Realtime Database and Storage. By bridging the gap between patients and healthcare providers, MediQR improves communication, enhances the efficiency of medical data exchange, and simplifies access to essential healthcare services.

CONCLUSION

MediQR represents a significant advancement in healthcare technology, offering a secure and efficient platform for managing medical information through the innovative use of QR codes. By integrating Firebase for data storage, user authentication, and real- time database management, the app ensures that both patients and doctors can access and share critical medical data seamlessly and securely. MediQR also enhances healthcare accessibility with features like location-based services for finding doctors, hospitals, and medicine shops. Through its user-friendly interface and robust security measures, MediQR addresses key challenges in medical data management, paving the way for more efficient and reliable healthcare interactions. This project not only meets current needs but also sets the stage for future expansions in telemedicine, AI-driven diagnostics, and comprehensive healthcare management.

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Oral Presentation – OP-08

Cost-Effective Nanomaterial for Bioethanol Production from Vegetable Peel: Waste-to-Green Energy

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ABSTRACT

The production of sustainable bioethanol from vegetable peel waste has gained increasing attention as an affordable and effective approach. Non-edible, cellulosic biomasses, such as potato peel, serve as a low-cost feedstock for the environmentally friendly production of chemicals and fuels. This process not only helps reduce fossil fuel consumption but also contributes to a significant reduction in CO2 emissions. Bioethanol production, therefore, presents a cost-efficient and sustainable method for managing food waste while generating clean energy. This research demonstrates how the synthesized cost-effective transition metal-based multimetallic catalyst boosts efficiency through processes such as C=O hydrogenation and C-OH hydrogenolysis, enabling the conversion of potato peel waste via one-pot chemocatalytic process into affordable, clean bioethanol and supporting sustainable energy solutions.

INTRODUCTION

In current scenario, the earth has experienced dramatic shifts in climate, with once predictable weather systems becoming more extreme and erratic. Human activities, particularly the emission of greenhouse gases, have intensified these changes, leading to rising global temperatures, melting glaciers, and rising sea levels that threaten coastal communities. The effects of climate change are exacerbated by the burning of fossil fuels, which not only degrade air quality but also contribute significantly to global warming through pollutants like carbon dioxide, nitrogen oxides, and sulphur dioxide. This has highlighted the need for alternative, sustainable energy solutions. As the demand for renewable energy grows, bioethanol, derived from renewable sources, has gained attention as an eco-friendly alternative to fossil fuels. Traditionally made from food crops like corn and sugarcane, bioethanol production can compete with food resources, raising concerns about food security. However, recent research has turned to waste biomass, such as potato peel, which contains high cellulose content, as a promising feedstock for bioethanol production. Potato peel waste, which is discarded in large quantities by the food industry, is a valuable source of bioethanol due to its cellulose-rich composition. Using a cost-effective, chemocatalytic process, we have utilized potato peel waste along with a cost-effective transition metal-based multimetallic catalyst to convert it into bioethanol, offering an environmentally friendly and sustainable alternative to traditional fossil fuels. Potato peel waste was sourced from local industries, kitchens, and canteens, with a significant portion converted into usable ethanol [1-4]. Bioethanol not only reduces harmful emissions but also has a much lower carbon footprint compared to petroleum-based fuels. The use of waste materials like potato peel not only addresses pollution issues but also provides an innovative solution for the growing need for renewable energy sources. Through this research, we aim to contribute to the global push for cleaner, greener energy solutions while promoting sustainable practices that can

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mitigate the impact of climate change. Scanning electron microscopy (SEM) is utilized for the structural and compositional elucidation of the synthesized bimetallic catalyst.

MATERIALS AND METHODS

To synthesize ethanol from potato peel-extracted cellulose in one pot process, a transition metal- based multimetallic catalyst was used. The catalyst was prepared via the impregnation reduction process. The morphology of the catalyst surface was characterized by JSM- 7610F Field Emission Scanning Electron Microscope.

RESULTS AND DISCUSSION

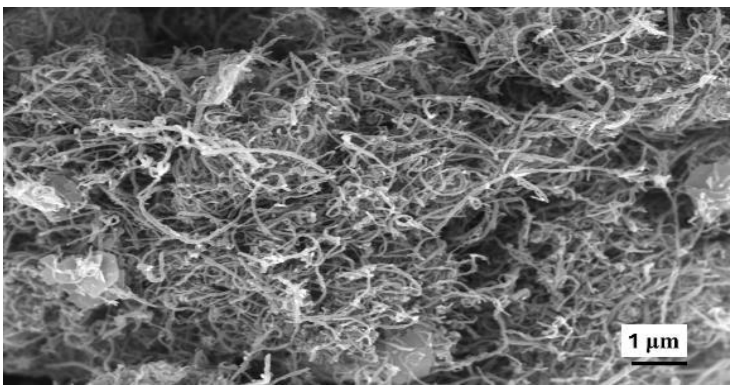

Figure 1. Scanning electron microscopy of transition metal-based multimetallic catalyst.

Figure 1 represents the catalyst's scanning electron microscopy (SEM). The MWCNT has a smooth surface and exists in the form of entangled tubes. The small chunks on these nanotubes demonstrate the impregnated metal on the surface of the support material, as expected.

CONCLUSION

This research presents an effective novel one-pot conversion process that transforms potato peel waste into ethanol. The cost-effective multimetallic catalyst synthesized on MWCNT support yielded an ample amount of ethanol, highlighting the process's efficiency and potential as a renewable fuel source. This approach offers an economically viable, sustainable solution for waste management, contributing to environmental protection and addressing climate-related issues.

ACKNOWLEDGMENT

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Oral Presentation – OP-09

Market Clearing Mechanism Considering Power System Congestion under the Influence of Virtual Power Plant

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[2]Department of Electrical Engineering, Narula Institute of Technology [3]Department of Electrical Engineering, IIEST Shibpur
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ABSTRACT

The integration of renewable energy sources and distributed energy resources (DERs) into power systems has introduced new challenges in market clearing and congestion management. A Market Clearing Mechanism Considering Power System Congestion under the Influence of Virtual Power Plants (VPPs) provides an innovative solution by leveraging the flexibility and aggregation capabilities of VPPs. This mechanism ensures efficient market operations by incorporating congestion constraints, minimizing total operational costs, and utilizing VPP flexibility to alleviate network congestion.

The proposed framework integrates VPPs into the electricity market as active participants, offering generation, storage, and demand response capabilities. It formulates an optimization problem to minimize the total system cost, including generation and VPP flexibility costs, while adhering to power balance, generation limits, and transmission constraints. Locational Marginal Pricing (LMP) is used to reflect congestion and guide energy dispatch decisions.

Simulation results demonstrate that VPPs effectively reduce congestion costs, enhance system flexibility, and improve market efficiency. This mechanism represents a crucial step towards the realization of a resilient and economically optimized power system that accommodates high penetration of renewable energy.

Keywords: Power System Congestion, Virtual Power Plant, Scheduling, Locational Marginal Pricing.

INTRODUCTION

The integration of renewable energy sources (RES) and distributed energy resources (DERs) has transformed traditional power systems, creating new challenges in market clearing, congestion management, and system flexibility. Virtual Power Plants (VPPs), as aggregators of DERs, offer promising solutions to address these challenges by providing coordinated energy and flexibility services. This literature review explores existing research on market clearing mechanisms that consider power system congestion under the influence of VPPs, focusing on their methodologies, benefits, and limitations. VPPs aggregate diverse DERs, including solar PV, wind turbines, batteries, and demand response, enabling them to participate in electricity markets as single entities (Palma-Behnke et al., 2011). Studies highlight that VPPs can enhance system flexibility and reduce operational costs (Li et al., 2019). By coordinating DERs, VPPs can bid into day-ahead and real-time markets, offering energy and ancillary services while mitigating grid constraints (Luo et al., 2021). Research by Zhang et al. (2020) formulated a mixed-integer linear programming (MILP) model for market clearing that incorporates VPPs' flexibility to manage congestion. Their results demonstrate that VPPs can significantly reduce congestion costs by redistributing energy across the network. Some researchers have explored decentralized market clearing mechanisms, where VPPs operate autonomously to manage local congestion while interacting with the central market (Tushar et al., 2022). This approach reduces computational complexity and enhances scalability. Studies show that incorporating VPPs into market clearing reduces the total system cost by optimizing the use of flexible DERs (Han et al., 2020).

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METHODOLOGY

Minimize the total system cost, including: Cost of generation, Cost of congestion management (e.g., redispatch, load curtailment, VPP flexibility), Penalties for violating constraints.

$$\min \sum_{g \epsilon G} C_g P_g + \sum_{v \epsilon V} C_v F_v + \sum_{l \epsilon L} C_l \Delta L_l$$

Where,

Cg : Cost of generation from unit g. Pg : Power output from generator g.
Cv : Cost of flexibility services from VPP v. Fv : Flexibility provided by VPP v.
Cl : Penalty cost for load curtailment l. ΔLl : Load curtailment at node l.

Subject to the Constraints: Power balance, Transmission Line Flow Constraints, Generator Limits, Flexibility Limits from VPP.

Case Setup: 3-Bus System

Generator G1: Cost = 20 $/MW, Limits: [0, 100] MW VPP: Flexibility Cost = 10 $/MW, Limits: [0, 50] MW Loads: L1 = 80 MW, L2 = 50 MW

Lines: Line 1 – 2: Limit = 100 MW

RESULT AND DISCUSSION

The optimization problem for this 3-bus system will yield the following results when solved successfully in Matlab/Python environment:

Table 1. Optimal solution: Generation, Total Cost and VVP Flexibility.

Component	Value
Generation	100 MW
Total Cost	2300 $
VPP Flexibility	30 MW

CONCLUSION:

Combining congestion management techniques with the flexibility of VPPs, market-based congestion pricing, and efficient market clearing can ensure the reliability and efficiency of power transmission systems. These mechanisms promote decentralized energy solutions, optimize grid usage, and provide economic signals for infrastructure investments.

ACKNOWLEDGMENT

The authors whose names are listed certify that they have no affiliations with or involvement in any organization with any financial interest, honorarium and grants. The authors are really indebted for the supervisor guidance and supporting work from Head of the department.

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Oral Presentation – OP-10

An Efficient Technique for the diagnosis of Sleep Apnea by Integrating Wavelet Transform and Statistical Analysis

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INTRODUCTION

Detection of sleep apnea is a challenging area of health research. Electrocardiogram (ECG) signals are typically utilized for clinical findings related to sleep apnea. The electrocardiogram, or ECG, is a voltage versus time graph that illustrates the electrical activity of the human heart. It is shown in Figure 1. In this work, Electrocardiogram (ECG) signals have been analyzed to detect the sleep apnea diseases.

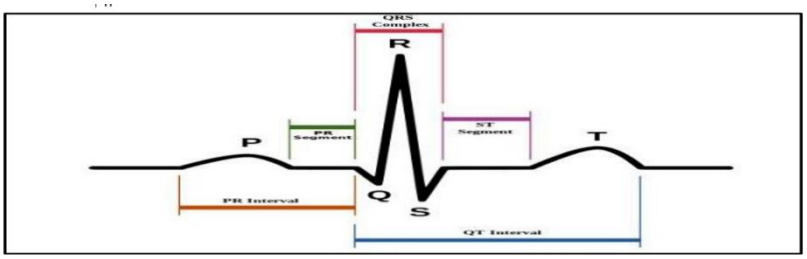

Fig. 1. Signal of ECG [2]

MATHEMATICAL TOOLS USED FOR SLEEP APNEA DETECTION

In this analysis, CWT and DWT based statistical analysis has been used to detect the obstructive sleep apnea. CWT and DWT is applied to extricate the time-frequency information. ECG waveform is inherently varying in nature. CWT and DWT is compatible to extract the information from a non-stationery or varying signal. The CWT of a signal x(t) can be expressed as,

$$X_{\omega}(c,d) = \frac{1}{|c|^{\frac{1}{2}}} \int_{-\infty}^{\infty} x(t)\varphi^{*}\left(\frac{t-d}{c}\right) dt \quad \text{------(1)}$$

2 Proposed Method

In this proposed method, ECG signal of healthy person, sleep apnea patient were considered. Collected ECG signals passed through a SG FIR filter for de-noising and then denoisied signals have been normalized for analysis. CWT

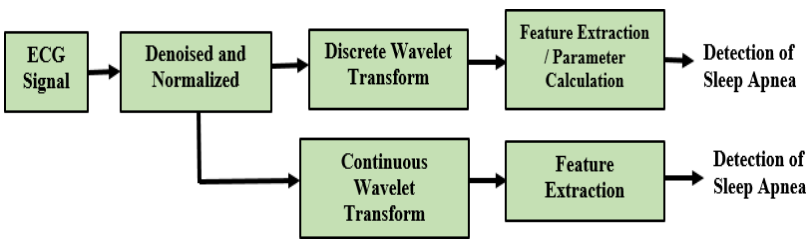

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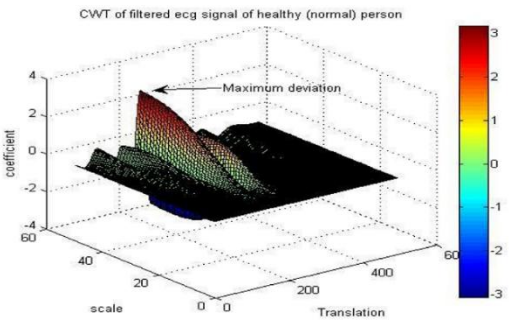
Fig. 2. Proposed Method Flow Diagram

and DWT based statistical analysis are applied on pre- processed ECG signals. The diagnosis procedure of sleep apnea is depicted in Fig. 2.

RESULTS AND DISCUSSION

CWT is used here for the diagnosis of sleep apnea. CWT has been done on the captured signals (ECG) of healthy person and sleep apnea patient. Fig. 3 and Fig. 4 are used to depict the CWT result (de-noised ECG signal) of healthy person, sleep apnea patient respectively. In Table 1, mean values (from detail and approximation coefficients) are given of a normal healthy person



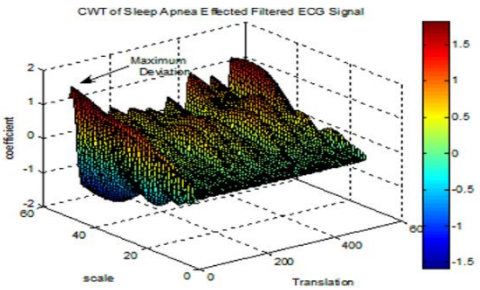


Fig. 3. CWT Of De-Noised and Normalized Healthy Person's ECG

Fig. 4. CWT Of De-Noised and Normalized Sleep Apnea Patient' ECG

TABLE 1. MEAN VALUES OF APPROXIMATION AND DETAIL COEFFICIENTS OF HEALTHY PERSON

Decomposition level (DWT)	Results of mean values from approximation coefficients	Mean values of detail coefficients
1	0.050197	-3.40E-23
2	0.050197	-1.05E-08
3	0.050197	2.74E-08
4	0.0502	-3.02E-06
5	0.050207	-7.36E-06
6	0.049592	0.000615
7	0.048949	0.000643
8	0.046104	0.002844
9	0.042817	0.003287

CONCLUSION

In this work, electrocardiogram signal has been analyzed to detect sleep apnea disease. CWT, DWT based statistical parameter has been computed from ECG signals of sleep apnea patient and healthy person. In CWT, distinct features have been extracted for sleep apnea patient over normal healthy person. In DWT based standard deviations and mean value analysis, clear differences have been noticed for both the coefficients (approximation, detail). Clear deviations were detected for standard deviations and mean values (approximation coefficients) in both the cases. These results can be utilized for diagnosis of sleep apnea.

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Oral Presentation – OP-11

Enhancing Short-Term Electricity Demand Forecasting with Arima-Based Machine Learning Technique

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ABSTRACT

This study explores load forecasting for the California Independent System Operator (CAISO) grid using Autoregressive integrated moving average (ARIMA) to predict next day hourly electricity demand. ARIMA excelled in capturing trends, seasonality, and stochastic behaviors, offering high accuracy for short- and medium-term forecasts. Challenges like parameter tuning and extreme weather are discussed, emphasizing ARIMA's utility and the potential of hybrid models combining statistical and deep learning methods.

INTRODUCTION

Electricity powers homes, industries, healthcare, and communication systems, making it essential in the modern world [1, 2]. Increasing demand, driven by urbanization, electric vehicles, smart homes, artificial intelligence, and renewable energy systems, underscores the need for accurate forecasting to ensure reliable and efficient power supply [3]. Forecasting mitigates grid strain during peak usage or extreme weather and facilitates proactive energy management [4].

While advanced machine learning models like Long Short-Term Memory (LSTM) networks and Transformers excel in capturing complex temporal dependencies, traditional methods such as ARIMA remain popular for their simplicity and effectiveness [5, 6]. Developed in the 1970s, ARIMA models linear temporal dependencies and seasonality [7, 8]. This study applies ARIMA to forecast one-day-ahead electricity demand on the CAISO grid, demonstrating its reliability and highlighting the potential of hybrid approaches combining ARIMA with machine learning to address nonlinear relationships, enhancing forecasting accuracy for modern energy systems.

MATERIALS AND METHODS

This study uses historical CAISO electricity load data, including hourly demand readings, to analyze temporal patterns influenced by time, seasonality, and weather. Pre-processing ensures data accuracy by addressing missing values, outliers, and non-stationarity. The ARIMA model, integrating AutoRegression, Integration, and Moving Average, effectively captures trends and seasonality for reliable time-series forecasting. Components of ARIMA [5–8]:

p: Order of the AR term (number of lagged observations). d: Degree of differencing to achieve stationarity.
q: Order of the MA term (number of lagged forecast errors).
The ARIMA model combines these components:

$$Yt = \varphi 1Yt{-}1 + \varphi 2Yt{-}2 + \cdots + \varphi pYt{-}p + \in t + \theta 1\epsilon t{-}1 + \cdots + \theta q\epsilon t{-}q$$

Where:

- Y_t: Current Observation
- φ_i: Autoregressive coefficients.
- $\in_t$: White noise/ error team

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- θ_i: Moving average coefficients
- ϵ_{t-i}: Error terms from previous time steps.

RESULTS AND DISCUSSION

The successful implementation of the ARIMA model for forecasting short-term electricity demand demonstrates its efficacy in handling time-series data. Using the hourly electricity demand data of December 31, 2024 from CAISO database as input, the model accurately generated next-day forecasts

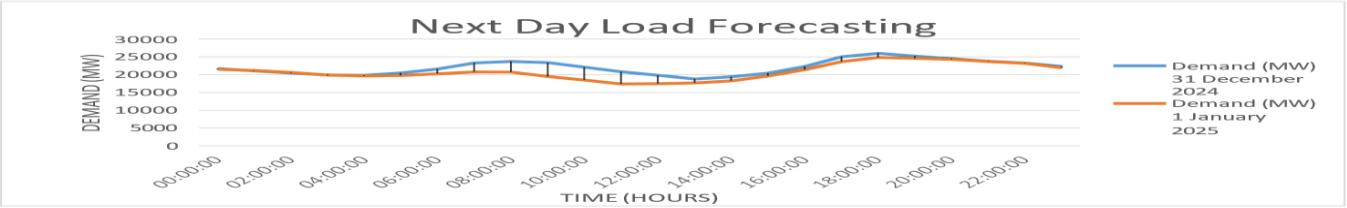

Figure 1. Forecasted electricity demand for Next Day

The results demonstrate ARIMA's effectiveness in handling temporal dependencies, achieving high accuracy for 24-hour load forecasts through systematic data pre-processing and parameter optimization. Validation metrics such as Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) confirmed reliability. Fig. 1 illustrates the next day demand forecast after successful application of ARIMA, which excelled in predicting peak and off-peak patterns but struggled during abrupt load changes, suggesting hybrid approaches with machine learning for improved performance.

CONCLUSION

This study demonstrates ARIMA's success in next-day electricity load forecasting using CAISO data, accurately capturing temporal patterns. However, its limitations during abrupt variations highlight the potential of hybrid models integrating machine learning and external factors like weather for improved accuracy.

ACKNOWLEDGMENT

The authors would like to express appreciation to California ISO for providing the electricity database.

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Oral Presentation – OP-12

Exploring $Ni_{0.5}Co_{0.5}Fe_2O_4$ Solid Microspheres as a Supercapacitor Electrode Material

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INTRODUCTION

Over the past few years, devoloping and storing of environmental-friendly and long- lasting unconventional energy sources are the foremost focus of the researches because of the rampant degradation of non-renewable energy resources along with their adverse impacts in environment and intermittent geneartion of energies from unconventional sources. In the field of advanced energy storage device, electrochemical supercapacitor has been recognized as the most promising candidate owing to their enormous power and energy density with appreciable life expectancy, easy portability and low-cost maintenance [1]. The electrochemical performances of supercapacitors mainly inclined on the properties of electrode materials. However, the enhancement of specific capacitance of supercapacitors are impelled by the specific surface area, morphology and structural hierarchy of electrode materials along with the rate of electron transfer and interfacial resistance at electrode electrolyte interface. The mixed ternary transition metal ferrites can be considered as potential electrode materials due to their multiple oxidation states, non-toxic, low cost, large abundance and easy to synthesis. The electrochemical behavior of nanostructured $Ni_{0.5}Co_{0.5}Fe_2O_4$ has been reported very few [2] whereas micro-structured $Ni_{0.5}Co_{0.5}Fe_2O_4$, composed of nanoparticles, is yet to be unfold to the best of our knowledge. Hence, the study of structural, microstructural and electrochemical performance of $Ni_{0.5}Co_{0.5}Fe_2O_4$ solid microspheres are expected to bring up an interesting result in connection to develop advanced electrode materials for supercapacitor applications.

MATERIALS AND METHODS

One-pot template free solvothermal method has been utilized to synthesis of $Ni_{0.5}Co_{0.5}Fe_2O_4$ solid microspheres (NC5050) by using the stoichiometric amount of precursors ($NiCl_2$,6H_2O, $CoCl_2$.6H_2O and $FeCl_3$.6H2O), surfactant (NH_4Ac) and solvent (EG). The powder X-ray diffraction (PXRD) pattern of $Ni_{0.5}Co_{0.5}Fe_2O_4$ microspheres has been carried out by using a Bruker D8 Advance diffractometer with CuKα (λ=1.54184 Å) radiation in the 2θ range of 10-80° and the morphology studies have been performed through FEI INSPECT F50 field emission scanning microscopy (FESEM) and the JEOL JEM 2100 plus high-resolution transmission electron microscopy (HRTEM). All electrochemical measurements i.e., cyclic voltammmetry (CV), galvanostatic charging discharging (GCD) and cyclic stability over 2000 GCD cycles have been carried out in 6M KOH aquous electrolyte by Autolab PGSTAT204 electrochemical workstation.

RESULTS AND DISCUSSION

The characteristics peak of NC5050 in the powder x-ray diffraction (PXRD) pattern depicted in Fig. 1 (a) match well with those of the reported PXRD patterns of cubic spinel structure (JCPDS ICDD card numbers 01-075-1517). The PXRD pattern has been refined through Rietveld refinement software MAUD2.33 with GOF value ~ 1.49, revealing the values of average crystallite size of ~ 44 (1.27) nm, microstrain of ~ $6.96x10^{-4}$($1.95x10^{-5}$) and lattice parameter of ~ 8.386 ($1.6x10^{-4}$) Å. The sample is crystallized in Fd-3m space group. The FESEM and TEM micrographs represented in Figure 1 (b) and 1 (c) suggest that sample is uniform and spherical in shape with average diameter of ~ 292 nm and composed of nanoparticles with average size ~17 nm.To investigate the electrochemical supercapacitive behavior of NC5050 solid microspheres, the CV and GCD measurements have been performed using

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conventional three electrode system in the potential range from -0.05 to -1.1V at scan rates from 10 to 100 mVs^{-1} with reference to the saturated Ag/AgCl electrode.

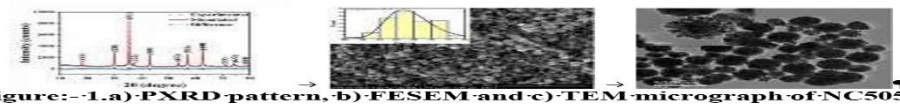

Figure:-1.a) PXRD pattern, b) FESEM and c) TEM micrograph of NC5050

Two prominent redox peaks have been observed in the CV curve (Fig. 2(a)) corresponding to reversible faradaic reaction attributing to the change of valence states of Ni/Ni^{2+},$Co/Co^{2+}$and Fe^{2+}/ Fe^{3+} ions. The nonlinearity nature of the GCD curve (Fig.2(b)) at different current densities (15 to 19 Ag^{-1}) confirms the pseudocapacitive behavior of the sample [3].

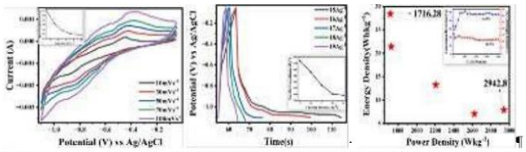

FIGURE 2. (a) CV curve at different scan rates, (b) GCD curve at different current density and (c) capacitance retention and coulombic efficiency after 2000 GCD cycles along with Ragon plot of NC5050

TABLE 2. Specific capacitance at various scan rates calculated from CV curve.

Scan rate ($mV\cdot s^{-1}$)	→	10	→	30	→	50	→	70	→	100
Specific capacitance ($Cs\cdot in\cdot F\cdot g^{-1}$)	→	1007	→	730	→	581	→	513	→	473

TABLE 2. Specific capacitance at different current densities calculated from GCD curve.

Current density ($A\cdot g^{-1}$)	→	15	→	16	→	17	→	18	→	19
Specific capacitance ($Cs\cdot in\cdot F\cdot g^{-1}$)	→	742	→	559	→	346	→	207	→	184
Energy density ($Whkg^{-1}$)	→	28.4	→	21.4	→	13.3	→	7.9	→	7.1
Power density (Wkg^{-1})	→	1715.7	→	1725.8	→	2206.2	→	2941.7	→	2622.9

The values of specific capacitance at different scan rates and current densities along with energy and power density are listed in Table 2 and Table 3, respectively. Longevity of supercapacitor has been probed through cyclic stability measurement over 2000 cycles at 22 Ag^{-1} as shown in Fig. 2 (c), where blue line depicts 42% increase in specific capacitance and the 15% increase in coulombic efficiency from its initial value demonstrated by red line. The Ragon plot (Fig. 2(c)) has showcased a notable energy density of 28.4 $Whkg^{-1}$ at a power density of 1715.7 Wkg^{-1}.

CONCLUSION

The PXRD, FESEM and TEM study of NC5050 solid microspheres synthesized by one-pot template free solvothermal method have confirmed that the sample is single phase cubic spinel ferrite with crystallite size (~44 nm) and spherical in shape (average diameter ~ 292 nm). The sample exhibits high value of specific capacitance of 1007 Fg^{-1} at 10 mVs^{-1} and outstanding power density of about 2941.7 Wkg^{-1} along with excellent capacitance retention of about 142% and coulombic efficiency of about 115% over 2000 cycles indicating an appropriate electrode material for supercapacitor application.

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Oral Presentation – OP-13

Synthesis, Structural Characterization, Antimicrobial Activity and DNA Binding Study of Sulfamethoxazole-Azo-2-Naphthol and its Metal Complexes.

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ABSTRACT

4-((2-Hydroxynaphthalen-1-yl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide (HL) (**1**) has been characterized by the single crystal X-ray structure and 1D supramolecular chain shows intra-molecular H-bonding, N(2)-H(2)----O(3)-S(1), N(1)---H(2)-N(2), N(3)----H(4)-O(4) and N(4)---H(4)-O(4) and intermolecular H-bonding, S(1)-O(2)---H(2)-N(2) along the b axis. HL has been used to prepare manganese(II), $[Mn(L)_2(H_2O)_4]$ (**2**) and copper(II), $[Cu(L)_2(H_2O)_4]$ (**3**) complexes and the spectroscopic characterization establish their structures. The interaction of CT DNA with $[Mn(L)_2(H_2O)_4]$ (K_b^{Mn}, $1.402x10^6$ M^{-1}) is stronger than $[Cu(L)_2(H_2O)_4]$ (K_b^{Cu}, $1.35x10^6$ M^{-1}) while HL shows least interaction (K_b^{HL}, $1.30x10^6$ M^{-1}).

INTRODUCTION

2-Naphthol is a fluorescent colorless crystalline solid that are naphthalene homologues of phenol, but it is more reactive. It is used as intermediate for the fabrication of dyes and other compounds. In order to minimize the side effects of SMX, coupling of sulfamethoxazolyl-di-azonium salt is carried out with 2-naphthol to synthesize 4-((2-hydroxynaphthalen-1-yl) diazenyl)-N- (5-methylisoxazol-3-yl) benzenesulfonamide (HL) which has been used to synthesize 3d transition metal complexes. Azo dyes of sulfa drugs are well known for their antiseptic activity [1].

MATERIALS AND METHOD

Sulfamethoxazole (SMX) was purchased from Sigma-Aldrich Chemical Company and used without further purification 2-naphthol was purchased from Merck, India. The acetonitrile used for electrochemical studies was dried with CaH_2 and distilled prior to use. The CT DNA was purchased from Sisco Research Laboratories, India, and dissolved in phosphate buffer (pH ~7.4) containing 120 mM NaCl (AR grade, Merck, Germany). The diazotization of sulfamethoxazole (0.5 g, 1.97 mmol) was carried out at 0-5°C in aqueous solution by adding $NaNO_2$ (1.0 g) solution followed by coupling with 2-naphthol (1 g, 0.0024 mmol) in presence of sodium carbonate (2.0 g) in water according to a general literature procedure [2]. Bright red precipitate filtered and dried at room temperature. It was then recrystallized by slow evaporation of hot alcoholic solution and purity was checked by TLC; yield: 85%.

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RESULT AND DISCUSSION

Empirical formula	C20 H16 N4 O4 S
system	Monoclinic
Space group	C2/c
a(Å)	38.9645(13)
b(Å)	5.3095(2)
c(Å)	19.7651(6)
$\alpha/^{0}$	90.00
β/°	112.846(2)
$\gamma/^{0}$	90.00
$V(Å)^{3}$	3768.3(2)
Z	8
θ range	1.13 - 27.55
Refine parameters	266
Total reflections	4330
R_1^{a} [I > 2σ	0.0510

Table 1. Summarized crystal structure of sulfamethoxazole-azo-2-napthol.

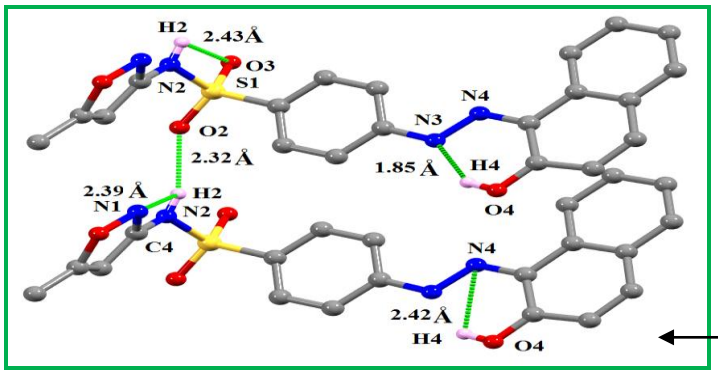

Fig. 1. Formation of 1D tape in HL through association of discrete HL monomeric units.

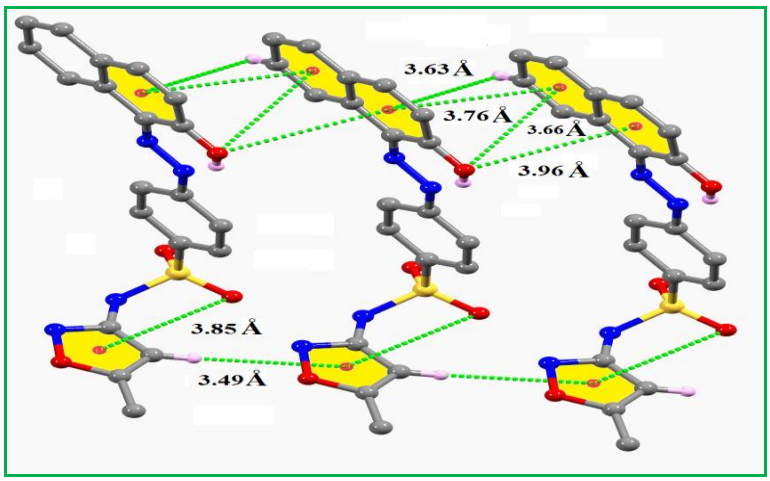

Fig: 2. One dimensional assembly of monomeric units of HL through interaction of lone pair of O of SO_2… π of oxazole ring and π …π interaction occurs between two 2-naphthol benzene ring. The extended network is shown in green dotted lines. This assembly is viewed along the b axis .

CONCLUSION: Single crystal structure of 4-((2-hydroxynaphthalen-1-yl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide (HL) (1) shows 1d supramolecular structure .

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Oral Presentation – OP-14

A Review Paper based on Temperature effect using different MEMS Sensor

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INTRODUCTION

A Micro electro mechanical sensors are widely used in different applications of sensors, actuators etc. MEMS devices are designed to realize mechanical device architecture with small dimensions. Very Large Scale Integrated (VLSI) processing and batch production of micromachined components are made possible by Micro Electro Mechanical System (MEMS) technology. The primary environmental factor influencing the performance of the MEMS piezoresistive pressure sensor is temperature. Due to temperature fluctuation, there is a change in sensor accuracy and reliability. Temperature fluctuation may lead to inconsistent behaviour of actuator also. All these will degrade the performance of the MEMS sensor in real world application. With an emphasis on ways to increase the stability, accuracy, and dependability of these systems under various thermal circumstances, this study provides a thorough review of temperature compensation strategies used with MEMS devices.

MATERIALS AND METHODS

Variations in temperature can impact MEMS devices in a number of ways. Thermal expansion and contraction of the structural materials in sensors cause the device geometry to change, which modifies resonance frequencies and results in output signal drift. Temperature changes can alter the material characteristics of actuators that control actuation forces, resulting in uneven performance. Performance variations can also be caused by parasitic effects, such as temperature-induced modifications to electrical characteristics like capacitance and resistance.

It is essential to comprehend these temperature correlations in order to create compensatory techniques that can stabilise and restore precision. In this paper a review work is done on research papers which are based on temperature effect of MEMS and temperature compensation.

RESULTS AND DISCUSSION

A research paper named “Analysing the effects of temperature and doping concentration in silicon based MEMS piezoresistive pressure sensor” by Suja K J et al. is reviewed here. The effects of temperature and doping concentration on a boron implanted piezoresistor for a silicon-based MEMS piezoresistive pressure sensor with high sensitivity are examined in this work. The dependence of a piezoresistor's conductivity and, consequently, its resistivity on operating temperature and impurity doping concentration is examined using the basic semiconductor equations. Additionally, it has been shown that stress has a greater impact on MEMS pressure sensor performance in physical environments than temperature does, and that output voltage fluctuates linearly for a given pressure. The simulation was conducted using the Coventor Ware R FEA simulation program.

Another research paper named “Thermostatic control for temperature compensation of a silicon pressure sensor” by Dirk D Bruyker et al. is reviewed here. A different method of temperature compensation for a silicon pressure sensor is introduced here. A thermostatic control loop is implemented here by using on chip heater and temperature sensing electrodes. By biassing the sensor at a reference temperature that is precisely maintained across a

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predetermined range, the pressure sensor output is no longer dependent on the outside temperature. There is no need for further calibration steps for external temperature sensor components or temperature correction.

Aspects of modelling and experimental findings are examined. In this paper a device compensation technique is discussed where the knowledge of TCS and TCO of the sensor is not required. This is possible because the piezoresistor is kept at constant temperature during operation and a thermal feedback mechanism is used to maintain the sensor temperature and no external sensing devices are required.

Another research paper named "Fabrication and temperature coefficient compensation technology of low cost high temperature pressure sensor" by Quan Wang et al. is reviewed here. The strain gauge chip of the piezoresistive pressure sensor is designed using separation by implanted oxygen (SIMOX) SOI (silicon on insulator) technology and is fabricated in the micro-machining work bay for use in the oil drilling industry and other industrial measurement and control systems for the purpose of measuring pressure at high temperatures. In this work the thermal coefficient of expansion which differs in different material is examined. By using high temperature packaging system the sensor is fabricated. There is a demonstration of the temperature coefficient of offset (TCO) and temperature coefficient of sensitivity (TCS) compensating circuitry. In this paper to measure the pressure at high temperature a mechanical structure is designed which will operate in the temperature region of -400C to 2200C and the pressure measurement range is 0 to 40MPa. Qunan Wang et al. manufactured high quality SOI wafer using SIMOX technology. The size of the piezoresistive pressure sensor is 5mm*5mm*0.5mm. One of the main obstacles to the commercialisation of high temperature sensors is their packaging, which might be the most expensive aspect of production. The discrepancy in thermal coefficient of expansion (TCE) between the mechanical characteristics of the heterogeneous materials is one of the most important factors influencing the dependability of electronic packaging. The functioning and dependability of the sensor may be adversely affected by the high amounts of stress generated by the packaging process. Qunan Wang et al. used Gold wire thermocompression bonding as exterior electrical wiring after silicon/glass ring electrostatic bonding in packaging.

CONCLUSION

Although temperature compensation is still a major design difficulty for MEMS, great success have been achieved in creating both software and hardware solutions. The impact of temperature changes on MEMS performance may be reduced, leading to more durable, precise, and dependable devices, by carefully choosing materials, refining device shape, and putting sophisticated compensatory mechanisms into practice. MEMS technologies are evolving day by day and the design of temperature compensation network will definitely play an important role for the future improvement of MEMS device.

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Oral Presentation – OP-15a

Phase Analysis, optical and electrical properties of Barium Bismuth titanate by modified solid state process

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INTRODUCTION

A colorimetric Barium bismuth titanate is one of the most widely used ferroelectric materials due to its high dielectric constant and low loss characteristics. As advanced miniaturization requires smaller circuit area, the multilayer ceramic capacitors (MLCCs) with higher efficiency were developed. The MLCCs films (thick or thin) usually require a sub-micron grain size of the ceramic. Conventionally, $BaBi_4Ti_4O_{15}$ powders are manufactured at high temperatures, by solid-state reaction or from chemically derived precursors. These methods produce large, non-uniform, and agglomerated particles that have to be milled and heat treated again to obtain the required particle size (0.5-1.5μm) to fabricate reliable MLCCs (B. D. Stojanovic et al., 2002). Another possibility to obtain the required grain size could be by mechanical activation of raw materials during powder preparation process. The mechanical activation using high energy milling process is one of the most effective methods for obtaining highly dispersed powders. It results in a decrease of particle size that leads to the initiation of solid state reaction between the starting components at lower temperatures (L. B. Kong et al., 2002; E. Brzozwski et al., 2003; V. Berbenni et al., 2001).

MATERIALS AND METHODS

Solid state reaction means of agate mortar activation is carried with 1:1 molar ratio of Barium titanate, Bismuth titanate. Agate mortar activation was carried for 6 hours while the mixed powder was annealed at 1100°C for 10hrs, 15 hrs for phase development. XRD for phase analysis, uv-vis spectroscopy for band gap, while LCR meter for dielectric measurements were performed.

RESULTS AND DISCUSSION

XRD indicates formation of Barium bismuth titanate after sintering at 1000°C, 1100°C for 10 hrs, 15 hours respectively. Peaks are noted to be indexed with JCPDS file number PDF#732184 having crystallite size estimated using Scherrer's equation to be 62.6nm
Band gap is estimated from UV-VIS spectra using Tauc relation. Band gap is estimated to be about 1.67eV for sample sintered at 1000°C for 10 hrs while it is 1.62eV for sample sintered at 1100°C for 10 hours.

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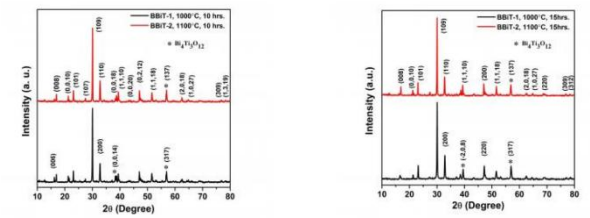

Fig1. XRD pattern of BBIT after sintering at 1000°C, 1100°C for 10hrs and 15 hrs respectively

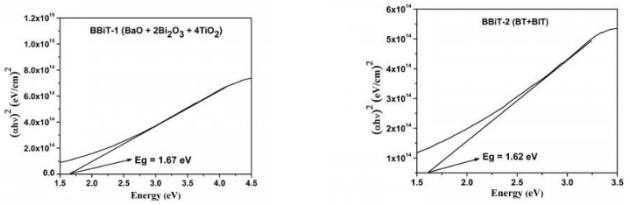

Fig2. Band gap of BBIT sintered at 1000°C, 1100°C for 10 hours respectively

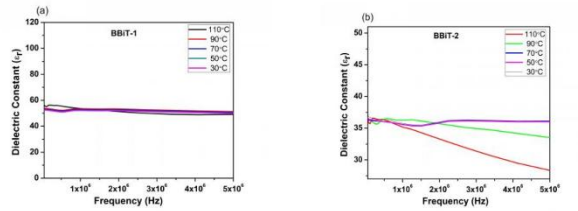

Fig3. Dielectric property of BBIT sintered at 1000°C, 1100°C for 10 hours respectively

All the samples were measured at different temperatures (30 °C, 50 °C, 70 °C, 90 °C and 110 °C) with 1V external bias and within a frequency range of 50 kHz to 5MHz. At low temperature (30 °C, 50 °C and 70 °C) the εr is near about constant about this frequency range. But at comparatively high temperature (90 °C and 110 °C) dielectric constant (εr) gradually decreased on increasing the frequency. BBiT-1 has more εr than BBiT-2 because impurity ($Bi_4Ti_3O_{12}$) within BBiT-1 is slightly more than BBiT-2.

CONCLUSIONS

Bi-layered structure ferroelectric material-bismuth titanate, $Bi_4Ti_3O_{12}$ (BIT) and barium-bismuth titanate, BaBi4Ti4O15 (BBiT) ceramic powders were prepared by the mechanical synthesis process. XRD pattern has confirmed the synthesis of BBiT has a tetragonal structure of an Aurivillius phase Bi-layered oxide. BaBi4Ti4O15 with good crystalline structure was formed after sintering without a pre-calcination step with a plate-like structure typical for layered structure materials. The dielectric constant of was found within 35-55 at frequency 50 kHz; however, it was found to increase with increases in the duration of heat treatment due to formation of more non-centrosymmetric crystals.

ACKNOWLEDGMENT

Author would like to express thanks to Department of Metallurgical & Material Engineering, School of Materials Science & Nano Technology, Jadavpur University for providing characterization facilities.

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Oral Presentation – OP-15

Mahali Tribe's Rice Beer 'Haria' - A Source of Bioethanol

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INTRODUCTION

In the 21st century, man is entirely dependent on fossil fuels to carry out his daily activities. In present day world the daily consumption of petrol and diesel combined is about 930 million gallons. This is really a matter of concern as the conventional fuels are depleting and the need of biofuels is increasing gradually [1]. Another important concern is the increasing concentration of CO2 in the atmosphere [2]. About 73% of fossil fuel exhausts contain CO2 which is effective in increasing the global temperature and also affects the health of plants and animals [3]. All these factors are driving us towards the use of bio alcohols as alternative sources of fuel. The reserves of fossil fuels are depleting and there is an urgent need to look for alternative energy sources. The Mahali tribe of West Bengal, India is preparing a liquid named 'Haria' from rice grains by their own recipe which they are using primarily as a fuel and also for consumption as energy drink in their festivals. The rice beer developed by them contains good alcohol content and may be effectively used for engines that can run on biofuel. The fermentation of Handi is usually done in earthen or aluminium pots at room temperature which takes about 4-5 days for the fermentation to be complete.

MATERIALS AND METHODS

Haria consists of rice beer and is made from the staple grain rice mainly; a cheap variety of rice named Oryza sativa L. is used for the purpose. At first, the earthen or aluminium pots are washed and sterilised [74]. They are dried in the sun, heated in direct fire followed by fumigation. Then the rice grains are cleaned to remove the impurities followed by boiling them. The boiled rice grains are cooled and dried. The dried rice grains are spread on a mat followed by addition of the bakhar i.e., the starter tablet. The bakhar is generally prepared from plant parts like bark and leaves of Diospyros melanoxylon Roxb., roots of Cissampelos pareira L., almost all parts of Lygodium smithhianum C. Presl., etc. The bakhar added to prevent rotting of the mixture. The mixture is then subjected to fermentation. It is poured into the pot and is closed with a lid. The pot is kept in a dark room for 3 – 4 days. The rice grains generally melt and get converted into a gelatinous paste like substance. The pot is then collected

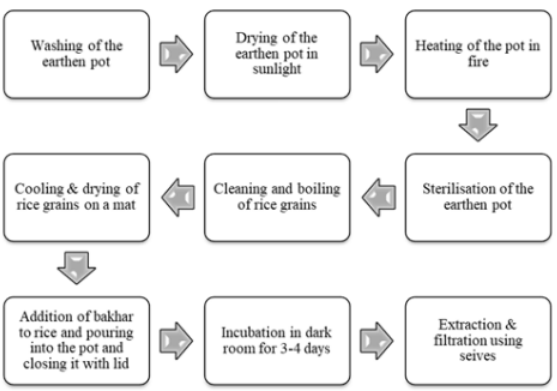

Figure 1 Steps for preparation of the rice beer

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and the constituents are filtered. The mixture i.e., rice beer is now ready for usage. In order to use it as a fuel, the obtained aliquot is then filtered to remove the impurities.

RESULTS AND DISCUSSION

The liquid 'Haria' is subjected to chemical analysis in this study in order to explore its efficacy as a biofuel. In course of the study it was obaserved that the pH of the mixture changes from around 6.81 on the first day to about 3.6 on the fourth day signifying that the amount of acidity has substantially increased. Also in addition the alcohol content increases from 3.4% on the first day to about 11% on the fourth day due to the the conversion of the sugars into alcohol using the process of anaerobic fermentation by alcohol producing bacteria. The rice beer obtained by fermentation of rice was subjected to dictation after being centrifuged for 20 minutes at 5000 rpm and 40oC. The amount of ethanol in the liquid obtained was then estimated using the chromic acid method. In addition, NMR, IR and UV studies were done to confirm the presence of a considerable amount of ethanol in the obtained sample solution. The results obtained from IR and NMR are illustrated in figure 2 and 3 respectively. All the studies clearly specified the presence of considerable amount of ethanol in the obtained sample and it justifies the efficacy of Haria as a fuel.

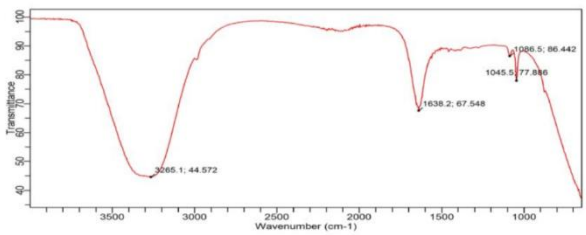

Figure 2: IR spectra of Haria

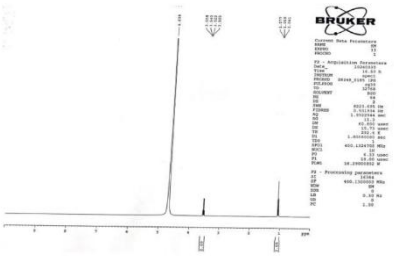

Figure 3: NMR spectra of Haria

CONCLUSION

Bio ethanol is becoming more and more popular due to its benefits and renewable and ecofriendly nature. Countries like USA and Brazil are the leading producers of bio ethanol producing about 59% and 36% respectively of the world's total bio ethanol. The greenhouse gas emissions are also found to reduce by increased use of bioethanol over conventional fuels. In India, the Mahali tribe of West Bengal, India is producing bio ethanol by a very unique way. Haria can be used in auto mobiles and hence may contribute towards the energy economy of the nation. Also it serves as an effective energy drink for the mankind. The alcohol content as well as the quality of the biofuel can be developed by further researches in this area.

ACKNOWLEDGMENT: We are grateful to the Mahali Community and Netaji Subhas Open University for supporting us with the necessary academic and research amenities.

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Oral Presentation – OP-16

Magneto-electrochemical Ammonia Synthesis: Boosting Nitrite Reduction Activity by the Optimized Magnetic Field Induced in Spin Polarized System

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ABSTRACT

Using low and optimized magnetic field along with electric field is a novel strategy to facilitate electrochemical nitrite reduction. Herein, we explore the magnetic field assisted electrocatalytic ammonia synthesis employing spin-thrusted β-MnPc at 95 mT magnetic field. The calculated rate of ammonia generation was 16603.4 µg h-1 mgcat-1, which is almost twice that of the non-polarized MnPc catalyst. Additionally, the Faradaic efficiency (FE) at –0.9V vs. RHE was found to be 92.9%, significantly higher compared to the non-polarized MnPc catalyst.

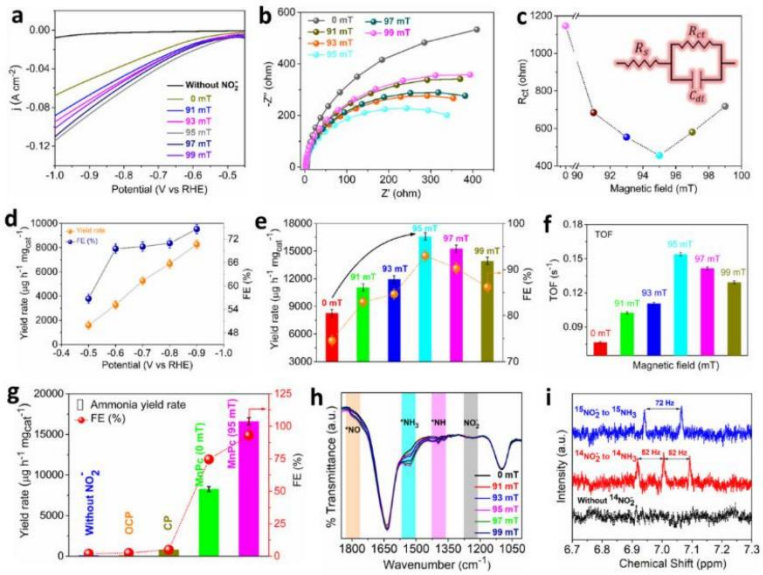

Figure 1. Electrochemical performance. a. LSV plot of MnPc with varying magnetic field. b. EIS spectra after simulation of MnPc with varying magnetic field. c. Rct vs. Magnetic field diagram of MnPc. d. Ammonia yield rate and FE at various potential without applying magnetic field. e. Ammonia yield rate and FE with applying various magnetic field @–0.9 V vs. RHE. f. TOF (s–1) plot of MnPc for NO2RR at various applied magnetic fields @–0.9V. g. Various control experiment of MnPc @–0.9V vs RHE. h. ATR-FTIR spectroscopy of electrolytes solution

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@–0.9V vs RHE. i. Isotopic labelling experiment of the electrolyte's solution after electrolysis @–0.9V vs RHE (50-time dilution).

CONCLUSION

In conclusion, theoretical calculations as well as experimental results confirm that exoteric magnetic field-induced spin-polarised MnPc has tremendous NO_2RR activity. MnPc, in presence of 95 mT external magnetic field shows a significantly higher ammonia yield rate of 16603.4 $\mu g\ h^{-1}\ mgcat^{-1}$ and Faradaic efficiency of 92.9% at –0.9V vs. RHE, which is almost twice that of the MnPc catalyst. A spin-polarized Mn-N centre was argued to be able to specify spin electrons to interact with the reaction intermediates and, as a result, strengthen adsorption to produce the desired ammonia, so enabling the hydrogenation of *NO.

ACKNOWLEDGMENT

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Oral Presentation – OP-17

Two Metal Site-mediated Efficient C–N Coupling for Efficienct Electrochemical Urea Synthesis

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ABSTRACT

Electrochemical urea synthesis holds great potential for carbon utilization. We present a dual metal CoPc–MoS_2 catalytic system for efficient C–N coupling reaction. The catalyst facilitates N_2 activation and CO_2 adsorption insertion to produce a urea yield of 175.6 mg h−1 mgcat−1 at −0.7 V vs. RHE.

INTRODUCTION

Urea, with 46% nitrogen content, is crucial for the fertilizer industry and societal growth. Current production relies on the energy-intensive Haber–Bosch process, which consumes 2–3% of global energy annually and emits significant CO_2. To meet growing demands and achieve carbon neutrality, green technologies are needed. Electrocatalysis, leveraging renewable energy for C–N coupling under mild conditions, offers a sustainable, net-zero-emission alternative for urea production.

MATERIALS AND METHODS

The catalyst was synthesized by mechanochemical blend formation. [1]

RESULTS AND DISCUSSION

The "acceptor–donor" mechanism in the CoPc–MoS_2 system suggests that the dual metal sites (Co and Mo) facilitate N_2 activation by accepting lone pair electrons and donating electrons back, which polarizes the N≡N bond. This enhances CO insertion, produced by CO_2 reduction at Mo or Co sites, and drives the C–N coupling reaction. Mo sites, with their localized negative charge, are particularly effective for CO_2 reduction.

The C–N coupling occurs through CO insertion into the activated N_2 molecule, leading to the formation of a triangular intermediate (CONN*), which induces angular strain, aiding N≡N bond cleavage and subsequent protonation to form urea. DFT-based electronic structure and Bader charge analysis support this activation, showing that the dual metal sites transfer approximately 12% more charge to N2 compared to single metal centers. This charge transfer alters the N≡N bond length to 1.196 Å for dual metal sites, compared to 1.155 Å for single metal sites and 1.130 Å for inactive N_2. The charge density difference image illustrates charge donation and back-donation to/from N_2.

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CONCLUSION

This study highlights the co-reduction of N_2 and CO_2 under ambient conditions using CoPc–MoS_2, achieving a urea yield of 175.6 mg h−1 mgcat−1 and a faradaic efficiency of 15.12% at −0.7 V vs. RHE in 0.1 M $KHCO_3$. The catalyst demonstrates strong electroreduction activity and effectively suppresses hydrogen evolution. This work offers an efficient, cost-effective electrocatalyst for N_2 and CO_2 co-reduction and opens new possibilities for using transition metal dichalcogenide/phthalocyanine catalysts in urea electrosynthesis.

ACKNOWLEDGMENT

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Oral Presentation – OP-18

$Fe(TCNQ)_2$ Nanorod Arrays: An Efficient Electrocatalyst for Electrochemical Ammonia Synthesis via the Nitrate Reduction Reaction

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ABSTRACT

The electrochemical reduction of nitrate to ammonia (NO_3RR) catalyzed by metal-organic frameworks (MOFs) is a promising and efficient method for reducing nitrate pollution in the water while simultaneously producing a valuable product, ammonia. Herein, we report the 3D nanoarray architecture of the metal-organic complex $Fe(TCNQ)_2$ as an efficient electrocatalyst that exhibits a high ammonia yield rate of 11 351.6 μg h^{-1} cm^{-2} and faradaic efficiency (FE) of 85.2% at −1.1 V vs. RHE and excellent catalytic stability up to 2 days. The excellent catalytic performance is evaluated by ATR-FTIR spectroscopy and a series of control experiments. Density functional-based theoretical calculations are carried out to identify $Fe–N_4$ active sites in metal-organic network structures. This study showcases the advancement of transition metal-based organic frameworks as very effective electrocatalysts for the reduction of nitrate to ammonia (NH_3)..

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Oral Presentation – OP-19

Performance Analysis of Dielectric Modulated Junctionless Trench DG GE Biosensors

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INTRODUCTION

Electrical detection of biomolecules has become more attractive using dielectric modulated field effect transistors (FET) based structures [1] owing to their natural competence of high degree of label-free sensing. Sensitivity is a very crucial parameter for biosensors which is related to the device structures as well as the types of biomolecules. A wide range of FET-based biosensors was proposed in different articles with different device architectures like tunnel FETs [2], impact ionization FET (IMOS) [3] and junctionless FET [4]. In this paper, for the first time, we are focussed on the performance analysis of a Ge channel trench gate DG JFET concerning its sensitivity from different aspects. Further, we study in detail the impacts of gate insulators on sensitivity and figure out the optimum performance of the device.

MATERIALS AND METHODS

A Ge channel trench gate JL DG FET is considered in the present work as depicted in Fig. 1. The two vertical gates are positioned on both sides of the channel in different trenches. In between the channel and gates, two vertical nanogaps are formed which are filled with air in the absence of biomolecules. We use ATLAS, a device simulator to simulate the device. In the absence of the biomolecules, the dielectric of the nanogap is taken as 1 which is modulated according to the dielectric constant of biomolecules present. This shifting of the dielectric constant makes a change in the gate capacitance which is reflected in different electrical parameters of the device. Fig. 3 represents the transfer characteristics of the biosensor in the presence and absence of biospecies having dielectric constants 2.1-7. The graph indicates a good ability to sense the signal by showing a large difference in the drain current with biomolecules w.r.t the air in the subthreshold region.

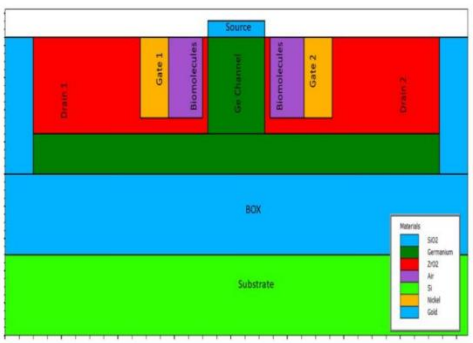

Fig. 1. Schematic diagram of the biosensor

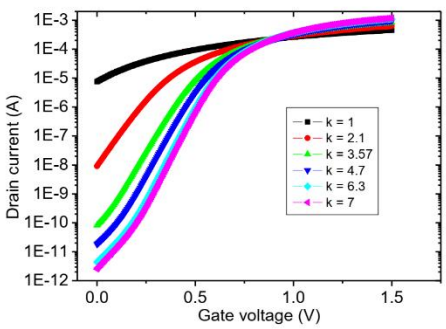

Fig. 2. Id-Vg Characteristics of the device

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Analysis of sensitivity In this work, we focused on two performance indicators for biosensing namely drain OFF current (I_{OFF}) and threshold voltage (V_{th}) The sensitivities are measured w.r.t the above-mentioned indicators as

$$S_{IOFF} = \frac{I_{OFF\ bio} - I_{OFF\ air}}{I_{OFF\ air}} \quad (1)$$

$$S_{vth} = \frac{V_{th\ bio} - V_{th\ air}}{V_{th\ air}} \quad (2)$$

Where $I_{OFF\ bio}$ and V_{thbio} are the drain current and threshold voltage in the presence of biomolecules. I_{OFFair} and V_{thair} are the same parameters in the absence of biomolecules. .

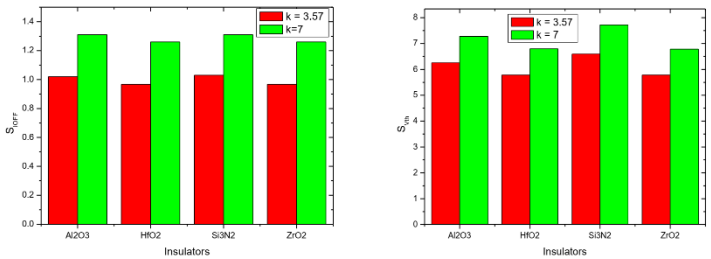

Fig.3. Variation of sensitivity w.r.t I_{OFF} and V_{th}

RESULTS AND DISCUSSION

We have investigated the role of gate insulators on the sensitivity of biosensors following Eq. 1- 2 and the Fig. 3 represents the same. We considered Al2O3, HfO2, Si3N4 and ZrO2 for the observation. From the figure, it is confirmed that gate insulators play a significant role to change the sensitivity of the device. For the present study, Si3N4 gives the optimum result w.r.t threshold voltage as well as OFF current.

CONCLUSION

We have presented the effects of gate insulators on the performance of dielectric modulated vertical trench gate DG Ge channel JFET for bio-detection. Results indicate that the gate insulators are a key parameter to obtain good sensitivity. In this regard, Si3N4 serves as the best insulator of the Ge channel trench gate DG JFET in detecting biomolecules.

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Oral Presentation – OP-20

Enhanced Extra Tree Classifier for Early Detection of Heart Disease

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ABSTRACT

Heart disease, the leading global cause of mortality, affects men and women equally and accounts for approximately 12 million deaths annually, according to the WHO (December, 2020)[1]. Often termed a "silent killer," it progresses without symptoms, making early detection crucial to prevent complications and save lives. Identifying key risk factors such as age, cholesterol, blood pressure, and chest pain is vital for effective intervention. Machine learning plays a transformative role by analyzing vast healthcare data to predict and classify heart disease accurately. The proposed system employs the enhanced Extra Tree Classifier algorithm as it has proven to be the most effective in classifying heart disease. Techniques like the Extra Tree Classifier, achieving a predictive accuracy of 98.6%.

INTRODUCTION

Cardiovascular diseases (CVD), responsible for 17.9 million deaths annually, remain a global health challenge. Early detection is crucial to reducing mortality and optimizing healthcare resources. Machine learning (ML) has revolutionized medical diagnostics, analyzing factors like age, cholesterol, and blood pressure to predict diseases. Researchers have explored various ML methods, including Naive Bayes, Random Forest, SVM, and KNN, for disease prediction. This paper presents the Gini Indexed Extra Tree (GET) classifier, which improves the traditional Extra Tree algorithm using Gini impurity for optimized node splitting. Tested on a dataset of 1,025 patients, GET achieved 98.6% accuracy, outperforming traditional models and showing promise for early CVD detection. advanced ML techniques in healthcare systems.

MATERIALS AND METHODS

Data Set - CVD's dataset was collected from the Kaggle[2] and includes both numerical and categorical features. The categorical attributes are thal, restecg, ca, cp, and FBS. Sex, Age, chol, thalach, exang, oldpeak, trestbps, and slope are numeric attributes. Based on this information of the dataset, the pattern that helps find people who are likely to get heart disease is extracted. The dataset consists of 1025 rows and 13 columns, where a record is represented by each row. Key steps and methodologies include: As shown in Fig:1 the steps are as follows:
Pre-processing : Pre-processing involves handling missing and noisy data through smoothing, standardization, and aggregation. A correlation matrix analyzes feature relationships, while categorical variables like chest pain, sex, and cholesterol are converted into dummy variables and scaled for training.

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Feature Ensemble: A training dataset comprising continuous and categorical data is represented as a feature vector. Important attributes are selected for each node in the model. **Data Splitting**: The dataset of 1,025 records is divided into training (70%) and testing (30%) subsets to build and evaluate the model. **Prediction Model**: The document describes the use of the Extra Tree Classifier, enhanced with and the Gini index. The Extra Tree (ET) classifier with Gini impurity for training a cardiovascular disease prediction system. Extra Trees generate multiple decision trees using randomized sampling and feature selection, with Gini impurity guiding splits to minimize classification errors. Evaluation Metrics: Model performance is assessed using metrics such as accuracy, sensitivity etc.

RESULTS AND DISCUSSION

The methods taken for the comparison include like Logistic regression, Navie Bayes, and SVM, to prove the effectiveness of the proposed model. The proposed system (GFET) outperforms existing methods in all performance metrics. Accuracy scores are .986, 0.8657, 0.8259, and 0.8607, respectively. Precision values are .994, 0.8348, 0.7949, and 0.8333, while sensitivity scores are 0.953, 0.9231, 0.8942, and 0.9135. Specificity values are 1.0, 0.8041, 0.7526, and 0.8041, and F1-scores are 1.0, 0.8767, 0.8416, and 0.8716, respectively, confirming the superior performance of the proposed system across all metrics.

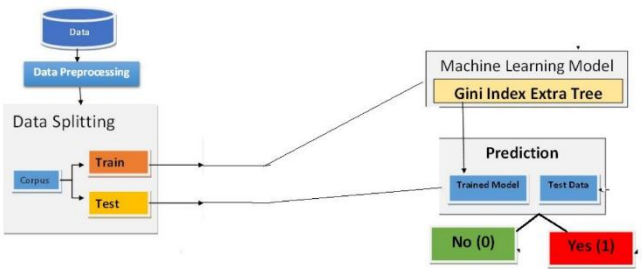

Fig. 1, Proposed Model (GET)

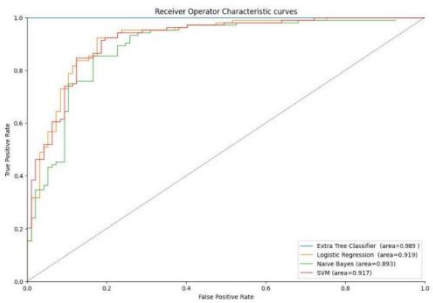

Figure 2. ROC Analysis

ROC analysis is shown in Figure 2. shows the TPR obtained with the suggested GET, Logistic regression, Navie Bayes, and SVM is 0.989, 0.919, 0.893, 0.917 respectively for an FPR of 0.1.

CONCLUSION

The study introduces a Gini Index-based Extra Tree classifier for heart disease detection, achieving 98.6% accuracy and showcasing potential for early diagnosis and better patient outcomes. However, its robustness is limited by data quality, potential biases, and lack of interpretability, which may affect adoption by healthcare professionals. Additionally, high training computational costs require optimization for practical use.

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Oral Presentation – OP-21

Comparative Study of Lipase Catalysed Esterification and Transesterification Processes to Produce Dilauryl Adipate

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ABSTRACT

The present work aimed at lipase-catalyzed preparation of dilauryl adipates. Commercial lipase NS435 was previously screened for its ability to catalyze esterification reactions. Lipase catalyzed ester preparations were carried out by both direct esterification as well as transesterification route. Though both the path proved to be equally efficient but transesterification proved to be better option in respect to reaction time, solvent, recovery and purification of product.

INTRODUCTION

Synthesis of different dibasic acid esters with enzyme catalyst attracts a new dimension of work for their application in different chemical, biological and medicinal fields. Adipic acid esters are used as low- temperature and low-viscosity plasticizers for polyvinyl chloride and its copolymers.

The present work aimed at lipase-catalyzed preparation of dilauryl adipate. Commercial lipases were previously screened for their ability to catalyze esterification between adipic acid and lauryl alcohol. Ester preparation was carried out by both direct esterification as well as transesterification route. Different reaction parameters like lipozyme concentrations, temperature, substrate concentration and choice of medium of reaction were studied in detail for both the routes.

MATERIALS AND METHODS

Lipase catalyzed direct esterification: The esterification reactions were carried out in a round- bottomed flask fitted with an air condenser, containing adipic acid and lauryl alcohol. Different reaction parameters like enzymes concentration, substrate concentration, time, temperature and solvent were optimised.

Lipase catalyzed transesterification: Transesterification reaction was carried out between dimethyl adipate and lauryl alcohol in an round-bottomed flask fitted with a water condenser with continuous stirring by a magnetic stirrer under different reaction conditions e.g., variation of enzymes, enzyme concentration, molar ratio of methyl ester and alcohol, time and temperature.

Gas-Chromatographic Analysis: Purity of isolated monoester and diesters were also confirmed by GLC analysis.

Continuous Packed bed reactor: A typical continuous flow packed bed reactor was constructed using a double walled glass tube. Lipase NS 435 immobilised on macroporous acrylic resin was packed in the tube. Pumps which can operate in semi-continuous mode were used to pump the substrates. The substrates dimethyl adipate and lauryl alcohol were mixed in a separate chamber and gradually introduced into through the packed bed reactor in a semi-continuous manner.

RESULTS AND DISCUSSION

Transesterication route proved to be more effective than direct esterification as evidenced from the graph. After 3 hours of continuous reaction, conversion of 94.3% adipic acid to its esters was achieved on transesterification whereas 89.5% conversion was achieved via direct esterification route. Transesterification proved to be better option in respect to reaction time, solvent, recovery and purification. A typical semi continuous flow packed bed reactor was constructed using a double walled glass tube and a series of batch reactions were carried out.

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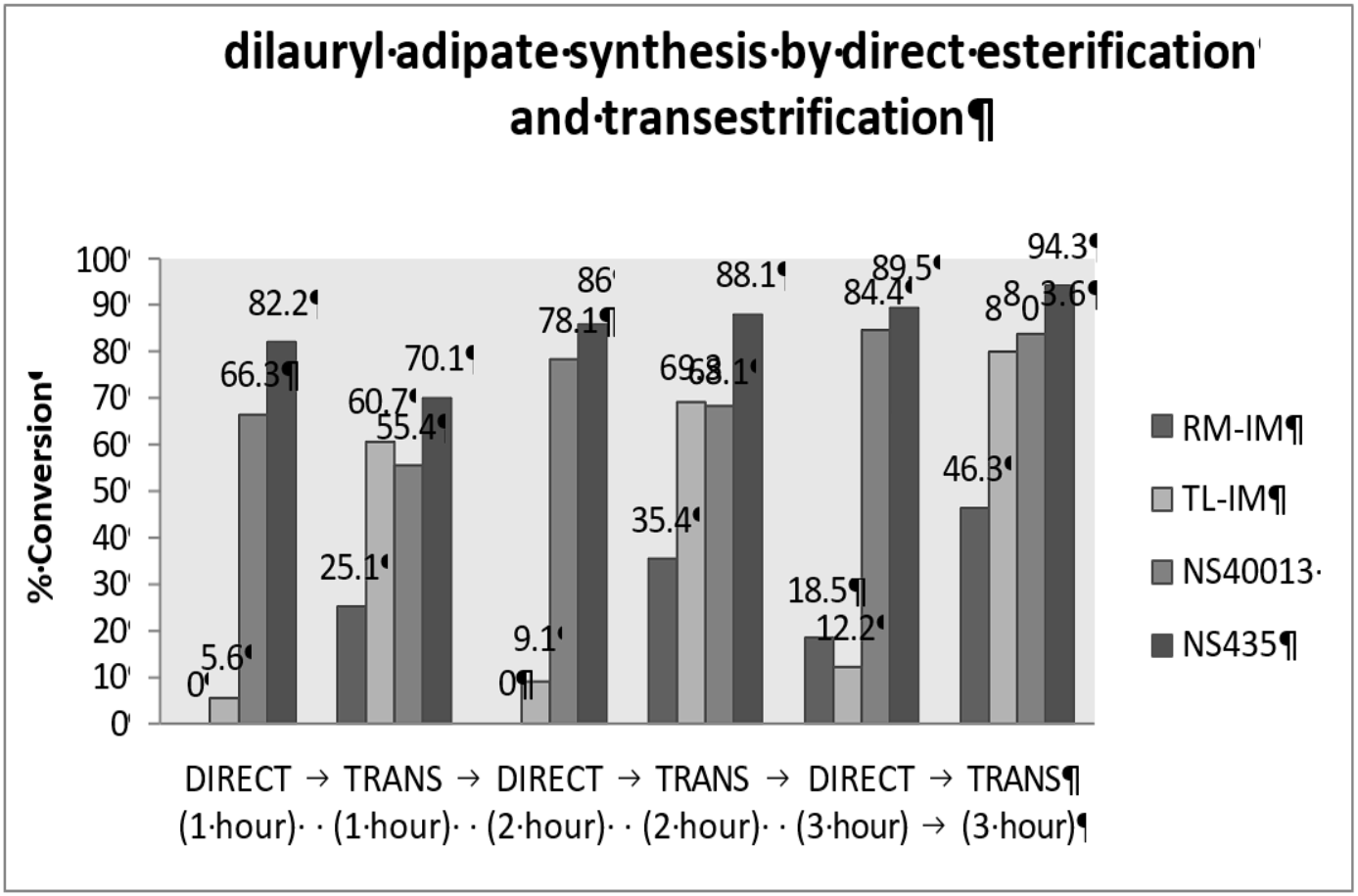

CONCLUSION

Lipase catalysed tranesterification proved to be one of the best methods for synthesis of dilauryl adipates. Further trial run in a packed bed reactor ensures the viability of the process along with the recycling and reuse of the biocatalyst.

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Oral Presentation – OP-22

Synthesis, Structural Characterization, Antimicrobial Activity, DNA Binding Study of Sulfamethoxazole-Azo-7-Hydroxy-4-Methyl Coumarin and its Metal Complexes.

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ABSTRACT

4-((7-Hydroxy-4-methyl-2-oxo-3,8a-dihydro-2H-chromen-6-yl)diazenyl)-N-(5-methylisoxazole-3-yl)benzenesulfonamide (HL) (1) has been characterized by the single crystal X-ray structure and has been used to synthesize manganese(II), $[Mn(L)_2(H_2O)_4]$ (2) and copper(II), $[Cu(L)_2(H_2O)_4]$ (3) complexes. The crystal packing shows H-bonded (both intra- and intermolecular) 1D polymer through N(3)…H(1)-O(4) and N(1)-(H1).....N(2) along the b-axis which generates a $R_2^2(8)$ cyclic motif. Antimicrobial activity of these molecules have also been examined against *B. subtilis* (ATCC 6633; IC_{50}: 166 µg/ml (HL), 155 µg/ml (2) and 99.5 µg/ml (3)) and *E. coli* (ATCC 8739; IC_{50} 314 µg/ml (HL) (1), 280 µg/ml (2) and 239 µg/ml (3)).

INTRODUCTION

Sulfamethoxazole (SMX) is a useful antibiotic in the treatment of different microbial infections including urinary tract[1], respiratory organ etc. However, long use of SMX induces toxicity in different parts of living body because of generation of toxic metabolic residues. In this work SMX is coupled with 7-hydroxy-4-methyl coumarin to synthesise 4-((7-hydroxy-4-methyl-2-oxo-3,8a-dihydro-2H-chromen-6-yl)diazenyl)-N-(5-methylisoxazole-3-yl)benzenesulfonamide (HL) (**1**). Coumarin has extensive biological activities like antioxidant , analgesic , anti-inflammatory

MATERIALS AND METHOD

7-Hydroxy-4-methylcoumarin was prepared by the reaction between resorcinol (10 g, 91 mmol) and ethyl acetate (13.4 g, 10 mmol) in catalytic amount of conc. H_2SO_4 at the temperature below 10°c as per the literature procedure by Pechmann Condensation . The diazotization of sulfamethoxazole (0.5g, 1.97 mmol) was carried out at 0-5°C in aqueous solution by adding $NaNO_2$ (1.0 g) solution followed by coupling with 7-hydroxy-4-methylcoumarin (1 g, 0.002 mmol) in presence of sodium carbonate (2.0 g) in water according to a general literature procedure [2]. Bright yellow precipitate filtered and dried at room temperature. It was then recrystallized by slow evaporation of hot alcoholic solution and purity was checked by TLC; yield: 82%. Microanalytical data for HL **(1):** Anal. Calcd. for $C_{20}H_{16}N_4O_6S$ (Mol. wt. 442) :C, 54.29; H, 3.61; N, 12.66%;

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RESULT AND DISCUSSION

Empirical formula of L1	**$C_{20}H_{16}N4O_6S$**
system	Monoclinic
Space group	C2/c
a(Å)	17.747(5)
b(Å)	7.561(5)
c(Å)	29.490(5)
α/^{0}	90.000(5)
β/°	91.892(5)
γ/^{0}	90.000(5)
V(Å)^3	3955(3)
Z	2
θ range	2.30 to 25.27°.
Total reflections	3537

Table 1. Summarized crystal structure of sulfamethoxazole-azo-7-hydroxy-4-methyl coumarin.

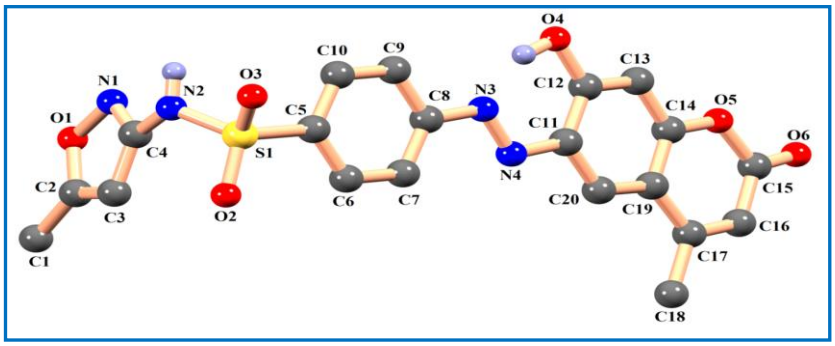

Fig. 1. Representation of Single crystal X-ray structure of L, showing labeling

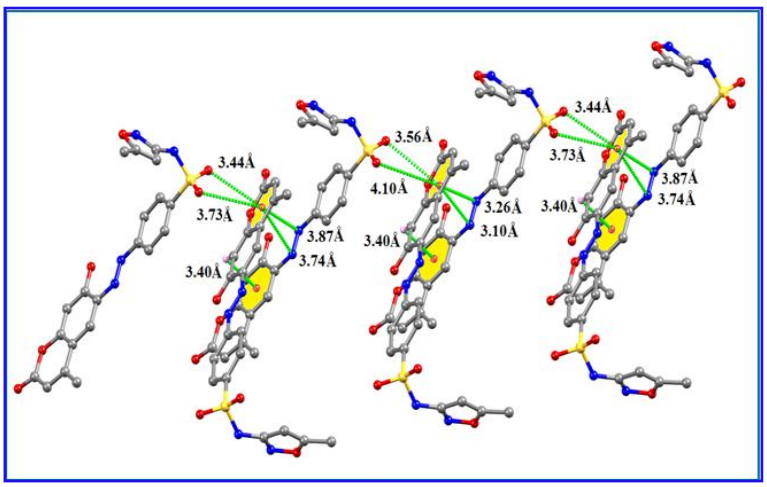

Fig: 2. One dimensional assembly of monomeric units of L through interaction of lone pair of O of SO2… π and π…lone pair of azo N through benzene ring and C-H…π interaction. The extended network is shown in green dotted lines. This assembly is viewed along the b axis.

CONCLUSION: HL (L) has been characterized by the single crystal X-ray structure that confirms its geometry and metal complexes have been characterized by IR, Mass, EPR, EDX-SEM data.

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Oral Presentation – OP-23

Heart Rate Estimation Using Facial Blood Volume Changes From Video Analysis

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ABSTRACT

The Facial video analysis monitors heart rate non-invasively by detecting subtle color changes linked to blood flow. Using image processing and Python tools, it offers a cost-effective, contact-free solution for vital sign assessment.

INTRODUCTION

Facial video analysis offers a non-invasive way to monitor heart rate by detecting color changes in the cheek caused by blood flow. Using red-channel pixel intensity analysis, bandpass filtering, and FFT, it provides a reliable alternative to contact-based sensors. Tools like MediaPipe Face Mesh and Python libraries ensure a scalable and cost-effective solution.[1][2]

MATERIALS AND METHODS

The study used a standard camera with controlled lighting to record facial videos. MediaPipe Face Mesh isolated the left cheek region, and red channel pixel intensities were averaged to create a time-series signal. A bandpass filter (1.16–2.16 Hz) reduced noise, and a Fast Fourier Transform (FFT) identified the dominant frequency, which was converted into beats per minute (BPM) for heart rate estimation, ensuring accuracy with visual outputs like signal and FFT plots.[3][4]

RESULTS AND DISCUSSION

The study evaluated heart rate estimation from facial videos by analyzing pixel intensity variations in the left cheek using grids of 9, 100, 900, and all pixels. Accuracy improved with grid size, with the best results from analyzing all pixels, closely matching actual heart rates. Smaller grids showed greater deviations due to limited data, while bandpass filtering and FFT enhanced signal accuracy. The findings demonstrate the effectiveness of full-pixel grids for accurate, non-invasive heart rate monitoring, with potential for remote health and fitness tracking.[5]

Table 1: Result Analysis

Sl No.	ActualHeartRate(BPM)	EstimatedHeart Ratefor 9 pixels(BPM)	EstimatedHeart Ratefor100 pixels(BPM)	EstimatedHeart Ratefor900 pixels(BPM)	EstimatedHeart RateforAll pixels(BPM)
1	95	100.25	88.63	95.24	92.58
2	103	113.39	99.21	77.00	100.66
3	67	76.68	85.88	75.07	65.88
4	82	80.40	80.48	80.48	84.50
5	89	95.63	90.25	88.25	87.96

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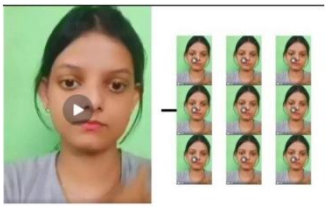

Figure1: Videobreaksintoimages

Figure2: Extractionofleft cheekregion usingmediapipe

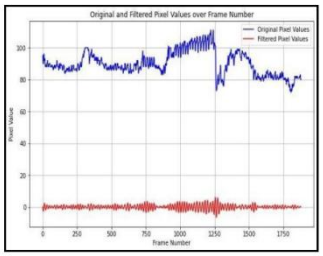

Figure3:Bandpassfilterappliedto thesignal

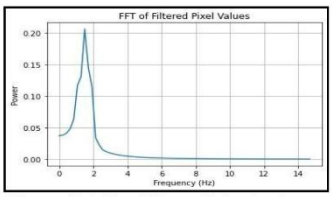

Figure4: Fft offilteredpixelvalues

CONCLUSION

The heart rate estimation system, leveraging video analysis and FFT, offers a noninvasive, cost-effective method for remote health monitoring, especially in telemedicine. While effective, its accuracy can be impacted by poor video quality or facial movement, requiring future improvements for robustness and broader applications.

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Oral Presentation – OP-24

A Review on Fabrication of Bio Plastic and its Application

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INTRODUCTION

The Petroleum-based plastics are linked with the cause of pollution, environmental toxicity, leaching, greenhouse gas emissions, etc. for their entire lifecycle. These environmental concerns combined with the increasing costs of petroleum have led to the search for alternative sources. Bio-plastics being naturally sourced and biodegradable, are less harmful than conventional plastics and could serve as a safer alternative, resulting in a better environment for us to live in. Conventional plastics are composed of synthetic and semi-synthetic compounds, which have the inability to be processed by microbes. There are so many research work has been done to synthesize bio-plastic by using glycerine, corn-starch, cellulose and other such natural substances instead results in an equivalent which do possess the property of being completely broken down completely. Generally, renewable resources (corn, sugars, starches, etc.) are used in bioplastics [1] and are created by several microorganisms [2]. Degradable plastics are of four types:
(1) **Photodegradable bioplastics:** Light-sensitive entities are incorporated as additives directly in the backbone of these polymers. Extensive UV radiation (over weeks or months) disintegrates them, exposing them further to bacterial degradation [3];
(2) **Bio-based bioplastics:** These are "plastics in which 100% of the carbon is derived from renewable agricultural and forestry resources such as corn starch, soybean protein and cellulose" (Business-NGO Working Group for Safer Chemicals and Sustainable Materials) [4];
(3) **Compostable bioplastics:** They biologically decompose during composting at a rate similar to that of other compostable substances and do not leave any visible toxic matter [5];
(4) **Biodegradable bioplastics:** These are completely degraded by microorganisms and do not leave behind perceivable toxic remains. The term itself ("biodegradable") refers to substances that can disintegrate naturally into biomass and biogases (majorly water and carbon dioxide) on exposure to humidity and microbial environment, like those present in the soil, thus reducing the amount of plastic waste [4].

Fabrication of Bio-plastic:

There are several methods were used in different research work to synthesize Bio-plastic. The commonly used materials were used like gelatine, glycerine, starch etc.

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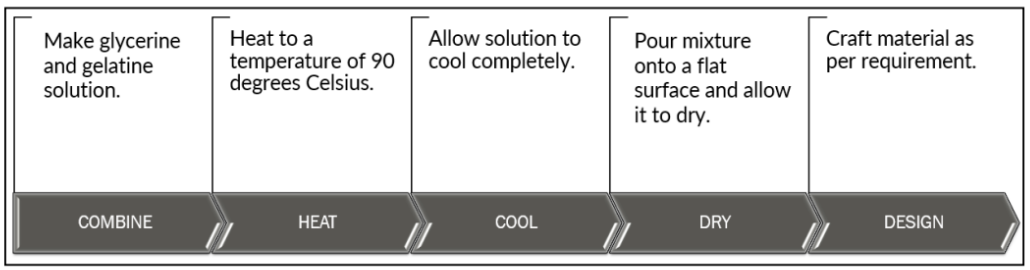

Fig 1: Schematic diagram of Synthesis of Bioplastic

Application of Bio-plastic:

The use of bio-plastics were focused in the field of food packaging, agricultural field and biomedical field. Now a days most of the food packaging industries are trying to use bioplastics as they are more sustainable and eco-friendly [6]. Bio-plastics , made of starch mainly used for foods like fruits, vegetables packaging. But some challenges like the high price and less effective as water must be solved before using in packaging. In agricultural field bio-plastics are widely used to make grow bags, net or mulch film. Generally these bioplastics are based on polyhydroxyalkanoets and substitute of polyethylene bags used for the growth of crops. There were many research work has published to study the use of bioplastic for tissue repairing, wound dressing and cancer detection [7].

Conclusion:

Bioplastic can be incorporated into the manufacturing, packaging and biomedical sectors in place of synthetic plastics, serving as a solution for these industries and reducing the burden on the environment.

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Oral Presentation – OP-25

State of an Art for A Price Maker to Exercise Market Power in Virtual Power Plants

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INTRODUCTION

The increasing interest in renewable energy sources such as wind, solar, and photovoltaic cells over the past decade which being driven, by the goal of reducing greenhouse gas emissions. This forces price makers—entities that aim to support the main grid through bidirectional power flow—to navigate the uncertainties in market prices and the output levels of these stochastic units. The price maker within a Virtual Power Plants (VPPs) can influence market prices in the day-ahead energy and reserve markets through their bidding and offering decisions. The strategic choices made by the price maker in operating the VPP can lead to the exercise of market power, both through the financial and physical capacities of the plant, potentially withholding power to manipulate prices. In markets characterized by uncertainty, the price maker can alter the market price for their own benefit, thereby maximizing profits—this is referred to as exercising market power. To address these uncertainties, a deterministic programming approach is used in this context. The market clearing problems are modeled using equilibrium constraints, resulting in a mathematical program with equilibrium constraints (MPEC). The key innovation in this paper lies in the "Here and Now" offering decisions made by the price maker in the day-ahead market, which aim to maximize expected profits. Specifically, this study focuses on the participation of the price maker in a virtual power plant within a one-hour scheduling horizon, considering one conventional source, one demand response, and one renewable energy source.

Key Words: Market Power, Price Maker, Scheduling, Uncertainty, Virtual Power Plant,

1. METHODOLOGY:

Participation of the price maker through scheduling of energy:

In the day-ahead energy and reserve markets, the price maker seeks to maximize profit by strategically selecting offer and bid prices while clearing the market. This problem is addressed using a bi-level model, which incorporates equilibrium conditions. The bi-level model consists of two interrelated problems: the upper-level problem and the lower-level problem. In the upper level, the price maker acts as the "leader," aiming to maximize profit while satisfying both technical and economic constraints. In the lower-level problem, the price maker assumes the role of the "follower," responding to the market prices and production levels determined by other participants.

Participation of the price maker through scheduling of energy and reserve market:

The price maker determines the market outcome by solving the scheduling problem using both deterministic and stochastic approaches. The deterministic approach is based on a single-point forecast, while the stochastic approach employs a probabilistic model. In the day-ahead (DA) market, the price maker makes decisions on quantity and

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price, leveraging the flexibility of reserve energy assets to increase profits. The price maker plays a crucial role in shaping the Virtual Power Plant's (VPP) operations by setting prices in the DA market.

Uncertainty Model:

While taking decisions for the offer and bid prices in the DA market the price maker faces a number of uncertainty namely.

- The available production for the stochastic renewables.
- The quantity of deployment in up and down reserves.

RESULT AND DISCUSSION:

Scheduling problem formulation of the price maker for the virtual power plant in the day ahead energy and power market.

Objective function

$$max_{\varphi,\, \varphi_t^E} \quad \sum_{t\in\Omega^T}[\ \lambda_t^E(p_t^{E+}\Delta t - (p_t^{E-}\Delta t) + \sum_{C\in\Omega^D} \quad (C_c^{C,F}u_{ct}^C + C_c^{C,V}p_{ct}^C\,\Delta t)] \qquad (1)$$

Subject to constraints

$$\sum_{C\in\Omega^C} \quad p_{ct}^C + \sum_{r\in\Omega^R} \quad p_{rt}^R + \sum_{r\in\Omega^S} \quad (p_{st}^{S,D} - p_{st}^{S,C}) - \sum_{d\in\Omega^D} \quad p_{dt}^D = p_t^{E+} - \ p_t^{E-},\ \forall t \in \Omega^T \qquad (2)$$

Table: 1 Data of two producers and demands of VVP

Parameter	Producer 1	Producer 2	Demand 1	Demand 2
Offer price ($/MWh)	30	50	-	-
Power offer quantity (MW)	50	30	-	-
Bid price ($/MWh)	-	-	50	70
Power bid quantity (MW)	-	-	50	50

Table 2. Schedule of the two producer and demand

	Producer 1	Producer 2	Demand 1	Demand 2
Power traded (MW)	50	0	30	50

CONCLUSION:

The price maker settles through the bi-level model that consists of the technical and economical constraint of the units of the VPP in upper and lower levels the upper and lower level coincide to clear the market exercising to earn profit by the facilitator in the lower level as well as to gain maximum social welfare for the customers to be benefited in the upper level.

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Oral Presentation – OOP-01

A Wide-Bandwidth Circularly Polarized Dielectric Resonator Antenna with Integrated Cross-Slot and Annular-Slot Feed Mechanism

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INTRODUCTION

Dielectric resonator antenna (DRA) draws significant attention in modern communication systems due to its attractive properties. Since its introduction in 1983, the DRA has become popular within the antenna community due to its remarkable features, including high radiation efficiency, compact size, wide bandwidth, high Q-factor, cost-effectiveness, and many more [1][2]. Moreover, the variety of available shapes and diverse feeding strategies provide DRAs with exceptional design flexibility. These kinds of features are not present in traditional metallic or planner antennas.

Different feeding mechanisms generate distinct electric field patterns or modes within DRAs, each enabling the production of specific polarizations, such as linear or circular polarization (CP). In [3], a cross-slot aperture feed was employed to achieve circular polarization in a cylindrical DRA (CDRA). Beyond the cross-slot, various other aperture feed shapes, including V-shaped, F-shaped, plus-shaped, annular-shaped, C-shaped, and rectangular slots, have also been reported for generating CP in DRAs [1]. To realize circular polarization in a CDRA, it is essential to arrange two orthogonal field components within the resonator, as shown in Figure 1.

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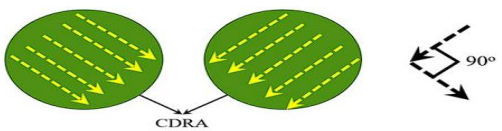

Figure 1. Orientation of the required E-field within the CDRA for generating circular polarization.¶

With its many benefits over linear polarization (LP), circular polarization (CP) is crucial for several applications, including radar systems and satellite and wireless communications. CP shows the capacity to enhance signal penetration through obstructions, reduce multipath interference, and provide constant performance irrespective of device orientation.

Bandwidth is a critical factor in antenna design, as it defines the frequency range over which the antenna operates effectively. Considering the advantages of CP and wideband performance, designing a CP antenna with a wide bandwidth is a challenging task.

Addressing the growing demand and associated challenges, this article introduces a wideband CP antenna featuring an integrated cross-slot and annular-slot feed mechanism combined with a stacked DRA design. The proposed antenna achieves an impedance bandwidth ranging from 3.1 GHz to 4.1 GHz and a 3 dB axial ratio bandwidth spanning 3.12 GHz to 4.11 GHz. With a peak gain of approximately 6.7 dBi, the antenna effectively covers the 3.5 GHz application band, making it ideal for IoT, 5G, vehicular communications, and a variety of modern communication systems.

MATERIALS AND METHODS

The DRA provides a degree of freedom that can be utilized to adjust its resonant frequency and radiation pattern.

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Among various DRA geometries, the CDRA stands out due to its versatile design. By varying its dimensions, specifically the radius (r) and height (h), the resonant frequency of the CDRA can be tuned effectively. The resonant frequency of the CDRA is determined using Eq. [1], where ε_r represents the relative permittivity of the dielectric material, and c is the speed of light in free space.

The proposed CP antenna system is depicted in Figure 2. Taconic, with a dielectric constant of 10, is used as the DRA material, while FR4, with a dielectric constant of 4.4, is employed as the substrate. The design incorporates an integrated cross-slot and annular-slot feed mechanism along with a t hree-layer stacked DRA structure. The stacked

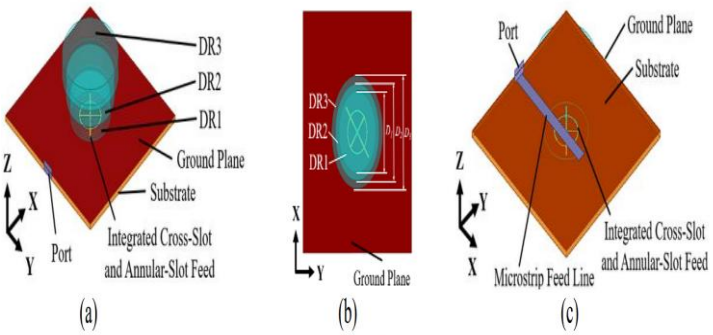

Figure 2. Antenna geometry. (a) 3D view (Top), (b) Top view in xy plane, (c) 3D view (Bottom).

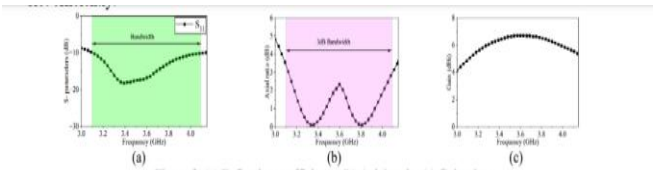

Figure 2. (a) Reflection coefficients. (b) Axial ratio. (c) Gain plot.

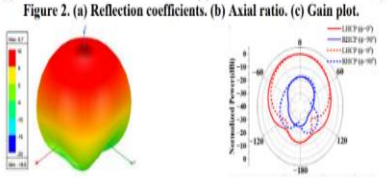

Figure 3. Radiation pattern at 3.4 GHz. (a) 3D radiation pattern (b) Far-field radiation pattern.

$$f_r = \frac{c}{2\pi r\sqrt{\varepsilon_r}}\left[1.71 + \frac{r}{h} + 0.01578\left(\frac{r}{h}\right)^2\right] \qquad [1]$$

layers play a crucial role in enhancing the bandwidth of the system [1]. The integrated cross-slot and annular-slot feed generate the required field components to produce CP within the stacked DRA [2]. A microstrip line is used to excite the slot efficiently.

RESULTS AND DISCUSSION

The proposed antenna geometry is analyzed using Ansoft HFSS. Figure 2(a) shows the impedance bandwidth from 3.1 GHz to 4.1 GHz, while Figure 2(b) depicts the 3 dB axial ratio bandwidth from 3.12 GHz to 4.11 GHz. Figure 2(c) presents the gain versus frequency plot, with a peak gain of 6.7 dBi. Radiation patterns are presented in Figure 3, where Figure 3(a) illustrates the 3D radiation pattern, and Figure 3(b) shows the far-field left-hand CP (LHCP) radiation pattern.

CONCLUSION

This article presents a wideband circularly polarized (CP) antenna featuring an integrated crossslot and annular-slot feed mechanism with a stacked DRA design. The antenna achieves an effective bandwidth from 3.12 GHz to 4.1 GHz and a peak gain of 6.7 dBi, making it highly suitable for modern communication applications.

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Oral Presentation – OOP-02

Automated Rice Variety Classification using Optimized Convolutional Neural Networks

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ABSTRACT

The classification of rice varieties is a critical task in agriculture, impacting quality control, yield optimization, and trade. Traditional manual methods are labour-intensive and error-prone. This study explores the application of convolutional neural networks (CNNs)—specifically VGG16, VGG19, ResNet50, and InceptionV3—for automated rice variety classification. Using a dataset of 75,000 images across five varieties (Basmati, Jasmine, Arborio, Karacadag, and Ipsala), models were evaluated based on accuracy, precision, recall, and F1-score. InceptionV3 achieved the highest accuracy of 99.80%, demonstrating its potential for agricultural automation.

INTRODUCTION

Rice, a global staple crop, requires precise variety classification for maintaining quality, enhancing yield, and enabling trade compliance [1]. Traditional manual methods lack scalability and reliability, prompting the adoption of deep learning techniques. CNNs, known for their ability to extract complex features from images, are applied here to classify five rice varieties. The models explored—VGG16 and VGG19 [2], ResNet50 [3], and InceptionV3 [4]—have shown promise in similar classification tasks.

EXPERIMENTT

The dataset used comprised 15,000 images per rice variety, standardized to 250×250 pixels. Figure 1 illustrates the classification process, including data preprocessing, model training, and performance evaluation. A five-fold cross-validation strategy ensured robust model evaluation. Metrics such as precision, recall, F1-score, and confusion matrices were calculated to assess the models' effectiveness. The hardware setup included an Intel Core i5 processor, 24 GB RAM, and Python 3.9 with Spyder IDE.

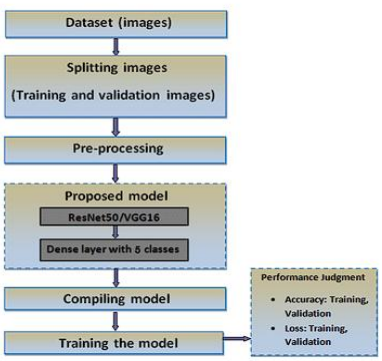

Figure 1: Workflow for CNN-based rice variety classification.

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RESULTS AND DISCUSSION

InceptionV3 achieved the highest accuracy of 99.80%, outperforming VGG16 (99.41%), ResNet50 (99.31%), and VGG19 (98.79%). The confusion matrix for InceptionV3 (Table 1) highlights its ability to correctly classify rice varieties. Despite using fewer folds in cross-validation compared to similar studies (Patel et al., 2017), the models maintained high performance, emphasizing their efficiency and robustness. These findings demonstrate the practicality of using CNNs for large-scale agricultural applications.

Table 1: Confusion matrix for InceptionV3

		Class Predicted				
		Arborio	Basmati	Ipsala	Jasmine	Karakadag
True class	Arborio	14935	0	0	25	40
	Basmati	0	14973	0	10	17
	Ipsala	0	5	14979	9	7
	Jasmine	0	15	7	14962	16
	Karakadag	0	0	0	0	15000

CONCLUSION

The study confirms the efficacy of CNNs for automated rice variety classification, with InceptionV3 standing out as the best-performing model. By optimizing cross-validation and computational resources, the research offers a scalable solution for agricultural automation. Future work could explore real-time implementations and broader datasets to extend the application scope.

ACKNOWLEDGMENT

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Oral Presentation – OOP-03

A Comparative Analysis of VLSI and Embedded Systems: Technologies, Applications, and Future Trends

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ABSTRACT

The rapid advancement of modern electronics has led to the widespread use of Very-Large-Scale Integration (VLSI) and Embedded Systems, both of which are pivotal in the development of high- performance, energy-efficient, and cost-effective hardware solutions. This paper provides a comparative analysis of VLSI and Embedded Systems, examining their fundamental principles, design complexities, application areas, and key differences.

INTRODUCTION

In the world of modern electronics, the design and development of integrated hardware systems are central to achieving the desired performance, efficiency, and cost-effectiveness in a wide range of applications. Two fundamental technologies that have played pivotal roles in this evolution are Very-Large-Scale Integration (VLSI) and Embedded Systems. While both technologies are essential to modern electronics, they serve different purposes and are optimized for distinct types of applications. Understanding the differences and synergies between VLSI and Embedded Systems is crucial for selecting the right technology for a specific task, whether it's for high-performance computing, embedded control, or real-time processing in diverse industries.

PURPOSE AND FUNCTIONALITY

VLSI aims to create integrated circuits that perform complex operations, such as computing and signal processing, in a compact and efficient manner, enabling the development of microprocessors, memory devices, and application-specific integrated circuits (ASICs) used in various electronic devices. In contrast, Embedded Systems are designed to control, monitor, or assist in the functioning of another system, with a focus on real-time performance, energy efficiency, and reliability. These systems are commonly used in applications such as automotive control systems, medical devices, consumer electronics, and industrial automation, where they are tailored to perform specific, predefined tasks within larger systems.

Convergence of VLSI and Embedded Systems

The lines between VLSI and Embedded Systems are becoming increasingly blurred as semiconductor technologies evolve. Many modern embedded systems now rely on advanced VLSI chips to provide the necessary processing power, memory, and connectivity. For example, System-on-Chip (SoC) designs combine the capabilities of VLSI with the requirements of embedded systems, enabling more sophisticated embedded designs with improved performance, power efficiency, and integration (Singh &Verma, 2023). The convergence of these technologies is also evident in the growing use of VLSI in automotive, industrial, and IoT applications, where embedded systems are required to operate in real-time with high reliability.

RESULTS AND DISCUSSION

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VLSI and Embedded Systems are distinct in their focus and application, with VLSI being centered around the integration of complex circuits into a single chip, while embedded systems are designed to fulfill specific tasks within larger systems. VLSI is crucial for creating the processing power that drives modern electronics, while embedded systems apply that power in real-world, task-specific applications, optimizing for real-time operation, low power consumption, and cost efficiency.

VLSI

- Creating integrated circuits with millions or billions of transistors.
- Extremely complex, involving advanced fabrication technologies and specialized expertise.
- High-performance computing, telecommunications, consumer electronics.
- Transistors, logic gates, memory, microprocessors, interconnects.
- High performance, larger size, and higher power consumption.
- Miniaturization, AI chips, 3D ICs, quantum computing.

Embedded System

- Developing systems to control or monitor specific tasks.
- Focused on hardware integration and software development for specific applications.
- Consumer electronics, automotive, healthcare, industrial control, IoT.
- Microcontrollers, sensors, actuators, memory, I/O interfaces, embedded software.
- Small form factors, low power, cost-effective.
- IoT, AI at the edge, real-time systems, wearable's, autonomous systems.

CONCLUSION

Both VLSI and Embedded Systems are indispensable to modern electronics, but they serve distinct purposes and are optimized for different types of applications. VLSI provides the computational power and scalability required for general-purpose computing and high-performance systems, while Embedded Systems are tailored for specific tasks with a focus on power efficiency, size, and real-time performance. The ongoing convergence of these technologies, driven by advances in semiconductor design and manufacturing, is enabling more sophisticated and efficient electronic systems for a wide range of applications.

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Oral Presentation – OOP-04

Effect of Hydrothermal Reaction Time on the Dye Removal Efficacy of Graphitic Carbon Nitride Clusters

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ABSTRACT

The present work represents the synthesis of graphitic carbon nitride (GCN) cluster by a low-temperature hydrothermal technique. Three different GCN samples were developed by varying the reaction time in the hydrothermal chamber. The as synthesized samples show excellent efficacy in removing textile dyes like Bengal rose as well methylene blue through a synergistic effect of photo-catalysis as well as adsorption. It has been seen that the synthesis time does not affect the morphology of the sample but due to the change in crystallinity, stoichiometry of the element and internal structure has a marked effect in dye removal efficiency. The optimized sample offered removal efficiency more than 95 % within a time interval lesser than 15 %.

INTRODUCTION

The water can be contaminated by various pollutants that include heavy metals, organic molecules, industry waste and most importantly textile dyes [1, 2]. Of which the coloured dyes that mainly come from the paper as well as textile industry effluents is one of the most important contaminants that has several negative impacts on every living species [3]. Dyes can be removed by some conventional techniques involving oxidation, extraction of solvent, coagulation or may be even through ozonisation and by many others. Of all these, the two most widely used processes for dye removal are probably adsorption and photon-induced catalytic reaction.

Keeping this in mind, the present work represents the synthesis of graphitic carbon nitride (GCN) cluster by a low-temperature hydrothermal technique. Three different GCN samples were developed by varying the reaction time in the hydrothermal chamber.

The as synthesized samples show excellent efficacy in removing textile dyes like Bengal rose as well methylene blue through a synergistic effect of photo-catalysis as well as adsorption. It has been seen that the synthesis time does not affect the morphology of the sample but due to the change in crystallinity, stoichiometry of the element and internal structure has a marked effect in dye removal efficiency. The optimized sample offered removal efficiency more than 95 % within a time interval lesser than 15 minutes.

MATERIALS AND METHODS

The GCN was developed through a low temperature hydrothermal process using urea as precursor. Here, certain amount of urea was crushed and heated to get melamine. Further to synthesis GCN by a low temperature hydrothermal process certain amount of melamine was stirred in DI water and was taken in an autoclave maintaining at 200^{o}C for different times and were filtered. After heating the residue over night at 60 oC a milky yellow coloured powder samples were obtained.

RESULTS AND DISCUSSION

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Fig.1 (a) shows the XRD pattern of as synthesized GCN. The only sharp peak at 2θ = 27 o is associated with the (002) plane for a graphitic structure having inter-planar spacing value of 0.326 nm whereas Fig.1 (b) shows the FESEM micrograph of the sample. The FESEM micrograph clearly shows the clusterd nature of the sample. Fig.1 (c) shows the UV-Vis absorption spectra of Bengal Rose dye treated by GCN for different time duration.

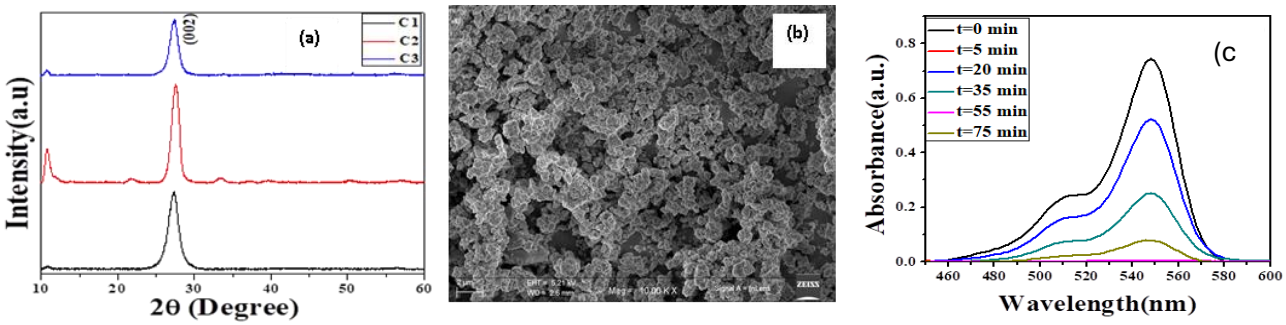

Fig.1: XRD pattern (a), FESEM micrograph (b) of GCN and UV-Vis absorption spectra of Bengal Rose dye treated by GCN (c)

CONCLUSION

GCN nano-clustered samples were synthesized by low-temperature hydrothermal method. The samples were characterized by X-ray diffraction (XRD), field emission scanning electron microscope (FESEM), Energy dispersive X-ray (EDX) analysis, UV-Vis reflectance and Fourier transform infrared (FTIR) spectroscopy.

XRD confirmed the proper phase formation, whereas FESEM shows the as synthesized GCN samples have cluster-like morphology. Stoichiometric analysis through EDX spectra shows that with the variation of reaction time has pronounced effect on the carbon/nitrogen ratio. In optical analysis while FTIR spectra revealed the different vibration energy level, UV-Vis reflectance spectra determined the optical band gap of the material.

The as synthesized samples show excellent efficacy in removing textile dyes like Bengal rose as well methylene blue through a synergistic effect of photo-catalysis as well as adsorption.

When reaction kinetics was studied it is seen that the reaction mainly followed 1st order kinetics.

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Oral Presentation – OOP-05

Design and Performance Analysis of Capacitive Micromachined Ultrasonic Transducer With Hafnium Oxide Dielectric Insulation Layer

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ABSTRACT

In this paper, to assess the characteristic parameters of a capacitive micromachined ultrasonic transducer (CMUT) in the presence of a high-K dielectric insulating layer, an analytical model has been created. The investigation of the performance of a parallel plate structured CMUT takes into account different insulation layer widths, actuation layer thickness, diameter, and bias. The results are then validated through the use of FEM modelling. Observable improvement of device capacitance, static and dynamic displacement, collapse voltage, coupling coefficient takes place due to usage of high-K insulating material. The investigation is done in comparison between silicon nitride and hafnium oxide insulation layers. CMUT having HfO_2 insulation of 500nm thickness exhibits resonance at 1.62MHz and displacement of 405nm. Approximately 20% enhancement occurs in displacement as compared with Si3N4 as insulation.

Keywords: SiC actuation layer, CMUT, High-K dielectric material, HfO_2 insulation

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Oral Presentation – OOP-06

Lumpy Skin Disease in Cattle Farm: a Study Incorporating Chemical Treatment and Vaccination

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ABSTRACT

Lumpy Skin Disease (LSD) is a frightening virus that primarily affects cattle and other livestock, particularly cows and buffaloes. To formulate a disease induced livestock model which accurately portrayed the spread and management of LSD, a five-dimensional system of ordinary differential equations has been developed. Direct contact or contact from vector bites can spread the disease. The basic reproduction number, R_0, is computed to illustrate the impact of model parameters. In contrast to previous research, this model incorporates the usage of chemicals and vaccinations as control variables. According to our findings, the occurrence of lumpy skin disease can be considerably decreased by utilizing strong chemical pesticides and isolating livestock from vectors. Additionally, it has been stated that vaccinations alone is ineffective at preventing the disease's transmission.

INTRODUCTION

Lumpy Skin Disease (LSD) is a notifiable disease, according to World Organization for Animal Health(WOAH), because of its rapid spread and economic losses. Direct contact and bloodsucking insects like ticks, mosquitoes, and some flies are the two ways it is spread. In developing countries like India, the use of mathematical models for recognizing livestock diseases is still relatively new and rare. Even though vaccines are the main method of disease prevention in the mathematical model, rural farmers can not vaccinate every animal on their farm. Furthermore, new farmers are confused of the proportion of the population that needs to be vaccinated in order to control the disease. In order to set this model apart from the earlier studies, we have tried to develop a five compartmental lumpy skin disease epidemic model for cattle and employed chemical management to ward off mosquitoes, flies, ticks, and other pests.

MATERIALS AND METHODS

Let $N_c(t)$ be the total cattle population density which is divided into three sub classes Susceptible ($S_c(t)$), Vaccinated ($V_c(t)$) and Infected ($I_c(t)$) and $N_v(t)$ is the total carrier population which consists off two sub classes susceptible vector ($S_v(t)$) and infected vector ($I_v(t)$). P is the capital value invested to buy cattle for farming and r_1 is the maintenance cost. It is assumed that the density of the carriers follow the logistic model with intrinsic growth rate r_2. The carrying capacity of carrier population is K_2. In this paper it is assumed that susceptible cattle are infected by directed contact with infected cattle with contact rate β and also infected by carriers indirectly with contact rate $\lambda_c(t)$ and $\lambda_v(t)$.

Vaccination and chemical control are used to control the disease. The natural death rate of cattle (μ_c) and carriers (μ_v) are considered to be proportional to the density of the cattle and carrier population respectively.The recovery rate r is assumed to be proportional to density of the cattle population. It is

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considered that the disease-related mortality rate, δ_c, is proportionate to the density of affected cattle,(i.e, $\delta_c I_c$).We have vaccinated susceptible cattle at the rate k in our model. σ_c and σ_v denote the maximum number of vector bites a cattle can sustain per unit time the number of times a vector would bite a cattle per unit time. p_{cv} and p_{vc} is the probability of pathogens transmission from infected vector to susceptible vector and probability of pathogens transmission from infected cattle to susceptible cattle respectively. By using the above consideration, the mathematical model is proposed by the following system of differential equations:

$$\begin{aligned}
\frac{dS_c}{dt} &= PN_c(1-\frac{r_1}{P}N_c) - \lambda_c(t)S_c - \beta S_c I_c - kS_c + rI_c - \mu_c S_c \\
\frac{dV_c}{dt} &= kS_c - \lambda_c(t)V_c - \mu_c V_c \\
\frac{dI_c}{dt} &= \lambda_c(t)(S_c+V_c) + \beta S_c I_c - rI_c - \delta_c I_c - \mu_c I_c \\
\frac{dS_v}{dt} &= r_2 N_v(1-\frac{N_v}{K_2}) - \lambda_v(t)S_v - \mu_v S_v - \tau_c p_c S_v \\
\frac{dI_v}{dt} &= \lambda_v(t)S_v - \mu_v I_v - \tau_c p_c I_v
\end{aligned}$$

where, $\lambda_c(t) = p_{cv}\frac{\sigma_c\sigma_v I_V}{\sigma_c N_c+\sigma_v N_v}$, $\lambda_v(t) = p_{vc}\frac{\sigma_c\sigma_v I_C}{\sigma_c N_c+\sigma_v N_v}$

RESULTS AND DISCUSSION

Arthropods may be important for mechanical transmission, even though contact transmis- sion seems to be ineffective. In our work, cattle infection rates rise with the increase of σ_c and σ_v. Bifurcation analysis of the infected cattle population with respect to control parameters has been shown, and the basic reproduction number with respect to the model parameters has been explained. Our model's findings suggest that the use of strong chem- icals may reduce infection rates in cattle populations even in cases where vaccination is unsuccessful. Numerical results are calculated using MATLAB software.

CONCLUSION

According to this study, immunizing susceptible cattle and employing efficient chemicals to protect cattle from anthropoids can both be very helpful in reducing the spread of disease.

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Oral Presentation – OOP-07

Photoluminescence Spectroscopic and Theoretical Investigations of the Interaction of Flavonoid Naringenin with Functionalized Graphene

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INTRODUCTION

Flavonoids are a group of natural polyphenolic compounds showing various pharmacological properties, such as antioxidant, anti-inflammatory, and anticancer activities.[1] Naringenin is one of the most well-known flavonoids, which has been a subject of considerable interest owing to its biological significance and potential application in drug delivery and pharmaceutical formulation. On the other hand, functionalized graphene (FG) materials have emerged as a flexible platform for the study of molecular interactions, due to its' outstanding electronic, mechanical, and chemical properties.[2] Thus the interactions between flavonoid naringenin and FG materials must be explored in order to comprehend the mechanisms in a comprehensive manner; which actually control their mutual interactions and hence this investigation could pave the way for the plausible utilization of this system in bio sensing, drug delivery and allied domains. This study utilizes photoluminescence (PL) spectroscopy as a powerful spectroscopic tool aided with theoretical modelling to explore the nature of various interactions present between naringenin and different FG materials with varying attributes.

MATERIALS AND METHODS

Two proprietary functionalized graphene materials, FG-1 and FG-2, were supplied by TerraCarb Private Limited (Coimbatore, India). FG-1 was chemically modified with hydrazine to produce FG-3. Naringenin solutions in ethanol were prepared to study optical interactions with these materials. Characterization techniques included UV-Vis and Photoluminescence (PL) spectroscopy, Scanning Electron Microscopy (SEM), Raman spectroscopy, and Powder X-ray Diffraction (PXRD). Samples containing dispersion of FG materials along with ethanolic solutions of naringenin were used to probe changes in the optical properties of naringenin. Density Functional Theory (DFT) simulations modelled interactions between naringenin and graphene or graphene oxide to elucidate non-covalent interactions. The combination of PL experiments and DFT simulations provided insights into electronic and microstructural characteristics of FG materials, revealing reproducible results across multiple trials and enhancing understanding of interaction mechanisms.

RESULTS AND DISCUSSION

EDAX analysis shows the highest and lowest oxygen content in FG-2 and FG-3 materials respectively. SEM micrographs indicate that in FG-2, flakes are densely stacked and less exfoliated, while in FG-3, flakes are thin and highly exfoliated. Naringenin shows a sharp peak centred around 290 nm in the respective UV-Vis absorption spectra, which eventually remains unaffected while adding FG materials with varying concentrations, evidenced

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the absence of any charge transfer type of interaction between these. PL studies of these samples exhibit two characteristics emission peaks centred around 410 nm and 430 nm respectively; both of which were equal quenched

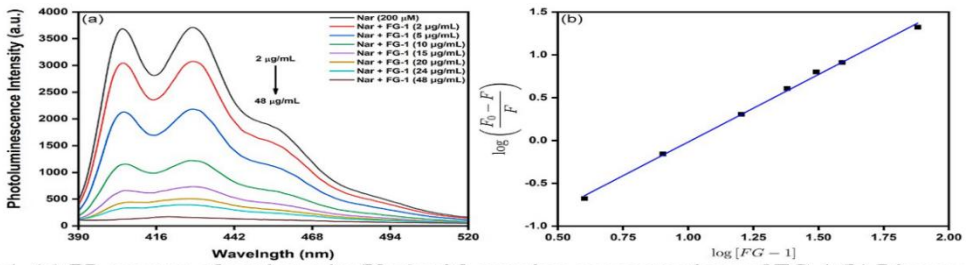

Figure 1. (a) PL spectra of naringenin (Nar) with varying concentrations of FG-1 (b) Linear plot of $\log[{}^{F_0 - F}/_{F}]$ vs log[FG-1] for the interaction of naringenin with FG-1

in the presence of different FG samples.

Binding analysis using the modified Stern–Volmer equation[3] (Eq. 1) reveals thatSS FG-1 (n = 2) promotes naringenin aggregation plaussibly via hydrogen bonding, π-π stacking, or allied van der Waals' interactions, facilitating non-radiative decay and quenching PL intensity. Representative PL spectra of naringenin in presence of FG-1 system and its' respective Stern–Volmer fitting are shown in Figure 1(a) and (b) respectively.DFT modeling and non-covalent interaction analysis (Figure 2) support these findings. Similar trends in PL spectra were also observed for FG-2 and FG-3, highlighting the critical role of oxygen content and flake characteristics in controlling naringenin–FG interactions.

CONCLUSION

This study highlights the interactions between naringenin and FG materials with varying surface functionalities and microstructures, providing insights into nanomaterials-based biological systems. Photoluminescence analysis shows that FG materials with moderate oxygen content enhance naringenin binding and aggregation via non-covalent interactions, quenching PL intensities. In contrast, FG materials with lower oxygen content and higher disorder bind strongly without inducing aggregation. By underscoring the role of surface chemistry and microstructural variation, this work advances the development of graphene-based nanoplatforms for applications in biosensing, drug delivery, and nanobiotechnology.

$$\log\left(\frac{F_0 - F}{F_0}\right) = \log K_{bind} + n \log[\mathrm{FG}] \qquad \text{Eq. 1}$$

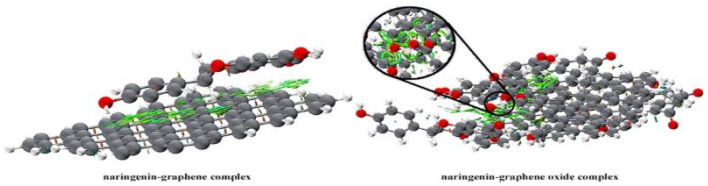

Figure 2. Non-covalent interactions through van der Waals' forces (green) and hydrogen bonding (blue) between ground state geometries of naringenin with model graphene and graphene oxide

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Oral Presentation – OOP-08

Electrical Characteristics of Manganese Doped Yttrium Chromite Nanoparticles

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ABSTRACT

In this work Manganese doped $YCrO_3$ nanoparticles are synthesized by sol-gel method. Experimental samples are characterized by the XRD and TEM measurements. The variation of dielectric permittivity is investigated in the temperature range 303K - 473K and in the frequency span 20 Hz-1 MHz. The temperature variation of dc conductivity is measured which indicates the semiconducting behaviour of the samples. The graphical depiction of current and voltage characteristics conveys non linearity which implies the idea of back to back Schottky diode. It has been observed that barrier height increases and ideality factor decreases for the doped sample with respect to undoped sample. The value of ideality factor is large due to recombination current and high leakage current.

INTRODUCTION

Nanostructured materials have significant applications in electronic devices [1] due to their unique physical properties, resulting from their large surface-to-volume ratio. Multiferroic materials, exhibiting ferroelectricity and ferromagnetism, are crucial for optoelectronic devices like memory- controllable devices. Rare earth chromites ($RCrO_3$), such as $YCrO_3$, crystallize in a distorted perovskite structure, with ferroelectricity linked to the chromium-oxygen polyhedral surrounding. $YCrO_3$ is particularly useful in high-temperature electrodes, thermistors, and thermoelectrics [2]. This study focuses on the synthesis, characterization, and electrical properties of Manganese-doped Yttrium Chromite nanoparticles, building on Seo et al.'s work on its ferroelectricity [3].

MATERIALS AND METHODS

Manganese doped Yttrium Chromite nanoparticles ($YCr_{1-x}Mn_xO_3$ where x = 0 for pure $YCrO_3$ and x = 0.05 for 5% Manganese doped Yttrium Chromite) are synthesized by sol-gel method. Initially precursor solution is get ready by dissolving weighted amount of Yttrium Nitrate Hexahydrate [$Y(NO_3)_3,6H_2O$], Chromium Nitrate Nonahydrate [$Cr(NO_3)_3,9H_2O$] and Manganese Acetate Tetrahydrate [$(CH_3COO)_2Mn,4H_2O$] in distilled water under constant stirring. Then 20 ml PVA solution is added to the above solution under constant stirring. Next the above solution is evaporated to get dry precursor powder. At last the grinded precursor powder is calcined in air at 800^0C for 1 hour. Here pure $YCrO_3$ is denoted as M0 sample and 5% Manganese doped sample is denoted by M5 sample.

RESULTS AND DISCUSSION

The labelled peaks in the Fig.1b gives different (*hkl*) planes of Yttrium Chromite(JCPDS NO. 34- 0365) which confirms the construction of the nanoparticles. Typical TEM image of M5 sample is shown in figure 1a**.** The particle size calculated is 45 nm**.**

The enhancement of dielectric property is seen for M5 sample with respect to M0 sample. For fixed frequency 1 MHz the temperature variation of real part of dielectric permittivity for M0 and M5 sample is shown in Fig.2

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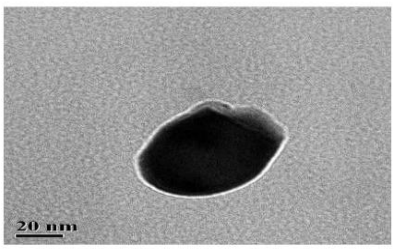

Fig.1a··TEM·image·of·M5·sample

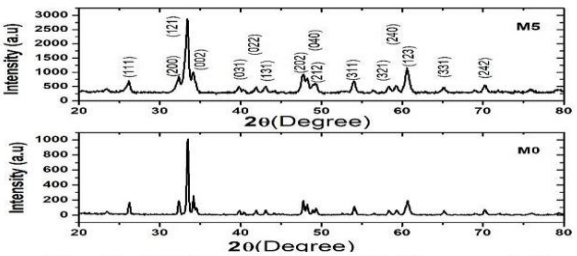

Fig.1b·XRD·of·M0·and·M5·sample¶

Current voltage characteristics (I-V) for M0 and M5 sample is shown in Fig.3. Considering the thermoionic emission model reverse saturation current (I_S) and the value of ideality (n) factor is calculated following equation 1 and 2

$$I = I_S[exp\{q(V - IR)/nkT\} - 1] \quad (1)$$

$$I_S = AA * T^2 \, exp\left(-\frac{q\varphi_b}{kT}\right) \quad (2)$$

Here A is the sample's area, A^* is modified Richardson constant, T is absolute temperature, q is electric charge, R is resistance, φ_b is the barrier height and k is Boltzmann's constant.

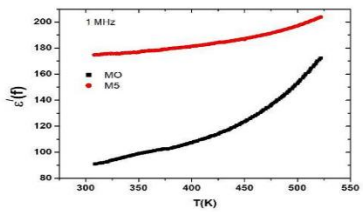

Fig.2 Temperature variation of $\varepsilon'(f)$

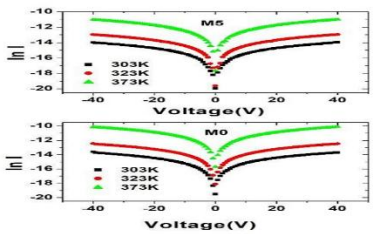

Fig.3 I-V characteristics of M0 and M5 sample

CONCLUSION

Dielectric property enhancement is observed for Manganese doped Yttrium Chromite samples. From the I-V characteristics it is observed that barrier height increases due to doping. The non linearty in I-V curve implies the idea of back to back Schottky diode.

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Oral Presentation – OOP-09

In search of most efficient antibacterial and antifungal Pyrazine derivatives towards future lead drug: an in-silico study

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INTRODUCTION

Pyrazines are used to prepare intermediates of various heterocyclic compounds having therapeutic values. Although having a wide range of antibiotics the growing resistance towards these drugs led us to explore further on the same. Pyrazine and its derivatives are commonly found in cooked foods, especially roasted meat, coffee, and some baked goods, contributing to their flavors and aromas. The pyrazine derivatives were screened from previous literature based on their inhibition activity. Pyrazine derivatives with antifungal and antibacterial activity were determined. They are further optimized to determine their stability and molecular orbital. The binding affinity of ENR to the Pyrazine derivative is also determined by docking. Pyrazine derivatives bind to ENR and inhibit the fatty acid synthesis which is essential for the survival of the bacteria and fungus. The relationship between structure and activity was studied and the prediction model was determined. The molecules were executed in ANN to determine the network followed and gave a good correlation value.

MATERIALS AND METHODS:

The structures were built in GaussView6, and optimized using B3LYP/LANL2DZ level of theory with Gaussian16 software to estimate DFT parameters such as electrophilicity and hardness. The docking study has been performed by AutoDock, which uses a Lamarckian genetic algorithm (GA) in combination with grid-based energy estimation. The protein structures (ENR) and ligands (pyrazinamide derivatives) structures have been modified by Autodock. ProTox-II is an open-source tool for predicting the toxicity of test substances based on their LD50 value and toxicity class. In this study, we assessed the performance of artificial neural networks (ANNs) based on machine learning techniques for predicting values related to Mycobacterium tuberculosis, Escherichia coli Candida tropicalis Saccharomyces cerevisiae.

RESULT AND DISCUSSION

A set of 55 molecules were selected during the primary screening of pyrazine derivatives, it was observed that the selected compounds were reported to have biological activity. The Binding energy obtained from Autodock, as well as Energy and Band gap were obtained after DFT analysis was plotted for each ligand. The regression model was also determined to verify the relation between the ligands. It was found that ligands were not correlated as the R2 values were close to 0.0 with a maximum of 0.1 for hardness. However ANN Analysis showed a good R2 showing the acceptance of the model.

CONCLUSION

The derivatives of pyrazine have shown better activity than pyrazine or the reference drug pyrazinamide. Pyrazinamide is an antibiotic used to treat bacterial infection. Based on the DFT Analysis, PY48 and PY52 showed a good result with

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lower energy along with a good band gap. The docking scores of the molecules were also found to be least, making them suitable lead molecules for bacterial as well as fungal species. However the prediction model showed a fair relationship of the bacterial and fungal strains with Number of Hydrogen bond acceptors. A prediction model was also established using ANN Model.

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Oral Presentation – OOP-10

Sulfamethoxazole-azo-4-hydroxy-benzaldehyde, synthesis, structural characterization and DNA binding study of its .

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ABSTRACT

4-((5-formyl-2-hydroxyphenyl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide (HL) has been characterized by the single crystal X-ray structure and 1D supramolecular chain shows intra-molecular H-bonding, One dimensional assembly of monomeric units of ligand via π---π interaction of benzene rings. The extended network is shown in green dotted lines. This assembly is viewed along the b axisN

INTRODUCTION

4-hydroxhy-benzaldehyde is a fluorescent colorless crystalline solid that is homologues of phenol, but it is more reactive. it has been studied for its potential applications in various fields including medicine, due to its potential anti-diabetic and GABA-T inhibitory effects, and is also a precursor to other compounds like vanillin It is used as intermediate for the fabrication of dyes and other compounds. In order to minimize the side effects of SMX, coupling of sulfamethoxazolyl-di-azonium salt is carried out with 2-naphthol to synthesize 4-((5-formyl-2-hydroxyphenyl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide (HL) which has been used to synthesize 3d transition metal complexes. Azo dyes of sulfa drugs are well known for their antiseptic activity [1-2].

MATERIALS AND METHOD

Sulfamethoxazole (SMX) was purchased from Sigma-Aldrich Chemical Company and used without further purification 4-hydoxy benzaldehyde was purchased from Merck, India. The acetonitrile used for electrochemical studies was dried with CaH_2 and distilled prior to use. The CT DNA was purchased from Sisco Research Laboratories, India, and dissolved in phosphate buffer (pH ~7.4) containing 120 mM NaCl (AR grade, Merck, Germany). The diazotization of sulfamethoxazole (0.5 g, 1.97 mmol) was carried out at 0-5°C in aqueous solution by adding $NaNO_2$ (1.0 g) solution followed by coupling with 4-hydroxy-benzaldehyde (1 g) in presence of sodium carbonate (2.0 g) in water according to a general literature procedure [3]. Red precipitate filtered and dried at room temperature. It was then recrystallized by slow evaporation of hot alcoholic solution and purity was checked by TLC; yield: 83%.

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RESULT AND DISCUSSION

Empirical formula of L7	C17 H14 N4 O5 S
system	Triclinic
Space group	P-1
a(Å)	6.1468(3)
b(Å)	8.5544(4)
c(Å)	16.7347(7)
$\alpha/^{0}$	80.039(3)
β/°	88.658(3)
$\gamma/^{0}$	84.608(3)
$V(Å)^{3}$	862.82(7)
Z	2
θ range	1.24 - 26.68
Total reflections	3626
wR_2^{b}	0.1568
Goodness of fit	1.026

Table 1. Summarized crystal structure of sulfamethoxazole-azo-4-hydroxy-benzaldehyde.

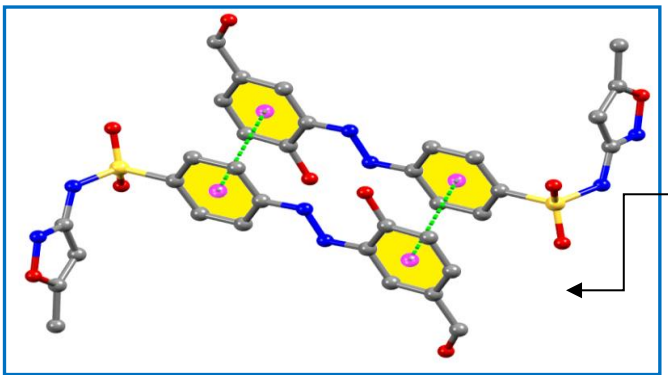

Fig. 1. One dimensional assembly of monomeric units of L7 via π---π interaction of benzene rings. The extended network is shown in green dotted lines. This assembly is viewed along the b axis

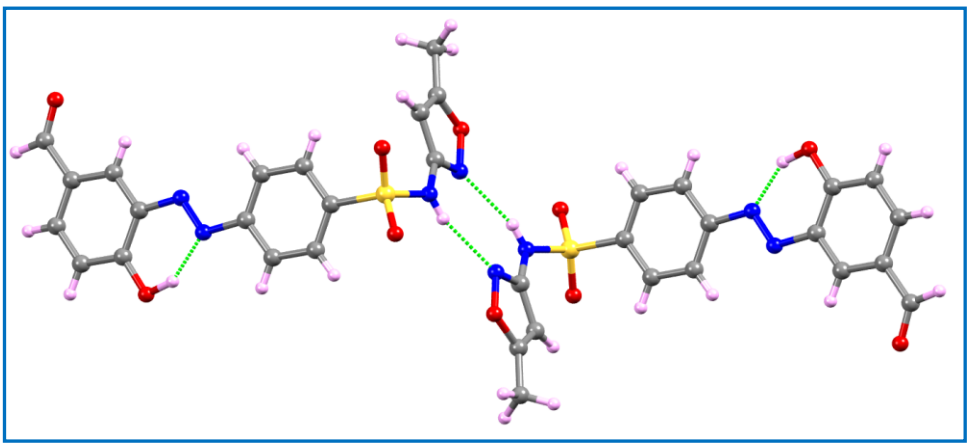

Fig: 2. Formation of 1D tape in ligand through association of inter molecular hydrogen bonding along the b axis. The extended network is shown in green dotted lines. This assembly is viewed along the b axis .

CONCLUSION: Single crystal structure of 4-((5-formyl-2-hydroxyphenyl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide (HL) shows 1d supramolecular structure and confirmed by single crystallographic study.

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Oral Presentation – OOP-11

Zero -Emission, Zero- Budget, Zero-Waste: A Circular Program for Green Energy Generation and Agricultural Productivity Using Solar and Biomass Sources

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INTRODUCTION

Many rural communities rear cows solely for milk, often overlooking the value of cow-based products and waste, leading to the unethical slaughter of non-yielding cows. A circular economy approach repurposes agricultural, livestock, and energy waste into fodder, manure, and panchagavya (fertilizer) using microorganisms. By combining solar energy and cow urine for electricity generation, supported by IoT, blockchain, and cloud computing to monitor cow health and productivity, the system enhances income, soil health, and sustainable agriculture.

Material and Methods

The system uses an ESP8266 microcontroller and IoT sensors to monitor and control animal behavior, soil health, weather, and cow urine output, with solar panels and cow urine electrolysis generating energy. It features a hybrid solar-cow urine system, algae-coated electrodes in microbial fuel cells for improved electricity production, and AI/IoT for tracking energy, cow health, and productivity. Five reactor tanks utilize cow urine and algae for electricity generation, with continuous urine flow enhancing efficiency.

Results and discussion

- Electricity produced from cow urine per cell, for 4 cycles. Below is the data for the four observations

Observation	Time (Hour)	Volume (L)	Voltage (V)	Current (I) mA	Power (P) W
1	24	5	6.00	187	1.122
2	48		5.62	150	0.843
3	96		5.32	112	0.595
4	144		5.16	47	0.242

- Supply of electricity for farmers and domestic use Safeguard cows
    - Expected electricity production for domestic use = 8- 10 units per day
    - Expected electricity production for Agriculture use = 10 - 15 units per day

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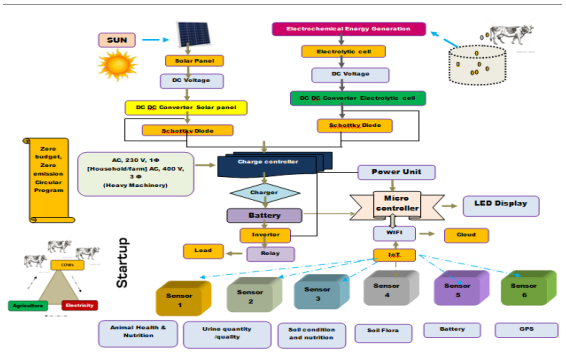
- Potential algae formulations at MFC expected to use cow urine for the below outcome:
- Expected electricity production per liter of urine by MFC = 1.2–2.8 Wh,

- Beneficiaries through solar setup:If we consider 20 solar panels

12KW*20 =240KWh*6 hours *30 days =43200KWh

For domestic purpose: Around 70- 120 households

- For agriculture purpose: Around 20 - 36 farms
- Total number of families benefit per month -Around 150



- Beneficiaries through goshalas [urine to electricity] Total cow =1500

Per month 180 units *1500 cows= 2850 KWh

- For domestic purpose: Around 6 - 8 households
- For agriculture purpose: Around 3-4 farms
- Total number of families benefit per month =Around 14

Conclusion

Backward communities often focus only on milk production, slaughtering non-yielding cows, which is unethical. A circular economy transforms agricultural and livestock waste into fodder, electricity, and value-added dairy products, boosting farmers' income and promoting self-employment..

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Oral Presentation – OOP-12

Multi-component Reactions Involving Barbituric Acid, Urea and Aldehyde in Presence of Yttrium Nitrate with the Biological Efficacy Study of the Products Against Tyrosine-protein kinase: A Combined Experimental and Theoretical aspects

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ABSTRACT

The present study reports a simple Yttrium nitrate-catalyzed, one-pot, three-component reaction pathway to synthesize Biginelli products and some spiro-fused heterocycle compounds from barbituric acid, urea, and aldehyde. The reaction pathway was designed in a green solvent (ethanol: water = 10: 1) medium. The generation of normal Biginelli products or its oxidized form or spiro compound depends upon the reactivity of aldehydes. All of the synthesized products were characterized by spectroscopic methods. A molecular docking study was used to check the efficiency of synthesized compounds against tyrosine-protein kinase (PDB ID: 1AD5). A molecular dynamics study was also performed to check the binding interaction between the most effective synthesized compound (E)-5-styrylpyrimido[4,5-d]pyrimidine-2,4,7(1H,3H,8H)-trione (Q2C) and tyrosine protein kinase. Global reactivity parameters and different electro-chemical parameters were also calculated for the most active compound Q2C. Biological activity of the most active compound Q2C was also predicted through computational analysis with SwissADME.

Keywords: Biginelli reaction, Spirofused-heterocycle, multi-component reaction, Yttrium nitrate, Green catalyst, Molecular Docking.

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Oral Presentation – OOP-13

Phase Analysis, Characterization, Optical Properties of CCTO by Modified Solid State Process

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INTRODUCTION

Calcium copper titanate based ceramics is of great interest as a material having giant dielectric permittivity values. The compound based on ternary oxides is a 1:3 A-site ordered perovskite ($A'A''B_4O_{12}$) with oxygen octahedra strogly tilted while A" site indicates Cu cations which have four fold square-planar coordinations. The high permittivity value may have extrinsic origin. GB effect or the extrinsic giant permittivity is possible due to internal barrier layer capacitor consisting of semiconducting grains and insulating grain boundaries.

MATERIALS AND METHODS

Stoichometric proportion of oxides was taken in dry condition to undergo agate mortar activation for 15 hours. Milled-mixed powders were then made to undergo annealing at 950°C for 24 hours duration to synthesize the powders. XRD confirmed the required phase, SEM morphology indicates morphology while luminescence behavior noted by PL spectra.

RESULTS AND DISCUSSION

XRD indicates formation of Calcium Copper titanate after annealing at 950° for 24 hrs. Peaks are noted to be indexed with JCPDS file number PDF#7752360 having crystallite size estimated using Scherrer's equation to be 25.9nm. No amorphous or non-stoichometric phase is noted. Dislocation density is estimated to be around $1.492*10^{-3}$ nm^{-2} which verified sufficient distortion generating dislocations within the sample.

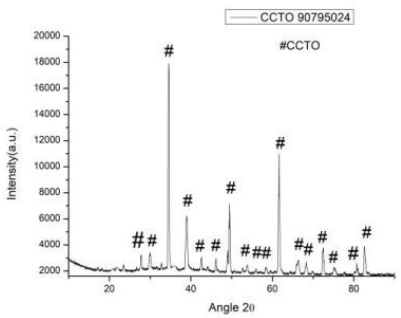

Fig1. XRD pattern of CCTO after annealing at 950°C for 24hrs

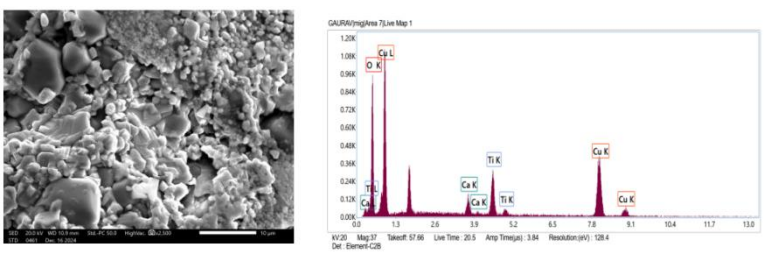

Fig2. SEM microstructure & EDX analysis of CCTO annealed at 950°C for 24 hours

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Microstructure analysis by SEM is observed to be dense packed interlocking with insignificant porosity. Particulates are polygonal, hexagonal in some portion with some serration marks. EDX indicate only the required elements.

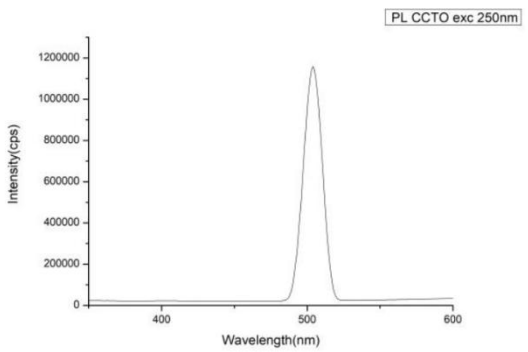

Fig3. PL spectra of CCTO annealed at 950°C for 24 hours

PL spectra observed on dispersed sample executes sharp luminensence peak centred at about 550nm. It indicates luminenscense nature within visible range with tentative band gap roughly estimated to be about 2.26eV corresponding to the PL peak.

CONCLUSIONS

CCTO is formed after agate mortar activation followed by annealing at 950°C for 24 hours duration having estimated crystallite size to be about 25.9nm, while dislocation density around $1.492*10^{-3}$ nm^{-2}. SEM microstructure reveals dense packed interlocking structure, negilgible porosity while individual particulates hexagonal, polygonal with serrations. EDX confirms presence of required elements for the phase development. PL spectra exhibits sharp intense luminenscence in the visible region.

ACKNOWLEDGMENT

Author would like to express thanks to UGC-DAE-CSR, Kolkata centre, School of Materials Science & Nano Technology, Jadavpur University for providing characterization facilities.

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Oral Presentation – OOP-14

Mechano-Chemical Activation to Synthesize $CuAlO_2$: Phase Analysis, Structural and Optical Propertie

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INTRODUCTION

The development of high quality $CuAlO_2$ through ball-milling has opened new avenues for its application in advanced optoelectronic devices. $CuAlO_2$, recognized for its p-type conductivity and delafossite structure, possesses a wide direct bandgap [1-2], making it an excellent candidate for UV light-emitting diodes (LEDs) and photodetectors [3]. Traditional synthesis methods, such as solid-state-reactions, often demand high temperatures and extended processing times, which can be inefficient and costly [4-5]. The ball-milling technique presents a viable alternative, offering a streamlined approach to achieving high crystallinity and phase purity in shorter timeframe. This research aims to provide a comprehensive characterization of $CuAlO_2$ synthesized via ball-milling, employing various techniques including X-ray diffraction (XRD), Fourier Transform Infrared spectroscopy (FTIR), Ultraviolet-Visible (UV-Vis) spectroscopy and photoluminescence (PL) spectroscopy measurements. Through this multifaceted approach, we aim to elucidate the structural and optical properties of $CuAlO_2$, highlighting its potential for integration into nextgeneration electronic and optoelectronic applications.

MATERIALS AND METHODS

High energy ball milling assisted mechanochemical process was adopted to synthesize $CuAlO_2$ with a 10:1 ball-to-sample ratio. High purity (99%) constituent oxides of CuO and Al_2O_3 were mixed in 1:1 molar ratio by a milling process, which was carried out in a FRITSCH pulverisette ball mill for 70 hrs at 370 rpm in acetone media. Milled mixed powder was heated up to 1200 °C in air for 6 hours for phase development.

RESULTS AND DISCUSSION

Phase analysis from XRD (PANalytical X-ray diffractometer) and bonding information from FTIR analysis provide a comprehensive understanding of the synthesized $CuAlO_2$. The XRD pattern (Fig 1.) confirms the high crystallinity and phase purity of the material, while FTIR spectra (Fig 2.) validate the presence of Cu-O and Al-O bonds around 589, 689 cm^{-1} and 882 cm^{-1} respectively, which are essential for $CuAlO_2$ formation.

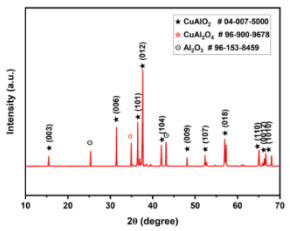

Fig1. XRD pattern of $CuAlO_2$ after sintering at 1200°C for 6hrs

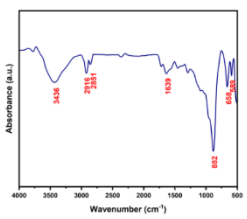

Fig2. FTIR of sintered $CuAlO_2$ at 1200°C

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The UV-VIS absorption spectrum as shown in Fig 3 indicates a direct band gap of 3.7eV, aligning with the expected properties of $CuAlO_2$ and highlighting its potential for optoelectronic applications. The PL spectral as shown in Fig.4, shows a significant emission peak centered at 433 nm, corresponding to the blue region of the visible spectrum, underscore the high optical quality and efficiency of the material, suggesting its suitability for applications in UV LEDs and photodetectors.

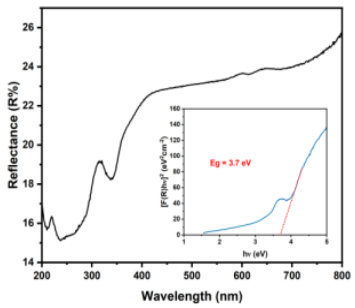

Fig 3. Diffuse-Reflectance UV-visible absorption spectrum of the synthesized powder $CuAlO_2$.

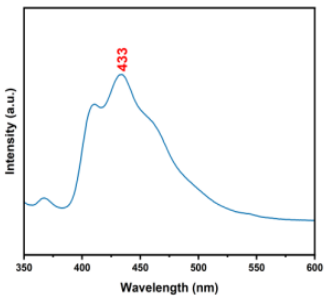

Fig4. Photoluminescence spectra of $CuAlO_2$ sintered at 1200°C for 6 hours respectively

CONCLUSIONS

The ball-milling synthesis of $CuAlO_2$ has proven effective, yielding high-crystallinity and phase-pure delafossite. XRD confirmed the structural integrity, while FTIR validated the presence of essential Cu-O and Al-O bonds. The UV-Vis analysis revealed a direct band gap of 3.7eV, suitable for optoelectronic applications, and PL spectroscopy exhibited strong blue emission at 433 nm, indicating high optical quality. These findings underscore the material's potential for integration into advanced UV LEDs, photodetectors, and other optoelectronic devices.

ACKNOWLEDGMENT

Authors would like to express thanks to Materials Science Centre, IIT Kharagpur, School of Materials Science & Nano Technology, Jadavpur University for providing characterization facilities.

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Oral Presentation – OOP-15

Adhesive Bonding Mechanisms and Their Applications In Modern Material

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ABSTRACT

The present study highlights significant trends and future directions in adhesive bonding technologies by integrating recent research findings and industrial experiences. The goal is to cultivate an awareness of how innovative adhesive solutions can satisfy the increasing demands for efficiency, sustainability, and performance in material assemblies. Adhesive bonding is an essential technology across multiple industries, providing benefits in material assembly. Recent improvements in adhesive bonding technology, especially within the automotive, aerospace, and electronics sectors, have resulted in creative applications [1]. The research investigates the fundamental concepts behind adhesive mechanisms, encompassing intermolecular forces, surface energy dynamics, and cure processes, to comprehend binding strength and endurance [2]. Innovative adhesive formulations, such as bio-based and nanocomposite adhesives, are analyzed for their contributions to performance enhancement and environmental sustainability [3-4]. The future of adhesives is shaped by rigorous environmental regulations, and progress in chemistry will be crucial for comprehending and mitigating the environmental impacts of plastics. This article assesses adhesive bonding technology across multiple automotive, aerospace, and electronics industries. It analyses the chemical composition, functional properties, and application requirements of adhesives. Experimental techniques, including temperature fluctuations and moisture exposure, assess bond longevity and resilience. Surface preparation techniques such as plasma treatment and mechanical abrasion are examined for enhanced adhesion strength. Innovative adhesive compositions, such as bio-based and nanocomposite types, are investigated for improved performance and ecological sustainability. This review synthesizes contemporary research and practical applications Adhesive bonding has garnered considerable attention across multiple industries owing to its advantages over traditional approaches. Nonetheless, the impact strength of adhesive joints may deteriorate considerably under harsh conditions, prompting questions regarding their long-term reliability. The investigation of bio-based and nanocomposite adhesives signifies a notable transition towards environmental sustainability in adhesive technology. Nanocomposites can improve the water resistance and mechanical properties of environmentally friendly adhesives by including nanoparticles [5]. The 3D printing of composites represents a significant advancement in additive manufacturing technology, enabling the customization of adhesives for intricate geometries and particular applications. Surface preparation methods are essential for the construction of hybrid structures composed

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of metals and composites. Surface treatments for aluminium alloys are increasingly utilized in sectors such as aerospace, automotive, and manufacturing to improve interlaminar strength and resistance to galvanic corrosion [6].
The commercialization of environmentally friendly alternatives encounters challenges related to cost-effectiveness and performance equivalence with conventional adhesives. The shift from laboratory advances to industrial applications is replete with obstacles. The equilibrium between compliance and upholding performance requirements is intricate and necessitates cooperative endeavours throughout the sector. Adhesive bonding technology has shown promise in the aerospace sector, although its utilization is limited by intrinsic constraints. ABJs have gained popularity because to their benefits and potential for lightweight and durable construction of composite components. Utilizing bonded connections devoid of supplementary fasteners poses challenges, such as fiber fracture and stress concentrations. Initiatives such as the COST project CERTBOND seek to address these difficulties. The research highlights the significance of adhesive bonding technology across multiple sectors, such as automotive, aerospace, and construction. These technologies enable lightweight composite structures, improve fatigue resistance, and are economically viable. As industries emphasize sustainability, the development of eco-friendly and high-performance adhesive formulations is essential. Environmental variables such as temperature variations, moisture uptake, aging, and fatigue influence adhesive joint efficacy, underscoring the necessity for innovation. Collaborative research is essential for tackling obstacles and capitalizing on new opportunities in structural applications. Subsequent study ought to concentrate on elucidating aging mechanisms, thermal properties, and sophisticated surface preparation methods to enhance adhesive efficacy [7].

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Oral Presentation – OOP-16

Impact of Solute (Arsenic) Migration in Bengal Basin: Pulse Type Simulation

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ABSTRACT

This study explored the migration of groundwater contamination especially arsenic in Bengal Basin (Semi-infinite aquifer). The aquifer is taken as heterogeneous and isotropic. a sensitive pulse type sinusoidal form of input source is deployed at the inlet boundary, while no flux flow is taken at the outlet boundary.

Introduction.

World health organization reported that over 140 million in more than seventy countries exposed by arsenic (exceeds 10 µg/L). Among this, largest affected area is Bengal delta (West Bengal-Bangladesh).

Mathematical Formulation of the Transport model.

Our proposed 2D model is governed by Fick's law of diffusion and conservative of solute mass as follows

$$\omega\frac{\partial c}{\partial t}=\frac{\partial}{\partial x}\left(D_x\frac{\partial c}{\partial x}+D_{xy}\frac{\partial c}{\partial y}-u_x c\right)+\frac{\partial}{\partial y}\left(D_y\frac{\partial c}{\partial y}+D_{yx}\frac{\partial c}{\partial x}-v_y c\right)+\sum R_k \qquad (1)$$

Where the physically reaction term can be expressed as

$$R_1=-\frac{\rho}{\phi}\frac{ds}{dt}-\lambda\left(c+\frac{\rho}{\phi}s\right)\quad,\quad R_2=\gamma\ ,\ \frac{\partial c}{\partial t}=-\lambda c \qquad (2)$$

R_1 is negative as the sorbed mass of compound increases the dissolved mass decreases. λ is decay constant (- negative sign taken because loss of mass)

$$\omega\frac{\partial c}{\partial t}=\frac{\partial}{\partial x}\left(D_x\frac{\partial c}{\partial x}+D_{xy}\frac{\partial c}{\partial y}-u_x c\right)+\frac{\partial}{\partial y}\left(D_y\frac{\partial c}{\partial y}+D_{yx}\frac{\partial c}{\partial x}-v_y c\right)-\frac{\rho}{\phi}\frac{ds}{dt}-\lambda\left(c+\frac{\rho}{\phi}s\right)+\gamma$$

Both from industrial and domestic site, the unmanaged disposal of garbage like as chemical, sewage continuously leached into the water body, that can be mathematically expressed as

$$c(x,y,t)=c_1+c_2\left[(1+px)(1+qx)\sqrt{\frac{D_{y0}}{D_{x0}}}\right]^{-\gamma}\quad x\geq 0, y\geq 0, t=0 \qquad (3)$$

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Pulse type input source is more realistic because some industrial firms have dumped their waste at an unauthorized place for their negligence or lack of infrastructure or no proper caution of effluent managing authority, this phenomenon expressed mathematically as

$$c(x,y,t)=\left|\begin{matrix} c_0\left[1+\sin\left(kt\right)\right] & , \; 0<t\le t_0 \\ 0 & , \quad t>t_0 \end{matrix}\right\}; x=0, y=0; \tag{4}$$

Also, the solute flux across the outlet boundaries is considered as zero, which can be expressed mathematically as

$$\left.\begin{aligned} \frac{\partial c}{\partial x}=0; x\to\infty, y\ge 0, t>0 \\ \frac{\partial c}{\partial y}=0, y\to\infty, x\ge 0, t>0 \end{aligned}\right\} \tag{5}$$

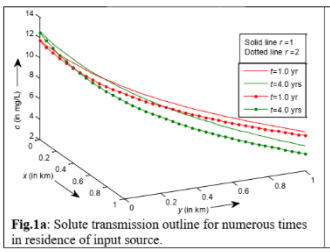

Fig.1a: Solute transmission outline for numerous times in residence of input source.

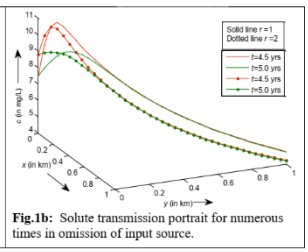

Fig.1b: Solute transmission portrait for numerous times in omission of input source.

Result and discussion.

Input source exists up to t0 = 4 years and then eliminated forever. The colored star line curve represents the solute profile for r = 2 and solid line for r = 1. All the figure indicates that a minor change of the associated parameters reveals a noteworthy change in the solute profile in the domain. The average porosity □ is taken as 0.32 for gravel, 0.37 for sand, and 0.55 for clay medium

Table 1a, In presence of input source for different value of *t*

Para meter	Position (0.0 km)	Position (0.2 km)	Position (0.4 km)	Position (0.6km)	Position (0.8km)	Position (1.0 km)	Rehabilitation Concentration Position(km)	Rehabilitation Concentration Value(μg/L)
1	2	3	4	5	6	7	8	9
$t=1.0$	11.76	9.1	7.627	6.75	6.203	5.853		
$t=4.0$	12.58	9.209	7.188	5.901	5.054	4.486		
$t=1.0$	11.70	8.478	6.959	6.171	5.731	5.472		
$t=4.0$	12.49	8.19	6.007	4.814	4.132	3.731		

Table1b, In absence of input source for different value of *t*

Para meter	Position (0.0 km)	Position (0.2 km)	Position (0.4 km)	Position (0.6km)	Position (0.8km)	Position (1.0 km)	Peak Concentration Position(km)	Peak Concentration Value(μg/L)
1	2	3	4	5	6	7	8	9
$t=4.5$	7.46	9.251	7.242	6.028	5.264	4.773	0.075,	10.89
$t=5.0$	7.46	8.969	7.23	6.006	5.233	4.737	0.125.	9.201
$t=4.5$	8.817	8.424	6.311	5.205	4.593	4.242	0.05.	10.57
$t=5.0$	8.817	8.23	6.287	5.171	4.552	4.197	0.075	9.065

Fig. 1(a) depicts the solute migration for different time in presence and absence of input source respectively in the gravel medium. Which are distinguished with the help of different colorful solid and dotted curves. The solute level for time t = 1year and t = 4years is depicted by the solid orange and green line curve for r = 1and same for the dotted curves for r = 2 . for both input of time, concentration level is higher for lower input r = 1 compared to r = 2 throughout the study domain. The solute concentration level attenuates more rapidly for r = 2 than r = 1.Fig. 1(b) depicts the change in solute level in absence of input source for different time. It illustrated that solute level start from the source end i.e.,(x y = = 0, 0) is7.46 μg/L and 7.472 μg/L for r = 1at time 4.5 years and 5.0 years and same 8.801 μg/L and 8.817 μg/L r = 2 ,which is represented by colored solid and dotted curves respectively. This is due to the combined effect existence of some already entered input source and continuous
background source, it moves to its peak for shorter time t = 4.5 years, which is 10.89 μg/L. It shows that the highest peak is attained for r = 1 at time t = 4.5years rather than r = 2 .

Conclusion.

The solute strength in groundwater is quite low for gravel medium as compared to clay and sand medium for all the cases. So, groundwater available in gravel medium is desirable for numerous agricultural and domestic purpose rather than sand and clay medium. The sensitivity of various geological parameters has been obtained for solute dispersion in gravel medium. The solute (Arsenic) concentration is increased with time and decreases with space. Its strength attains a higher level with the lower amount of density as compared to higher in gravel medium. The decreasing tendency of solute profile with space and time may help to assess the harmless solute level in the aquifer.

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Oral Presentation – OOP-17

Transforming Learning in AI for Energy Systems: A Knowledge-Cognition-Application Paradigm with SDGs

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INTRODUCTION

This paper presents a 3D Teaching-Learning Framework for AI applications in renewable energy, aligned with Sustainable Development Goals (SDGs). While renewable energy is vital for combating climate change and supporting sustainable growth, challenges like intermittent generation and integration complexities remain [1][2]. The Knowledge-Cognition-Application (KCA) paradigm tackles these challenges by providing learners with theoretical knowledge, critical thinking, and practical skills. Its implementation involves aligning Course Outcomes (CO) and Program Outcomes (POs) with educational and industry needs, ensuring relevance and applicability

MATERIALS AND METHODS

2.1 Development of the 3D Teaching-Learning Framework: Knowledge Domain: Provides foundational understanding of AI methodologies and renewable energy concepts, such as solar and wind technologies. Example: Solar radiation prediction using support vector regression models [3]. Cognitive Domain: Fosters problem-solving skills through tasks like energy demand forecasting. Example: Deep learning models for wind energy generation prediction [4]. Application Domain: Focuses on real-world implementations, enabling learners to apply AI in energy optimization. Example: Optimizing grid integration using reinforcement learning [5]

2.2 Mapping CO and POs:

The CO-PO mapping ensures the alignment of the 3D Teaching-Learning Framework with academic and industry requirements enabling learners to address real-world energy challenges effectively.

CO: Demonstrate understanding of AI algorithms and their application in renewable energy systems.

PO 1: Applying AI principles to optimize renewable systems. PO 3: Designing innovative solutions for energy challenges. PO 7: Promoting environmental sustainability in energy solutions. PO 12: Emphasizing lifelong learning and the adoption of advanced AI tools.*

RESULTS AND DISCUSSION

The 3D framework enhances learning outcomes across knowledge, cognitive, and application domains.

Knowledge Domain:

 Improved theoretical understanding (30-50% increase in assessments) [6].

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 Higher enrollment in AI energy courses [7].

Cognitive Domain:

 Innovative solutions during hackathons (3-5 prototypes/event) [8].

 Increased confidence (40%) in addressing energy challenges [9].

Application Domain:

 Functional prototypes for energy forecasting (2-3 models/semester) [10].

 Reduction in prediction errors (MAPE from 15% to 7%) [11].

Integration with SDGs:

 Supports SDG 7 by promoting renewable energy education.

 Addresses SDG 13 through practical climate action solutions

Table 1. Assessment Results

Domain	Metrics	Expected Outcome	Reference
Knowledge	Pre/post assessments	30-50% improvement	[6]
	Enrollment in AI energy courses	Increased participation	[7]
Cognitive	Innovative prototypes	3-5 feasible solutions per event	[8]
	Confidence surveys	40% increase	[9]
Application	Predictive models developed	2-3 functional models/semester	[10]
	Reduced error rates	MAPE reduced from 15% to 7%	[11]
	IoT-integrated solutions deployed	Optimized renewable energy systems	[12]

CONCLUSION

The 3D Teaching-Learning Framework integrates Knowledge, Cognition, and Application to enhance learning in AI-driven renewable energy systems. Its alignment with CO, POs, and SDGs ensures practical and theoretical impacts. Future work will refine the framework for broader applications.*

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Oral Presentation – OOP-18

NANO Zno Induced PVC for Mechanical Property Modification

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INTRODUCTION

PVC is a common commodity plastic with poor impact strength and challenging processability. Impact modifiers and processing aids, which can be either polymeric or non-polymeric modifiers, have helped to mitigate these issues to some extent. The drawback of using a non- polymeric modifier is that it alters one polymer property at the expense of another. PVC nano composites have garnered a lot of attention due to their versatility and value in challenging environmental applications. New functionalities are produced by adding functional nanoparticles to polymers, providing a practical means of boosting performance. The final polymer nano composites are the result of the cooperation of the reinforcing phase and the polymer matrix. The current study makes use of this concept by adding nano zinc oxide (ZnO) to a polyvinyl chloride matrix [1].

PVC needs better qualities in regards to a number of environmental issues because it is frequently used outside. These restrictions might be lessened with the use of nanofiller. The addition of nano ZnO to PVC in this study is equivalent to a blended system where strength parameters like modulus with ultimate tensile strength are improved without significantly reducing toughness and elongation at break, as compared to the basis material, which is unmodified PVC [2]. The objective of this study is to boost PVC's modulus and ultimate tensile strength for enhanced environmental resistance in light of this fundamental knowledge. In order to evaluate the dynamics of the blended system over a range of additional nanofiller, nano ZnO is added in different proportions.

MATERIALS AND METHODS

An air tight dry blender was used to mix PVC resin (100 parts by weight) with 30 parts by volume of dioctyl phthalate plasticizer (DOP),along with 2 parts of tribasic lead sulphate (TBLS) as heat stabilizer. Nano ZnO was added to the powdery mass in 3, 6, 9, 12 and 15 parts by weight to form separate batches and the mix was thoroughly blended. The prepared batches were then compression moulded separately under heat and pressure in a compression moulding machine to form sheets for testing.

The mixed powder was placed in the mould of dimension 0.95 m x 0.65 m x 0.001 m and was heated at a temperature of 160ºC and 15 tons/cm^2 pressure for 5 minutes. Henceforth, the temperature of the mould was reduced to 100^{0}C and retained for 30 min for widespread nanomaterial dispersion. Consequently, the moulded sheet was ejected at room temperature [3].

RESULTS AND DISCUSSION

The incorporation of nano zinc oxide in PVC results in the mechanical property modification of the polymer which is explicit from the modulus, ultimate tensile strength, elongation at break and toughness parameters. The modulus and ultimate tensile strength exhibit a steady rise on raising the dose of nano ZnO from 3 to 15 phr. The rise may be attributed to the nanofiller reinforcement due to the nano sized particles and dispersion. The presence of nano ZnO can promote better alignment of the polymer chains or improve the crystallinity of the PVC material.

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A more organized polymer structure typically results in better mechanical performance, including an increase in tensile strength. The rise in ultimate tensile strength is depicted in Figure 1

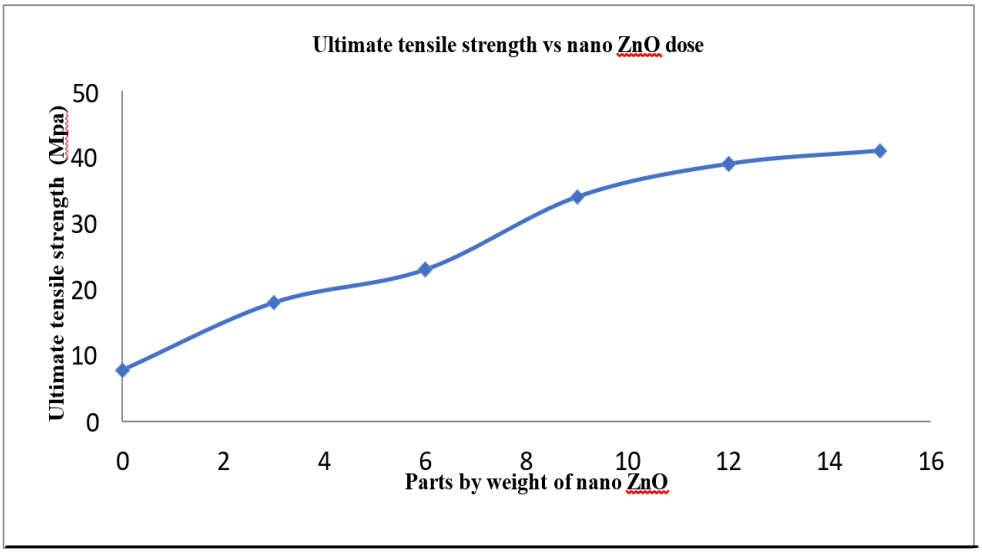

Figure 1: Variation of Ultimate Tensile Strength with nano ZnO dose

The rise in the tensile parameters is associated with a consequent reduction in the flexibility parameters of elongation at break and toughness. However, the reduction is significantly marginal and it is well compensated for by the introduction of zinc oxide. It is evident that PVC is typically plasticized by nano ZnO to improve its flexibility.

CONCLUSION

The incorporation of nano ZnO into PVC typically results in improved modulus and ultimate tensile strength corroborated with marginal decrease in elongation at break and toughness. The strength parameters typically undergo an enhancement with increase in the dose of the nanofiller nano zinc oxide. So, the dynamics of nanofiller incorporation is explicit in the present study making PVC a promising material suitable for significant applications.

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Oral Presentation – OOP-19

Structural Transformation through Photochemical [2+2] Cycloaddition of Metal Organic Coordination Compounds Impact the Electrical Conductivity

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ABSTRACT

The structural architecture of crystalline compounds plays a pivotal role in its function. Therefore, alteration in the molecular construction can change electrical properties of the compounds. In the current discussion, we are considering two coordination compounds based on photo-reactive ligands. Under the introduction of light the structural transformation has taken place and electrical conductivity of the fabricated devices has changed remarkably.

INTRODUCTION

In this current scenario, generation conducting materials is a real challenge. The proper stability and activity need to optimize in a suitable manner. To achieve the appropriate green synthetic method solid-state photochemical reactions received considerable attention in the field of material sciences. This actually corresponds to the participation of a solvent-less synthetic method and the generation of materials that may otherwise be challenging to obtain by a conventional route. Among various solid-state reactions, photochemical [2+2]-cycloaddition, in which a cyclobutane ring, is generated in the photoactive olefinic organic ligand of coordination compounds. In the present discussion, two different compounds have been obtained which can undergo a [2+2] cycloaddition reaction in the presence of light. Here we are discussing two of our published compounds[1,2] with the photo-active phenomenon and also the changing of electrical property with the modifications of secondary interactions.

MATERIALS AND METHODS

The compounds are already reported by us;[1,2] in this aspect the structural units and solvents were collected from TCI chemicals and Sigma-Aldrich and used as collected.

RESULTS AND DISCUSSION

A systematic and comparison study has been performed to make an initial concluding remark regarding our two published works[1,2] with above title. First case, a metal−organic compound [Cd-(quin)$_2$(4-nvp)$_2$] [**1**; Hquin = quinoline-2-carboxylic acid and 4-nvp = 4-(1-naphthylvinyl)pyridine] undergoes topochemical [2 + 2] cycloaddition by sunlight irradiation to generate a one-dimensional coordination polymer. Remarkably, this structural modification has been accompanied by switching of the electrical conductivity between the monomer and polymeric compounds.[1] In the another case, the same 4- nvp ligands has been aligned in head-to-tail fashion in a one-dimensional (1D) double chain ladder polymer [Cd(adc)(4-nvp)$_2$(H_2O)]$_n$ (**2**; H_2adc = acetylenedicarboxylic acid) that undergoes a photochemical [2 + 2] cycloaddition reaction with structural transformation from a 1D chain to a 2D layer structure and changing of electrical property.[2] The study revealed that structural changes have a substantial impact on the conductivity. The secondary π···π interactions among the aromatic system played a pivotal role in the alteration of conductivity.

CONCLUSION

This result suggested that the structural modifications can act as the pivotal role in the material property. The changing of π···π interaction distances upon light irradiation and hence structural transformation altered the electrical property.

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Oral Presentation – OOP-20

Synthesis and Characterization of a Zn(II)-Based 2D Coordination Polymer for Schottky Diode Device Fabrication

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ABSTRACT

Using two distinct bridging ligands, 4,4′-Dipyridylsulphide (4,4′-DPS) and 5-Nitroisophthalic acid (5-H2NIA), we have prepared a hetero-bridging Zn (II)-coordination polymer{[Zn(4,4′- DPS)2(5-HNIA)2(H2O)]n} (Zn-CP) and characterized the crystalline compound with Single Crystal X-ray diffraction (SCXRD) technique. Through a variety of non-covalent interactions, a 2D network self-assembles to produce a 3D supramolecular structure. Hirshfeld surface analysis ia carried out to understand the possibilities of non-covalent interactions present in Zn-CP. Density functional theory (DFT) based numerical calculation using crystallographic parameters has estimated the band gap 3.51 eV Which the value is closer to the experimental value (3.71 eV) indicating the semiconducting nature of Zn-CP. The Zn-CP shows good electrical conductivity (8.54 x 10–7 S m-1) at room temperature.

INTRODUCTION

In recent years, metal organic frameworks (MOFs) and co-ordination polymers (CPs) are utilized to fabricate active electronic devices. [1-2] In order to produce the difference in polarity on the surface of such systems, mixed ligand-based CPs are purposefully made so that one of the components is electron rich and the other is electron deficient. In that way, the redox inefficiency of metal nodes may be ignored. Despite being redox inactive, Zn-based coordination systems are typically quite stable and capable of forming long-range crystalline systems. The Zn (II) metal center is capable of designing a wide range of regulated dimensional coordination polymeric systems in the varied coordination atmosphere. Keeping in mind all these facts, we carefully chose electron-rich 4,4' diphyridyl sulphide (4,4′-DPS) and electron-deficient 5-nitroisophthalic acid (5- H2NIA) ligand systems to co-ordinate with Zn(II) centre and successfully built 2D CP having outstanding crystallinity [3]. SCXRD is used to structurally analyze well-diffracted single crystals, while PXRD is used to confirm the phase purity of the bulk materials. TGA and UV-Vis spectroscopic study are used to support thermal consistency and electronic nature of CP, respectively. It is interesting to note that this material exhibits electrical conductivity at room temperature and in dark conditions when used to manufacture Schottky interface electronic devices. The Schottky character of the metal-semiconductor contact is confirmed by the non-linear rectifying nature of current-voltage. The Zn-CP displays optical band gap 3.71 eV within semiconducting region and exhibits high electrical conductivity (8.54 x 10–7 S m-1) at ambient temperature.

MATERIALS AND METHODS

A solution of 4,4′-DPS (0.036 g, 0.2 mmol) in Methanol (2 mL) was slowly and carefully layered onto a solution of Zn(NO3)2 ·6H2O (0.060 g, 0.2 mmol) in H2O (2 mL) using DMF and MeOH (2 mL, 1:1 (v/v)) mixture as buffer followed by layering of 5-H2NIA (0.042 g, 0.2 mmol) neutralized with Et3N (0.042 g, 0.4 mmol) in ethanol (2 mL). Then the whole solution was kept undisturbed for a week. The yellowish white, block-shaped crystals of {[Zn(4,4′-DPS)2(5- HNIA)2(H2O)]n} (Zn-CP) were obtained after a week.

RESULTS AND DISCUSSION

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The crystal belongs to monoclinic crystal system with space group P 21/c and Z = 4 ; Dx = 1.482 g.cm-3 , according to X-ray crystallographic data analysis. The distorted pentagonal bipyramidal geometry of the architecture is represented by the ZnO3N2 unit (Fig. 1(a)), where 5- nitroisopthalate ion (5-HNIA-) acts as monoanionic carboxylate-O bridging agent; one water molecule coordinates and Pyridyl-N of two 4,4′-Dipyridylsulphide (4,4′-DPS) bridges Zn (II). The two ligands function as a two-dimensional network to construct a 2D rectangle framework

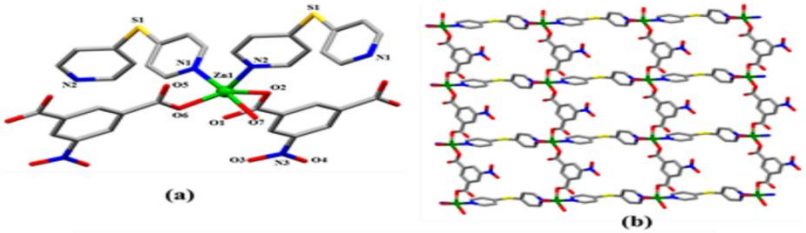

Fig. 1. (a) Coordination environment around Zn(II)-metal of Zn-CP; (b) view of a section of 2D framework constructed through repeated coordination of 4.4'-DPS and 5-HNIA.

(Fig. 1(b))

The geometry of Zn-CP is optimized by DFT computation method by using Single crystal X-ray diffraction coordinates. In DFT computation, a discrete molecular synthon is considered. The energy of frontier molecular orbitals (FMOs) is calculated and the energy gap, (ELUMO (-3.68 eV) – EHOMO (-7.19 eV)) is 3.51 eV and the value is closer to the experimental value (3.71 eV). The Zn- CP displays optical band gap 3.71 eV within semiconducting region and insists for studying the Schottky diode behaviour. The Zn-CP demonstrates good electrical conductivity at room temperature with the value of 8.54 x 10^{-7} S m^{-1}. The DC activation energy of the device is found to be 9.05 × 10^{-19} eV with the conductivity limit 4.71 $(\Omega\text{-m})^{-1}$ having Richardson constant value of 7.07 × 10^{-10} Am^{-2} K^{-2} which suggest this Zn-CP can be categorized as an n-type material. The temperature-dependent barrier height indicates that the MS-junction has a non-uniform barrier height distribution at 0.87 eV. The device also exhibits good ideality factor of 2.64 and reasonably low series resistance with values of 991 kΩ.

CONCLUSION

In summary, a Zn (II)-coordinated 2D CP using 4,4'-Dipyridylsulphide and 5-Nitroisophthalic acid is structurally characterized. The purity of crystal is confirmed by the PXRD of the as-prepared Zn- CP, which likewise matches the simulated spectrum quite well. At room temperature, the Zn-CP displays good electrical conductivity with the value of 8.54 x 10^{-7} S m^{-1}. In light of technological considerations in this period of rising energy consumption, the new study may offer a simple route for laboratory-to-land use of such energy materials.

ACKNOWLEDGMENT

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Oral Presentation – OOP-21

Green Route Synthesis of PVA-Cellulose Nanocomposites: Sustainable and Eco-Friendly Approaches

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INTRODUCTION

In recent years, eco-friendly green composite materials are gaining attention to make the future products safer and free from pollution, environmental and health hazards. Cellulose is a green material that is biodegradable, biocompatible, non-toxic, low cost and abundant in nature Recycling products can bring better environmental protection and sustainable resource use. Hence, cellulose nano fibers are potentially used materials nowadays due to their various applications and superior characteristics in terms of renewability, biodegradability, biocompatibility, high mechanical strength, high elastic modulus, lightweight, low thermal expansion, optical transparency and thermal stability. Nanoparticles, when engineered appropriately, exhibit a variety of unique and tunable physiochemical properties. In the present research work, trials are given to prepared nanocomposites of cellulose-polyvinyl alcohol having various cellulose loading percents using ionic liquid via green route, and to characterize them. A successful attempt has been made to recover the ionic liquid which was later confirmed by 1H-NMR study.

MATERIALS AND METHODS

In the present study pure cotton used as a source of cellulose (reinforcement) has been collected from local market and PVA used as matrix, is a Loba Chemical product. Ionic liquid BMIMCl (1-butyl-3-methyl imidazolium chloride) (Sigma –Aldrich, Product Number: 94128, CAS-No.: 79917-90-1) has been used as the solvent for dissolving cellulose and ethanol (Changshu Yangyuan Chemical product) was used as a non-solvent for PVA.
The dissolution of cellulose was done by using BMIMCl. At first the measured amount of cotton (0.5%, 1.0%, 1.5% cellulose loading) was mixed with BMIMCl, in measured quantity and heated to 100°C temperature in water bath for 5 hours. Viscous gel type solutions were prepared.
Poly vinyl alcohol-cellulose nanocomposites were prepared at different cellulose percent loading (0.5, 1.0 and 1.5 wt.%). At first PVA solutions (5 wt.%) was prepared by dissolving

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0.5 gm of PVA in 10 ml of water at 60°C temperature using magnetic stirrer. Cellulose (cotton) was dissolved in BMIMCl almost in the same ratio for each sample (1:98). Dissolution was done by heating in a water bath for 5hrs at 100°C temperature. The prepared cellulose solution was poured dropwise in the PVA solution with a syringe with continuous stirring. The cellulose got precipitated in the PVA solution as water was a non-solvent for cellulose. The cellulose dispersed solution was then homogenized and sonicated separately for 30mins. Ethanol was then added to the homogenized solution when PVA/cellulose was precipitated (ethanol was a non-solvent for PVA). Then the PVA-Cellulose precipitate was separated by centrifugation and filtration. The precipitate (mainly PVA and cellulose) was mixed with 10ml water and heated to a 60°C temperature to make a solution of poly vinyl alcohol containing dispersed cellulose particles. This PVA/cellulose solution was cast onto Petridis for drying at room temperature to form films. The filtrate obtained in the last experiment was a clear solution, containing BMIMCl, ethanol and water. The filtrate was continuously heated at 55°C temperature until ethanol and water were evaporated out and a yellow-coloured liquid were observed which contained mainly BMIMCl. The recovered BMIMCl was slightly different in colour from the pure ionic liquid.

RESULTS AND DISCUSSION

The PVA-Cellulose nanocomposites, are characterized by X-ray diffraction (XRD) Fourier transform infrared (FTIR), Field emission scanning electron microscopy (FESEM) and Atomic Force Microscopy (AFM) analysis. XRD analysis showed significant changes in the crystalline nature of PVA due to the incorporation of cellulose nanoparticles at different loading percent. Cellulose nanoparticles, having dimension around 7-9 nm are observed to be incorporated in the PVA-Cellulose films under the FESEM. The presence of nano form of cellulose particle is also confirmed by AFM analysis. The interaction of cellulose and PVA is confirmed by FTIR study. The chemical structure of the recovered the ionic liquid has been confirmed by 1H-NMR study.

CONCLUSION

Our main objective of this work was to develop the PVA-Cellulose nanocomposites using by ionic liquid as a solvent for dissolution of cellulose. PVA composite films were prepared by the reinforcing of nanocellulose into a PVA matrix at different cellulose loading percentage. The structures of PVA-Cellulosic nanocomposites have been discussed. From the AFM and FESEM analysis we also confirmed generation of cellulose nano particle into the PVA matrix. XRD result showed that the incorporation of cellulose nano fibers changes the crystallinity of PVA matrix. FTIR result showed that the interaction of O-H bonding is take place into the PVA composite films. And also, we recovered the ionic liquid from the PVA-Cellulose composites using the ethanol as the non-solvent, which is confirmed by NMR analysis. This ionic liquid also can be used for the further application.

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Oral Presentation – OOP-22

Investigation of Thermodynamics of Aggregation between the Ionic Surfactant and Polymer mixture

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INTRODUCTION

This study explores the aggregation behavior of polymer-surfactant mixtures and the effect of alkali (NaOH) using surface tension and conductivity measurements. It examines two anionic surfactants (SDS, SDBS) with partially hydrolyzed polyacrylamide (PHPA) and guar gum. Aggregation begins at the critical aggregation concentration (CAC), stabilizing at the polymer saturation point (PSP). Synergistic effects of surfactants, polymers, and NaOH significantly impact surface tension and conductivity. Thermodynamic analysis (Gibbs free energy, enthalpy, entropy) indicates that the stability of mixed micelles increases with higher negative free energy, driven by electrostatic attraction between surfactant head groups and polymers.

MATERIALS AND METHODS

Chemicals: SDS, SDBS-solution, Guar Gum solution, PHPAM, NaOH. Surface tension measurements: Ring method (Auto tensiometer using platinum ring, Model: 6801ES). Conductivity measurements: Digital Conductivity meter (Century Inst. Pvt. Ltd. Model CC601)

RESULTS AND DISCUSSION

Tensiometric investigation of the interaction between Polymer and Surfactant in absence of alkali. This study explores the interactions between polymers (Guar Gum and PHPAM) and surfactants (SDS and SDBS) using tensiometric and conductometric methods, focusing on the absence of alkali. Surface tension of SDS and SDBS solutions decreased with increasing surfactant concentration due to adsorption at the solution surface, reaching a constant value beyond the critical micelle concentration (CMC). The CMC of SDBS (0.075 wt%) was lower than SDS (0.1 wt%) due to structural differences (Fig. 1)

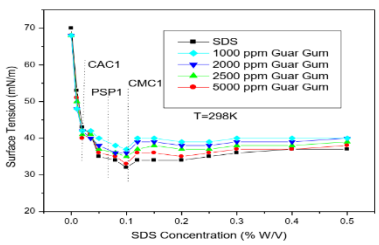

Fig. 1: *Effect of guar gum on surface tension of SDS at 298K.*

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Thermodynamics of Micellization for tensiometric investigation of the polymer and surface Tension interaction. The presence of polymers altered the surface tension behavior, with Guar Gum and SDS mixtures showing distinct trends compared to PHPAM and SDBS mixtures. Thermodynamic parameters of micellization, including Gibbs free energy (ΔG^o_m), enthalpy (ΔH^o_m), and entropy (ΔS^o_m), were analyzed using a pseudo-phase model (equation. (i), (ii) & (iii)). Results showed micellization was more favorable for SDS-Guar Gum than SDBS-PHPAM mixtures. Negative ΔG^o_m indicated spontaneous processes, while ΔH^o_m values varied between endothermic and exothermic reactions.

$$\Delta G^0{}_m = 2RT(0.5 + \beta)\ln X_{CMC} \quad \text{.....(i)}$$

$$\Delta H^0{}_m = -2RT^2(0.5 + \beta)\left(\frac{d\ln X_{CMC}}{dT}\right)_p \quad \text{.....(ii)}$$

$$\Delta S^0{}_m = \left(\frac{\Delta H^0{}_m - \Delta G^0{}_m}{T}\right) \quad \text{.....(iii)}$$

CONCLUSION

(1) Investigation of interaction between surfactant and polymer in presence and absence of alkali, (2) Thermodynamic parameters (ΔG^o, ΔH^o, ΔS^o) reveal spontaneous and exothermic micellization, (3) Temperature and composition of mixtures affect micellization behaviour, highlighting their significance in modifying interfacial properties. (4) Applicable in oil removal from polluted soil.

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Oral Presentation – OOP-23

An increase of efficiency as packaging by blending of recycled Polypropylene with rice husk extracted nanosilica and phthalated starch

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ABSTRACT

Polypropylene is extensively used in packaging industry which is creating a huge environmental pollution. This work highlights on the conversion of recycled polypropylene with phthalated starch and modified nanosilica into environmental friendly biodegradable polymer blend. Starch is modified to starch phthalate in order to undergo a good dispersion in Polypropylene matrix. The surface functionalization of nano silica is done by salinization process using aminopropyl trimethoxy silane.

INTRODUCTION

Plastic is widely used in the production of packaging goods, biomedical instruments and energy storage devices as it is light in weight and less costly. The process of production of plastic goods is very easy (Jehanno et al., 2022). Over the last 50 years, exponential growth has occured in plastic production and it breaks the 7-billion-ton mark (Geyer et al., 2017). Now most of the plastic is non-biodegradable and it decreases the Nitrogen and sulphur content of soil. Thus, the fertility of soil gets hampered. Burning of plastic produces greenhouse effect. Besides this, the health of human beings is at stake due to the burning of plastics. About 91% of plastic is not recycled (Improving the Mechanical Performance of LDPE/PP Blends through Microfibrillation,2022). The common methods to decrease the dispersion of plastic waste in the environment are landfills, incineration etc (Meereboer et al., 2020) and recycling but incineration produces toxic gases which is released into the environment. Different polymers blend together to form a matrix. Blending is highly important and it has the advantage of acquiring most of the blend's components' desirable properties economically (Araujo et al., 2018).

MATERIALS AND METHODS

MATERIALS: a) Extra purecorn (maize) starch which is almost 98-99% hydrolysable. b) 28% amylose along with phathalicanhydride c) 3-aminopropyltrimethoxysilane (97%) d) Formamide e) Potassium Acetate

METHODS: 1. Synthesis of Starch Phthalate 2. Mixing of the ingredients in the individual batches 3. Moulding of the materials to produce film

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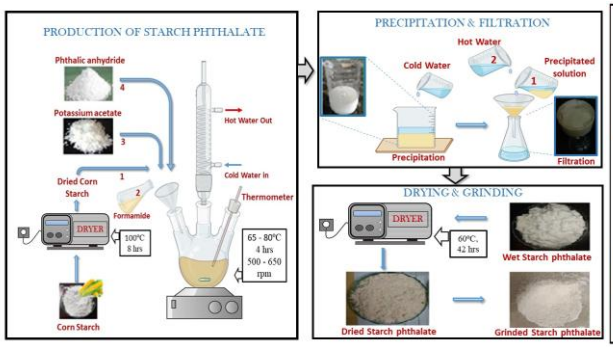


Fig-1: Preparation of starch phthalate

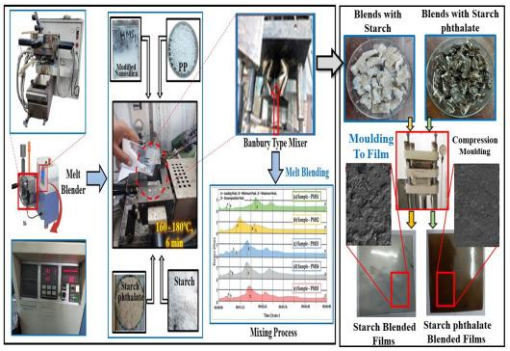
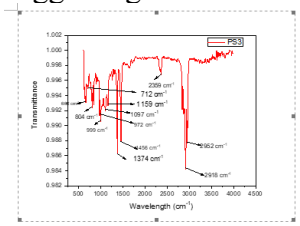


Fig-2: Production of Biodegradable film

RESULTS AND DISCUSSION

Comparision of Modified starch with respect to starch Fourier Transform Infra-red analysis Figure 3and 4 illustrates the FTIR analysis of starch/PP (PS1 and PS3), modified starch/PP (PMS1 and PMS3) respectively. At finger print region 970-999 cm-1, a strong band is observed for both starch and modified starch which suggests about the C-O stretching vibration of polysaccharides [Zarski et al., 2016]. An extra band at about 1582-1584 cm-1 arises for modified starch due to the presence of carbonyl group in ester [Fang et al., 2002; Mathew and Abraham, 2007], suggesting esterification of starch.



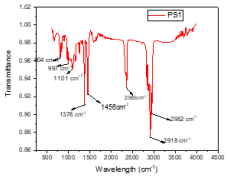
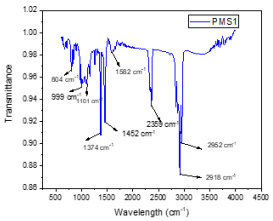


FIG 3: FTIR analysis of PP/starch blend



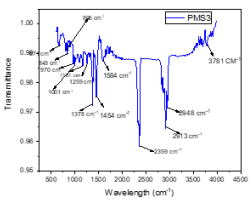


Fig 4: FTIR analysis of PP/modified starch

CONCLUSION

The modified starch was prepared by formation of starch phthalate. The PP/starch blend and PP/modified starch blend was prepared and it was converted into fine sheets by compression moulding. The TGA, XRD, FTIR, FESEM was carried for various compositions of PP/starch and PP/modified starch and it was evident from the studies that modified starch /PP blend was much more decomposable than PP/starch blend.

ACKNOWLEDGEMENT

The authors would like to express appreciation to the Department of Chemistry Brainware University and Department of Chemical Engineering Calcutta University for the completion of this project.

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Oral Presentation – OOP-23

Optimal scheduling through deterministic and stochastic approach in Virtual Power Plants

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INTRODUCTION

With the global shift towards reducing greenhouse gas emissions, renewable energy sources such as solar photovoltaic (PV) and wind have gained significant attention. These energy sources, due to their zero operational costs, present a compelling case for their adoption as part of a cleaner, more sustainable energy system. However, their intermittent nature, primarily driven by variable weather conditions poses a challenge for ensuring a stable and reliable power supply. One potential solution to this challenge is the combination of renewable energy with conventional generators, a strategy known as mixed generation. In such a system, conventional generators act as backup or balancing resources to support the fluctuating output of renewable. While these conventional generators are more expensive to operate due to fuel costs, they provide the necessary reliability and flexibility to manage grid stability when renewable generation is low or variable. To handle the variations in renewable generation and maintain grid stability, deterministic and stochastic approaches can be used to model both static and dynamic load conditions. Deterministic models provide a fixed, predictable representation of load demand and supply. These models are useful in scenarios where conditions are relatively stable or predictable. Whereas stochastic models account for uncertainty and variability in load demand and renewable generation, helping operators plan for less predictable conditions. These models can incorporate factors such as weather patterns, time of day, and system outages to optimize the operation of both renewable and conventional resources.

Keywords: Virtual Power Plant, Distributed Energy Resources, Uncertainty, Load management,

METHODOLOGY:

A possible solution to mitigate the negative effects of the uncertainty in the production of renewable energy sources (RES) is to integrate them with other energy-generating units, storage facilities, and flexible demand systems. This approach ensures a more balanced and reliable energy supply by compensating for the variability inherent in RES. Other generating units, such as thermal or hydroelectric power plants, can provide backup when RES output is low, while storage facilities like batteries or pumped storage systems can store excess energy produced during periods of high generation for later use.

The basic model of network constraints can be represented through the following equations:

$$\sum_{g\in\Omega_n^G} p_{gt}^G - \sum_{l\backslash s(l)=n} p_{lt}^L + \sum_{l\backslash r(l)=n} p_{lt}^L = \sum_{d\in\Omega_n^D} p_{dt}^D \quad \forall n \in \Omega^N, \forall t \in \Omega^T \quad (1)$$

$$p_{lt}^L = \frac{1}{X_l}(\partial_{s(l)t} - \partial_{r(l)t}) \quad \forall l \in \Omega^L, \forall t \in \Omega^T \quad (2)$$

$$-P_l^{L,up} \le p_{lt}^L \le P_l^{L,up} \quad \forall l \in \Omega^L, \forall t \in \Omega^T \quad (3)$$

$$\partial_{nt} = 0 \quad n: ref., \forall t \in \Omega^T \quad (4)$$

$$p_{gt}^G \in \psi_{gt}^G \quad \forall g \in \Omega^G, \forall t \in \Omega^T \quad (5)$$

$$p_{dt}^D \in \psi_{dt}^D \quad \forall d \in \Omega^D, \forall t \in \Omega^T \quad (6)$$

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Energy storage facilities are a crucial component of virtual power plants (VPPs), as they provide the capability to store excess energy during periods of high production and release it during times of low production or high demand. This functionality enhances grid stability and ensures a reliable energy supply. The basic model of a storage facility can be represented through the following equations:

$$u_{st}^{S} \in \{0,1\}; \forall s \in \Omega^{S}; \forall t \in \Omega^{T}, \quad (7)$$

$$0 \leq p_{st}^{S,C} \leq P_{st}^{S,C\,up} u_{st}^{S}, \quad \forall s \in \Omega^{S}; \forall t \in \Omega^{T}, \quad (8)$$

$$0 \leq p_{st}^{S,D} \leq P_{st}^{S,D\,up} (1-u_{st}^{S}); \forall s \in \Omega^{S}; \forall t \in \Omega^{T}, \quad (9)$$

. RESULT AND DISCUSSION:

A. Data of Price in time Periods:

Time Period	Price($/MWH)
1	20
2	50
3	35

B. Results of Production in Six time periods

Time Period	Power(MW)
1	17
2	7
3	17
4	27
5	20
6	30

CONCLUSION

So we can conclude that in the case of Inflexible demand, flexible demand and very flexible demand the costs are 4125$, 3900$ & 3640$ respectively.

ACKNOWLEDGMENT

The authors whose names are listed, really indebted for the supervisor's guidance and supporting work from Head of the department.

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Oral Presentation – OOP-25

Formulation of General Estimation Strategy for Population Variance under Two-Phase Cluster Sampling

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ABSTRACT

We have formulated the general estimation technique for population variance in two-phase multistage cluster sampling, where random non-responses may occur. Available information on one auxiliary variable has been utilized to develop one general class of estimators that may handle the nuisance effect of non-responses in practical surveys. It may be observed that several estimators may originate belonging to this proposed class. The properties of the proposed class of estimators have been discussed. The supremacy of the suggested strategy over the conventional ones has been established through the empirical investigation carried over the data set of natural populations as well as simulated populations. The encouraged findings are forwarded to the survey statisticians for their application in practical surveys.

Introduction

In practical surveys, it is noted that non-responses are unavoidable phenomenon. Rubin (1976) addressed three concepts: missing at random (MAR), observed at random (OAR), and parameter distribution (PD). There is a lack of significant attempt to address the problem of random non-responses situation in estimation of population variance through cluster sampling schemes.

Fascinating and inspired with the points raised above, we have constructed a general estimation procedure for population variances under two-phase cluster sampling scheme in two-stages. We have also incorporated the problems of random non-responses (MAR) in real life surveys.

Formulation of Proposed Class of Estimators

We have assumed that the second auxiliary variable Z is readily available for all over the population U. We propose the following functional type estimation based on responding of the second stage sample S_2 to estimate the population variance $S^2_{y..}$

Utilizing information on an auxiliary variable x and z, we construct a general class of estimators of population variance in two-phase cluster sampling as

$$T= f\left(s^2_{y_{n(m-r)}}, s^2_{x_{n(m-r)}}, h_1\left(s^2_{x_{n'M}}, s^2_{z_{n'M}}\right)\right) \quad (1)$$

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where $h_1\left(s^2_{x_{n'M}}, s^2_{z_{n'M}}\right)$ is a class of estimators of $s^2_{x_{..}}$ using information on $s^2_{x_{n'M}}$ and $s^2_{z_{n'M}}$, such that $h_1\left(S^2_{x..}, S^2_{z..}\right) = S^2_{x..}$ (2)

Empirical Investigation for the Performance of Proposed Strategy

We have compared the efficiencies of our proposed class of estimators with sample variance estimator $s^2_{y_{nm}}$ in cluster sampling under complete response situation.

The variance of s^2_{ynm} up to first order of sample size is obtained as:

$$V\left(s^2_{y_{nm}}\right) = S^4_{y..}\left[\left(\frac{1}{n} - \frac{1}{N}\right)c_o^{*2} + \frac{1}{n}\left(\frac{1}{m} - \frac{1}{M}\right)\bar{C}_o^{*2}\right] \quad (3)$$

The percent relative loss in efficiency of the proposed class of estimators T with respect to natural sample variance estimator s^2_{ynm} is defined as

$$L = \frac{M(T)_{opt} - V\left(s^2_{y_{nm}}\right)}{M(T)_{opt}} \times 100 \quad (4)$$

The details about findings are displayed in table 1.

Table 1: Losses in Efficiencies of the Proposed Class of Estimators for different choices of non-response probability p, sample sizes $(n', n \text{ and } m)$ and correlation coefficients $\left(\rho_{yx} \text{ and } \rho_{xz}\right)$.

p	n'	n	m	ρ_{yx}	ρ_{xz}	L	P	n'	n	m	ρ_{yx}	ρ_{xz}	L
0.05	4	3	10	0.7	0.5	-16.5201	0.05	4	3	10	0.9	0.5	-29.0987
	4	5	2			-5.8937		4	5	2			-23.8912
	4	3	10			-9.4794		4	3	10			-19.7654
0.10	4	3	10	0.7	0.5	-19.4194	0.10	4	3	10	0.7	0.75	-22.1567
	4	5	2			-9.7852		4	5	2			-26.5834
	4	3	10			-14.5736		4	3	10			-18.7687
0.15	4	3	10	0.7	0.5	-7.75361	0.15	4	3	10	0.9	0.5	-21.6785
	4	5	2			3.69675		4	5	2			-7.567
	4	3	10			-2.8677		4	3	10			1.0791

Conclusion:

It is noted from table 1 that:

(a) For different choices of sample sizes our estimator produces precise estimates.
(b) For different choices of non-response probabilities, our suggested methodologies are found to be effective.
(c) For increasing values of correlation coefficient, we are having gain in efficiencies.

Hence, our suggested methodology unifies several preferred results and therefore, it may be recommended to the survey statisticians for their applications in real life.

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Poster Presentation

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Poster Presentation – PP-01

Production of Biofuel from Algal Biomass by Aqueous Phase Reforming

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ABSTRACT

With the growth of the human population, the need for sustainable resources of energy has increased a lot. Large scale utilisation of fossil fuels would lead to absence of viable energy resources for our future progeny, so, for that we need renewable and clean sources of energy which are called Green Energy Resources.

Biological hydrogen (H_2) production (BHP) enhancement through the use of nanoparticle (NPs) supplements in the media is being recognized in recent times as an encouraging approach. The NPs, including those of metal and metal oxides, have shown a significant improvement in the BHP. A number of organisms as pure or mixed cultures can produce H_2 in presence of NPs from pure sugars and biowaste as a feed. However, their H_2 production efficiencies have been found to vary significantly with the type of NPs and their concentration.

Therefore, Suitable bacteria like C. butyricum as inoculum and AuNPs provided a suitable approach for efficient H_2 production from sucrose. Also, Kappaphycus alvarezii and sludge was processed for bio-hydrogen production.

As a result, Reforming of aqueous phase with 7.5 wt% Au It is found that, with synthetic wastewater containing sucrose as a feed, anaerobic culture resulted in 62.3% higher yield than those to the control applying the minimum amount of AuNPs, remarkably, the H_2 production, overall catalyst showed 61.25% of bio-hydrogen. Maximum bio-hydrogen yield was 36.1% for 2:1 (sludge: algae) at 360°C.The high ratio of acetate to butyrate and low production of ethanol in the presence of AuNPs is associated with a significant increase in H_2 production.

Aqueous phase reforming produces hydrogen from biomass-derived oxygenated compounds such as glycerol, sugars, and sugar alcohols. APR is unique in that reforming is done in the liquid phase. The process generates Biohydrogen without volatilizing water, which represents a major energy saving and therefore produces emission-free Hydrogen from biofuel with the use of macroalgae Kappaphycus alvarezii toWith the purpose of expanding applications in the field of production of Hydrogen with the help of Bionanotechnology, the Biosynthesis of Au NPs by aqueous reforming of a synthetic compound (brewery wastewater) is supported on activated Carbon. It is observed that AuNPs has the catalytic performance for the degradation of pollutants at the industrial level.

Therefore, Gold nanoparticles exhibit excellent catalytic degradation and decomposition of pollutants making the environment cleaner and sustainable.

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Thus, Hydrothermal gasification (APR) resulted in syngas, biochar and higher H_2 production by liquid phase formation and Anaerobic Digestion of cyanobacterium lead to the breakdown of complex Inorganic and organic compounds in the Industrial Wastewater that led to easy Reforming process. Recent Research with Certain Limitations and Recommendations are also to be taken care of for the Aqueous Phase Reforming Process. It can be used at domestic sectors and small scale Industrial operations for synthetic wastewater treatment and production of biofuels and Biohydrogen since the procedure is costly than the normal established SMR or CFR (Steam Methane Reforming & Catalytic Reforming).

The process including the Bioreactor and Pyrolysis Incineration Plant should be more cost-effective for synthesising Au and H_2 production.

Keywords: Hydrothermal gasification, Macroalgae, Microbial sludge, Bio-hydrogen production (BHP), Aqueous phase reforming (APR), Gold nanoparticles (AuNPs), Anaerobic Digestion

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Poster Presentation – PP-02

VLS Deposition of Cu_2Se_{1-X}: Electrocatalyst for Hydrogen Evolution

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INTRODUCTION

Recent situation deals with environmental pollution as well as depletion of fossil fuels which attracts a group of researchers to investigate the alternatives. Hydrogen is an ideal candidate to replace the traditional fuels due to its pure and high energy density and zero emission of green- house gas [1]. Hydrogen can easily be produced by electrochemical water splitting but the reaction is sluggish in nature due to its high overpotential and low energy conversion efficiency [2, 3]. In recent years, transition metal chalcogenides like (M= Ni, Co, Fe), (Chalcogenides: S, Se) are well known for their enhanced electrocatalytic HER performance [4]. Here, orthorhombic, smooth facets Cu_2Se_{1-x} is grown on Cu foil is introduced as electrocatalyst under acidic condition.

MATERIALS AND METHODS

Cu_2Se_{1-x} is grown on Copper (Cu foil) substrate via VLS growth mechanism. Bi_2Se_3 has been used as selenium source whereas Cu foil is itself utilized as Cu source. Entire synthesis procedure is performed at Nitrogen (N_2) atmosphere.

RESULTS AND DISCUSSION

The crystal structure and phase of as synthesized sample is investigated by X-ray diffraction pattern (XRD) as represented in figure

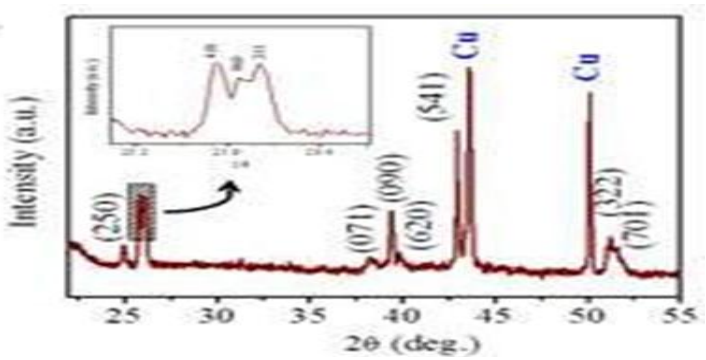

Figure. 1. XRD spectra of Cu_2Se_{1-x}

Morphology of Cu_2Se_{1-x} is investigated by FESEM. Fig.2 demonstrates steplike structure of as synthesized Cu_2Se_{1-x} film on Cu substrate.

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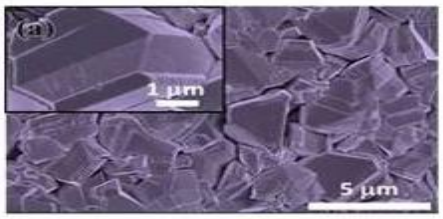

Figure 2. FESEM image of Cu_2Se_{1-x}

To study its electrochemically hydrogen evolution property linear sweep voltammetry (LSV) is recorded at 10 mV/S scan rate for bare Cu foil, Cu_2Se_{1-x} and Platinum (Pt) tip electrode in N_2 saturated acidic media i.e. 0.5 M H_2SO_4 in a typical three electrode system and it is shown in Fig. 3(a)

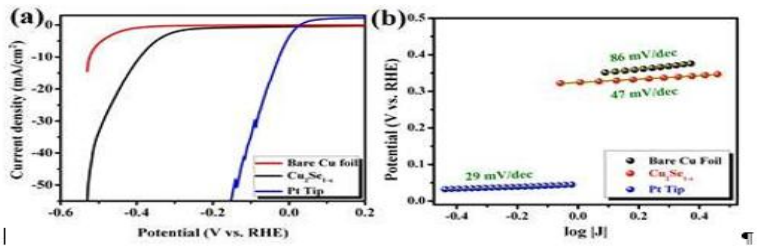

Figure 3. (a) Comparative LSV study of HER using different catalysts at 0.5 M H_2SO_4 (b) Tafel Slope

VLS deposited Cu_2Se_{1-x} sample exhibits onset potential of 200 mV and 380 mV of potential (V vs. RHE) to achieve 10 mA/cm^2 current density which is much lower than bare Cu foil that shows onset potential of 400 mV and 524 mV@10 mA/cm^2 potential. As the potential increases after onset value, there is an enhancement of current density which is comparable with Platinum (Pt) tip in acidic environment To understand the HER reaction mechanism, Tafel slopes are derived from polarization curves. It proceeds via two elementary steps in acid medium. Small Tafel slope implies that low overpotential is required for high current density. In the Fig. 3(b), the Tafel slopes of Pt tip, bare Cu foil, Cu_2Se_{1-x} are 29, 86, 47 mV/ dec respectively.

CONCLUSION

Here, a new material Cu_2Se_{1-x} is introduced on bare Cu foil in the group of catalyst for hydrogen evolution. It requires low overpotential of 380 mV to achieve current density 10 mA/cm^2 and it is also highly durable catalyst for long hours even in strong acidic condition

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Poster Presentation – PP-03

Microstructural $ZnFe_2O_4$: A Promising Electrode Material for Advanced Supercapacitors

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INTRODUCTION

Nowadays, researchers and scientists across the world are developing supercapacitor energy storage devices to fulfill the never-ending energy demand considering environmental concerns. Bimetallic transition metal oxides can be promising candidate for supercapacitor electrode material owing to their multiple oxidation states and thus better redox activity [1]. Among them, nanostructured $ZnFe_2O_4$ are most investigated electrode material because of their inexpensiveness, abundancy, non-toxicity and eco-friendliness [2]. Moreover, $ZnFe_2O_4$ with their hierarchical structure may possess large number of electroactive sites, reducing interfacial resistance and fast charge transfer kinetics which further improve the overall electrochemical performances by enhancing specific capacitance, energy density, power density and cyclic stability [3]. However, the supercapacitive behavior of $ZnFe_2O_4$ micro cubes is still uninvestigated to the best of our knowledge. In this context, this study aims to investigate structural, microtructural and electrochemical performance of $ZnFe_2O_4$ micro cubes as a supercapacitor electrode material.

MATERIALS AND METHODS

$ZnFe_2O_4$ micro cubes have been synthesized by hydrothermal method by mixing $ZnCl_2 \cdot 2H_2O$ and $FeCl_3 \cdot 6H_2O$ in stoichiometric ratio at 60 mL H_2O, adding 20 mL 0.34 M NaOH dropwise, and autoclaving at 180 °C for 22 h. After washing, filtering, and drying at 60 °C for 6 h, the material was characterized by using PXRD (Bruker D8), FTIR (Shimadzu IRAffinity-1S), and FESEM (FEI Inspect F50). Electrochemical measurements were performed by using Autolab PGSTAT204 in a 3M KOH aquous electrolyte with a three-electrode system.

RESULTS AND DISCUSSION

Fig. 1(a) shows the powder xray diffraction (PXRD) pattern of the sample. The diffraction peaks at 2θ values of 29.89°, 35.26°, 36.90°, 42.93°, 53.35°, 56.60°, and 62.30° match the (220), (311), (222), (400), (422), (511), and (440) planes of $ZnFe_2O_4$ (ICDD card No. 22-1012), confirming single-phased $ZnFe_2O_4$ without impurities. Rietveld refinement using MAUD2.33 software verifies the sample as single-phase cubic spinel with Fd-3m space group.

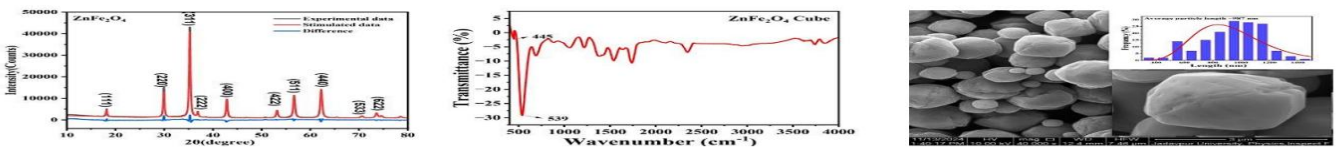

FIGURE 1. (a) PXRD pattern fitted by Maud, (b) FTIR spectrum, (c) FESEM image (inset: histogram drawn from FESEM image)

The lattice parameter obtained from Rietveld refinement is 8.443 Å and crystallite size is 23.84 nm. The FTIR spectrum of the sample (Fig. 1(b)) exhibits two prominent peaks at 445 cm^{-1} and 539 cm^{-1}, corresponding to Fe-O and Zn-O lattice vibrations, confirms the spinel structure of $ZnFe_2O_4$. The FESEM images of $ZnFe_2O_4$ cube is shown in (Fig. 1(c)) suggest that the particles are cubic in shape and uniform in size with average length is ~ 0.9 μm. The cyclic voltammetry (CV) profiles

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(Fig. 2(a)) of $ZnFe_2O_4$ micro cubes, recorded at multiple scan rates between -0.1 and -1.0 V potential range with respect to Ag/AgCl reference electrode, showcase two redox peaks at -0.64 V (oxidation) and -0.81 V (reduction) demonstrating pseudocapacitive behavior of $ZnFe_2O_4$. The galvanostatic charge discharge (GCD) curves of the samples recorded at various current densities exhibit a triangular shape and non-linear deviation from ideal traingular shape is attributed to pseudocapacitive behavior, originating from faradaic redox reaction process. The values of specific capacitance derived from CV and GCD curves at various scan rates and current densities are

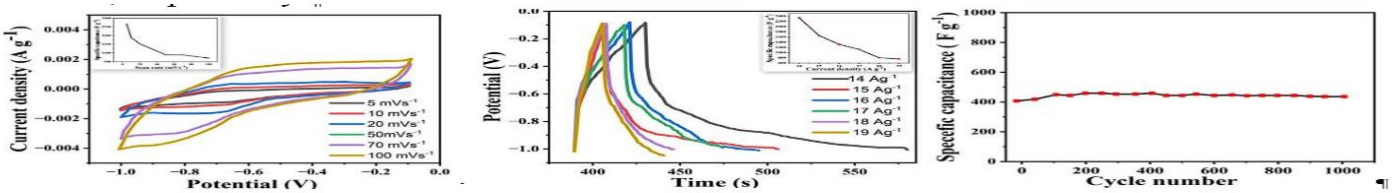

FIGURE 2. (a) CV curve at different scan rates (inset: specific capacitance vs scan rate graph), (b) GCD curve at different current density (inset: specific capacitance vs current density graph), and (c) cyclic stability over 1000 GCD cycles of $ZnFe_2O_4$ micro cube

calcualted by conventional formulae mentioned in our previous work [4] and are presented in tables 2 and 3, respectively.

Table 2. Values of specific capacitance (Cs) at different scan rates calculated from CV curve.

Scan rate (mV s^{-1})	5	10	20	50	50	70	100
Specific capacitance (Cs in F g^{-1})	2651	1913	1547	1528	903	890	708

Table 3. Values of specific capacitance (Cs) at different current density calculated from GCD curve

Current density (A g^{-1})	14	15	16	17	18	19
Specific capacitance (Cs in F g^{-1})	2333	1650	1315	1120	802	755

The stability curve exhibits 93% capacitance retention after 1000 cycles, highlighting the excellent longevity of the $ZnFe_2O_4$ micro cube.

CONCLUSION

$ZnFe_2O_4$ micro cube, synthesized via a one-pot solvothermal method, exhibit a well-crystallized, single-phase cubic spinel ferrite structure with a cubic shape (avg. length is ~ 0.9 μm). The material demonstrates exceptional electrochemical performance by showing high specific capacitance of 2333 F g^{-1} at 5 mV s^{-1} and impressive capacitance retention (93%) over extended cycles, making them a promising candidate for high-performance energy storage applications

ACKNOWLEDGMENT

S. Gazi gratefully acknowledges Department of Physics, Jadavpur University for the instrumental facility and UGC Ministry of Minority Affairs for providing Maulana Azad National fellowship

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Poster Presentation – PP-04

Observation of Non-Linear Optical Properties of A Mott Insulator Sr_2CuO_3 Through Spatial Self-Phase Modulation

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ABSTRACT

Strontium cuprate (Sr_2CuO_3), a charge transfer type Mott Insulator, has become a subject of experimental and theoretical interest after the discovery of high-temperature superconductors. The material Sr_2CuO_3 is suspected to possess gigantic optical nonlinearity which makes it an interesting material for Spatial Self Phase Modulation (SSPM) experiment. In this study Sr_2CuO_3 nanomaterial have been synthesized using traditional solid-state method; and its nonlinear optical (NLO) responses have been explored, and the value of second order nonlinear refractive index (n_2) and third order nonlinear susceptibility ($\chi^{(3)}$) have been calculated through SSPM method.

INTRODUCTION

The physics of charge transfer type Mott insulators were studied intensively over the past decade due to their relevance in superconductors and the magnetic and electronic properties. Sr_2CuO_3 falling in this category, shows unique magnetic and electronic, as well as gigantic nonlinear optical (NLO) properties [1]. These NLO responses of Sr_2CuO_3 calls for dedicated study for the improvement of modern optical technology.

There are various techniques to investigate the NLO properties of nanomaterials, among which SSPM is widely conducted due to its relatively simple experimental setup and short measurement time [2, 3]. Polarization of a material is connected to the strength of the applied optical field, especially the electric field of the incident light, which is main theme of SSPM method. This work focuses on the experimental synthesis of Sr_2CuO_3 and takes a close look at the NLO responses by conducting SSPM. Also the calculations of n_2 and $\chi^{(3)}$ were carried out.

MATERIALS AND METHODS

Sr2CuO3 was synthesized by calcining a fine mixture of stoichiometric quantities of strontium carbonate ($SrCO_3$) and copper oxide (CuO) in alumina crucibles in air at 1050˚C for 3days (6h each day). The synthesized Sr_2CuO_3 was characterized by XRD, DRS, FT-IR spectroscopy. SSPM was then carried out with the solution of this synthesized Sr_2CuO_3 in NMP solvent with laser beam having wavelength, $\lambda = 671$ nm.

RESULTS AND DISCUSSION

The orthorhombic structure of Sr_2CuO_3 was revealed from the XRD analysis. The diffusive reflectance spectroscopy (DRS) estimated the direct band gap energy of Sr_2CuO_3 (1.45 eV). FT-IR measurements was also done for sample characterization.

This study next focuses on the NLO responses of Sr_2CuO_3. The Kerr nonlinear effect is studied as it has an influential role in these NLO responses, characterized by, eq 1

$$n = n_0 + n_2 I \qquad [1]$$

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where n_0 and n_2 are the linear and nonlinear refractive indices, respectively. A nonlinear phase shift is induced in the outgoing laser beam after light matter interaction. Due to this phase shift, self- diffraction pattern or rings arises in the far field, as a main effect of SSPM. The n_2 and $\chi^{(3)}$ is directly linked with the number of rings formed,

$$n_2 = \frac{\lambda}{2n_0 L_{eff}} \frac{dN}{dI} \quad [3]$$

and

$$\chi^{(3)}_{total} = \frac{cn_0^2}{12\pi^2} n_2 = \frac{c\lambda n_0}{2.4\times10^4 \pi^2 L_{eff}} \frac{dN}{dI} \quad [4]$$

given by, eq 3 and 4.

where, $\frac{dN}{dI}$, the variation of the ring number with the incident laser intensity, is the crucial parameter for analyzing NLO responses of materials.

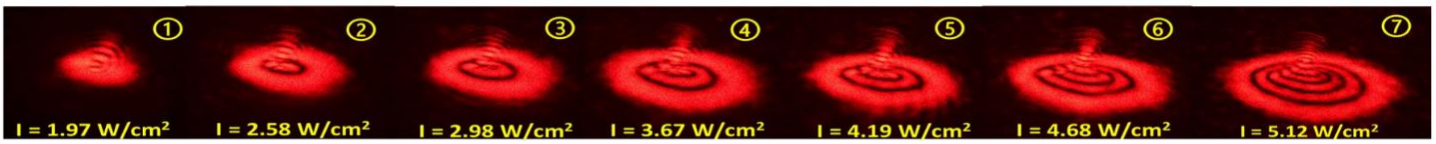

Figure 1: Digital images of the increasing self-diffraction ring numbers with the increase in the incident light.

Fig. 1 shows the self-diffraction ring numbers as a function of incident intensities. The calculated values of n_2 and $\chi^{(3)}$ through SSPM are 3.97×10^{-5} cm^2/W and 2.17×10^{-3} esu, respectively.

CONCLUSION

In conclusion, we investigated the NLO responses of Sr_2CuO_3 which was synthesized using solid state method. The values of n_2 and $\chi^{(3)}$ were found to be 3.97×10^{-5} cm^2/W and 2.17×10^{-3} esu, respectively. We believe that this study will support Sr_2CuO_3 as a good candidate for development of photonic devices.

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The authors would like to appreciate Dr. Kalyan Kumar Chattopadhyay and Dr. Subrata Sarkar for their valuable support and advices.

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Poster Presentation – PP-05

Morphologically Tuned $ZnSnO_3$ for Dye Selective Photocatalytic Degradation Under UV Irradiation

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INTRODUCTION

$ZnSnO_3$ nanostructures have attracted huge attention for its wide range of applications as piezoelectric mechanical energy harvesters, sensors, photo-electrochemical devices, photocatalysts etc.[1-4] Especially, their efficiency increases multifold in low dimension due to an increase in aspect ratio. This work demonstrates the synthesis of $ZnSnO_3$ nanocuboids (ZS) via a simple solution precipitation method and nanosheets (ZH) after hydrothermal treatment. In both cases, the as-prepared powder was calcined at 600 °C to obtain pure $ZnSnO_3$ phase. The efficiency of both the samples for photocatalytic dye degradation depending upon their ionic identity under UV light was investigated. It was observed that the samples were more efficient to degrading the cationic dye Rhodamine B (RhB) than the anionic dye Methyl Orange (MO). Also, the rate constant for ZH was greater than that of ZS in each case. The behavior can be explained by the surface area and surface electrostatic properties of the samples.

MATERIALS AND METHODS

Appropriate amount of $Na_2SnO_3 \cdot 3H_2O$ and $Zn(CH_3COO)_2 \cdot 2H_2O$ were dissolved in a mixed solution of ethanol and D.I. water (1:3) separately. Then the sodium solution was added dropwise to the zinc solution under stirring. The mixture solution was treated in two different ways. In the 1st case, the solution was magnetically stirred for 5 h at 120 °C, and in the 2nd case, the solution was transferred to a teflon-lined autoclave and treated hydrothermally for 5 h at 120 °C. In both cases the solution was allowed to cool down to room temperature and then washed with ethanol and D.I. water. The precipitate was dried at 80 °C in an oven. The as-synthesized powder was then calcined for 3 h at 600 °C to obtain pure phase of $ZnSnO_3$. The samples were designated as ZS and ZH respectively.

RESULTS AND DISCUSSION

The X-ray diffraction peaks of fig. 1a suggest the formation of orthorhombic $ZnSnO_3$ (JCPDS file no. 28-1486). Fig. 1b demonstrates cubelike morphology for ZS sample having dimensions in between 30 nm and 100 nm. From fig. 1c, the thickness of the nanosheets was estimated to be around 50-60 nm for ZH sample. The optical band gaps of ZS and ZH were 4.1 eV and 3.9 eV respectively as evaluated from the UV-Vis DRS spectra (Fig. 1d). As the band gaps of both the samples lie in UV region, the whole photocatalytic dye degradation experiment was conducted under UV excitation. The standard dye-to-catalyst ratio was maintained, and the time-evolved UV- Vis absorbance spectra were recorded. From fig. 1e, it can be seen that both the samples took less time to degrade RhB in comparison to that for MO. The corelation between the ionic identity of the dye and the surface charge of the samples is the reason behind it.[5] It is wellknown fact that RhB is a cationic dye and MO is anionic. Having negative zeta potential (fig. 1g), both samples exhibited a strong electrostatic attraction towards the aqueous solution of cationic dye RhB than that of the aqueous solution of anionic dye MO and this helps in faster degradation of RhB. The large surface area and more negative zeta potential of ZH are responsible for high rate constant (fig. 1f). Fig. 1h shows that there is almost same RhB degradation efficiency even after

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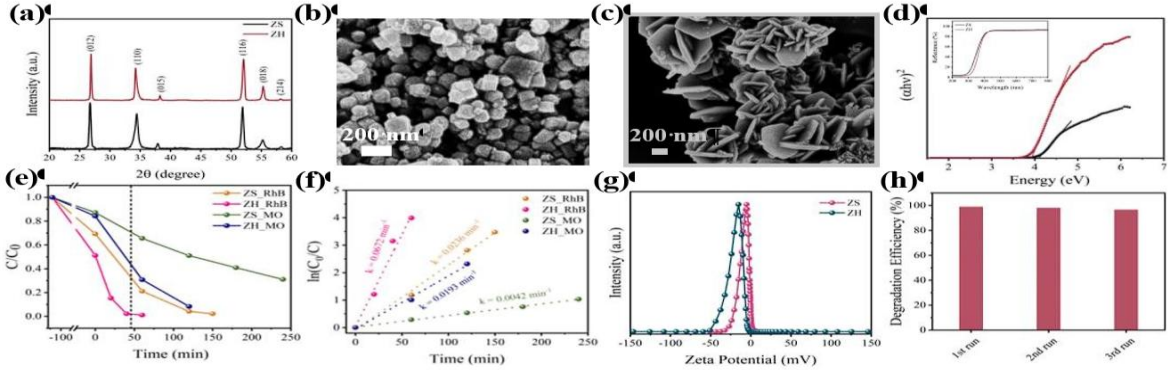
4th cycle was executed by ZH sample which is very useful for practical application.Theoretically calculated positions of conduction and valence band edges of ZH sample were at -0.34 eV and 3.56 eV respectively *vs.* The normal hydrogen electrode (NHE). It was found that the CB and VB edge positions facilitate the formation of different radicals, which in turn disintegrate the target dye into CO_2 and water.



Figure·1.·(a)·XRD·pattern·of·ZS·and·ZH·samples;·FESEM·image·of·(b)·ZS·and·(c)·ZH;·(d)·band·gap·of·the· samples.·The·inset·shows·the·UV-Vis·DRS·spectra;·(e)·the·degradation·profile·and·(f)·plot·of·ln(C₀/C)·*vs.*·t·graph· for·RhB·and·MO·dye;·(g)·zeta·potential;·(h)·the·plot·of·degradation·efficiency·of·the·dyes·RhB·for·different· Photocatalytic·cycles.¶

CONCLUSION

Photocatalytic degradation efficiency of hazardous azo dyes with different ionic identities was investigated using $ZnSnO_3$ nanocuboids and nanosheets. It was found that both the samples showed better efficiency to degrade cationic dye RhB than the anionic dye MO. The negative zeta potential (-5.27 mV for ZS and -15.18 mV for ZH) of the samples is the reason behind this behavior. Also, the more negative zeta potential along with the large surface area of ZH sample is responsible for a higher rate constant than that of ZS. Therefore, this work establishes a facile method to prepare morphology-tuned $ZnSnO_3$ photocatalysts for harmful dye degradation.

ACKNOWLEDGMENT

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Poster Presentation – PP-06

Photocatalytic and Cold Emission Properties of Morphology Altered β-Ga_2O, Nanostuctures

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ABSTRACT

Dimensional shrinkage and morphological variation of the nanostructures plays a vital role in regulating the photocatalysis and cold emission performance of β-Ga_2O_3). Typically, this nanostructures were obtained by calcination of gallium oxide hydroxide (GaOOH) synthesized via a simple chemical route. On the other hand, commercial extra pure bulk β-Ga_2O, was considered as the base sample for subsequent comparative investigation. In addition to traditional characterizations, the photocatalytic performance of Ga $_2O_3$ systems were studied by time evolved UV-Vis absorption spectrum of degradation of eosin B (EB) solution. It was observed that porous β-Ga O nanobars exhibited larger effective surface area and enhanced optical absorption in UV- Vis range as compared to the irregular shaped commercial Gallia. Under UV irradiation for 60 min, the Ga_2 O $_3$nanobars exhibited a high photodegradation efficiency of (98%), enhanced remarkably compared to that of bulk Gallia (45%). Also it shows a remarkable enhancement in cold emission properties. This work proposes a simple, cost effective, eco-friendly route for synthesis of Ga-based oxide photocatalysts for wastewater treatment and cold-emitter which is advantageous over commercial Gallia.

INTRODUCTION

In attempt to face the challenges of industry-originated environmental pollution, especially in consumable water, inorganic semiconductor nanomaterials are under prime research focus during last few decades. Gallia and its derivatives have shown remarkable performance regarding this by exhibiting controlled, recyclable photocatalytic activities. Present work investigates the potential application of Gallia in the removal of cosin B and efficiency of low dimensional β-Gallia structures in this regard compared to commercially available bulk Gallia. In this work, low dimensional β-Ga_2 O_3 structures were synthesized using simple chemical route and subsequent open air annealing excluding any difficult experimental set up. The synthesized samples were subjected to standard characterization tools to investigate its crystalline phase, morphological features, surface area measurements and optical band gap. Finally, the ability of the Gallia samples to trigger photo induced disintegration was investigated for eosin B (EB). All the characterizations were performed for commercially purchased Gallia samples also. It was observed that samples synthesized in chemical route exhibit porous surface features leading to better degradation of the dye molecules compared to the performance exhibited by the commercially available bulk sample

MATERIALS AND METHODS

All the reagents used were of pure analytical grade, without any further purification. Hydrated gallium nitrate ($Ga(NO_3)_3nH_2O$), ammonium hydroxide (NH_2OH), ethanol and commercial extra pure gallium oxide (99.99%) were purchased from Sigma Aldrich. Eosin B was purchased from Merck. All the solutions were prepared using deionized (DI) water. To prepare the growth solution the mixture of 0.45 g of hydrated gallium nitrate and 15 ml. ammonium hydroxide was stirred for 1 hour at room temperature and then was heated at 90 °C for 5 hours. After cooling to room temperature, the white precipitate (Gallium Oxide hydroxide bars) was collected by centrifugation, washed several times with absolute

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ethanol and Di water and dried at 60 °C for 24 h. Further the as-prepared GaOOH nanobars were calcined in a furnace at 700 °C for 3 hours to obtain gallium oxide structures of B phase. The as-synthesized and the commercially available gallium oxide were labeled as SGO and CGO respectively.

RESULTS AND DISCUSSION

The entire investigation of photo induces dye degradation capability was carried out under UV illumination. The time evolved absorption spectra of EB under the influence of the samples SGO is presented in Figure 1. It can be clearly seen that the samples could disintegrate EB almost entirely within less than 60 min. The fraction of EB remaining in the catalysis media was plotted against the illumination time which shows a stiffer curve for sample SGO compared to CGO. Even under dark. condition, the performance of SGO is much better than that of CGO. It may be inferred that the nominal removal of EB under dark condition via the catalytic action should be associated with absorption of the dye molecule by the catalyst particle. Better uniformity and larger pore dimension in the case of SGO facilitates higher possibility of physical absorption of the dye molecules within it. Due to higher attachment probability, this morphological facility was extended for the dye degradation capability of SGO in the illumination condition also. As a result EB degradation efficiency was estimated to be -98% for SGO which is much higher compared to CGO (-45%). Typical In(CoC) vs. time data was plotted and fitted linearly to determine the degradation rate constant using the following the Langmuir-Hinshelwood pseudo first order kinetic reaction,

$$\ln(C_o / C_t) = kt \quad [1]$$

The first order rate constant was estimated to be 0.0098 min for CGO which enhanced up to 0.0588 min for SGO. This remarkable enhancement of degradation rate constant was also correlated with increased enhanced porous feature of the sample SGO.

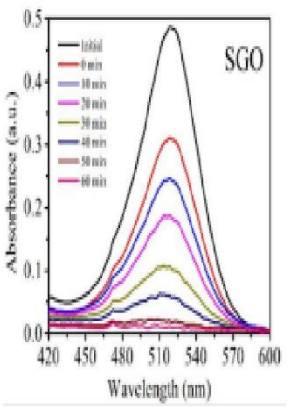

Figure 1. Time dependent UV-Vis absorption spectra of the dye eosin B in presence of catalyst SGO

CONCLUSION

The synthesized low dimensional Gallia samples showed much higher degradation efficiency compared to commercially available sample in the disintegration of hazardous dye eosin B. It showed an enhancement of degradation rate constant by 6 times. The Gallia samples synthesized in this work adds an important contribution to the dye degradation records of ß-Ga2Os by first ever investigation of its influence in degrading eosin B.

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Poster Presentation – PP-07

Enhanced Electron Field Emission Properties of rGO/Co_3O_4 Nanocomposite

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ABSTRACT

rGO/Co_3O_4 nanocomposites were synthesized by ex-situ synthesis method. This nanocomposites exhibited higher field emission performance compared to flower-like Co_3O_4 nanoflakes. The enhancement in field emission originates from the band structure of the nanocomposites and sharp edges of the graphene resulting in good electron transport from Co_3O_4 nanoflakes to graphene.

INTRODUCTION

To improve the field emission properties of metal oxide based composite, high electrical conducting materials such as graphene, carbon nanotube are chosen as a matrices for decorated the metal oxide based nanoparticles (1). Graphene wrapped structure is beneficial for charge transport and also in practical application, high current density and low turn-on field are more essential for good electron emitters. In this report, we have successfully synthesized flower-like Co_3O_4 nanoflakes and its graphene wrapped nanocomposites (rGO/Co_3O_4) at room temperature. Enhancement of field emission properties of rGO/Co_3O_4 nanocomposites has been investigated.

MATERIALS AND METHODS

Flower-like Co_3O_4 nanoflakes were synthesized by chemical co-precipitation method. 0.07 g of $NaBH_4$ was added in the mixture of 0.29 gm $Co(NO_3)_2$. $6H_2O$ and DI water. Black coloured precipitate was filtered and dried. Finally that dried powder was calcined at 500 ^oC for 2h in air to obtain flower-like of Co_3O_4 nanoflakes. Go was synthesized from natural graphite by modified Hummers method (2). 0.15 g Co_3O_4 was dispersed in 200 ml absolute ethanol and 2 ml APTES was poured into the above solution. This solution was added to 12 mg GO solution and dispersed. The solution of hydrazine and NH_3 was then added to reduce GO. The mixture was filtered and washed with water and dried in air oven at 80 °C for 12 h.

RESULTS AND DISCUSSION

Figure 1(A). a, b and c display the XRD patterns of highly crystalline pure Co_3O_4 (JCPDF: 78- 1969), rGO/Co_3O_4 nanocomposites and rGO respectively. FESEM (Figure 2(B)) shows that nanoflowers are composed of many nanopetals. The nanopetals are curved with ultra sharp edges and sharp tips at the end of each nanoflakes. So graphene wrapped Co_3O_4 provide the protrusions on the surface,which can act an emission sites and enhance the field emission properties.

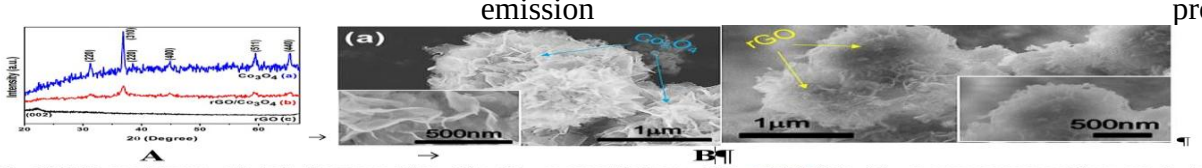

Figure 1(A). XRD pattern of (a) flower-like Co_3O_4 nanoflakes, (b) rGO/Co_3O_4 nanocomposites and (c) rGO
Figure 1(B). FESEM images of (a) flower-like Co_3O_4 nanoflakes and graphene wrapped Co_3O_4 nanoflakes.

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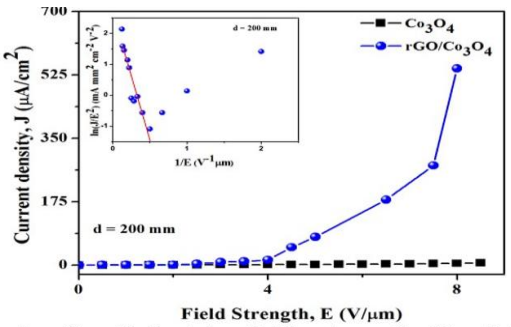
The characteristics can be expressed by the following Fowler–Nordheim (F-N) equation (3)

$$J = \frac{A(\beta E^2)}{\phi} \exp[-\frac{B\phi^{3/2}}{\beta E}]$$

A and B are the constant with the value of $1.56 \times A\ V^{-2}$ eV and 6.83×10^7 V cm^{-1} $eV^{-3/2}$ respectively. β is the field emission enhancement factor.



Figure· 2.· Field· emission· current· density· J-electric· field· strength· E· of· flower-like· Co_3O_4· nanoflakes· and· rGO/Co_3O_4· nanocomposites;· Inset· of· the· figure· shows· the· Fowler–Nordheim· (FN)· plot· of· rGO/Co_3O_4· nanocomposites¶

Fitting curve (The inset of figure 2 - solid line) shows the linear relationship which indicating the field emission behavior from rGO/Co_3O_4 is a barrier tunneling i.e. quantum tunneling process. This nanocomposite showed better field emission properties in comparison with Co_3O_4 nanoflake. The turn-on fields (for 1 μAcm^{-2}) are 0.49 $V\mu m^{-1}$ and 2.99 $V\mu m^{-1}$, β values are 8238 and 4985 for rGO/Co_3O_4 nanocomposite and single phase Co_3O_4 respectively. This enhancement is due to the electron emission from the ultra sharp edges and sharp tips which give the strong local field strength at the end of each flakes of flower-like Co_3O_4. As the electron affinity of rGO (4) is less than the work function of Co_3O_4, a lower energy barrier is established for electrons to escape from rGO sheets to vacuum as a result of the tunneling effect.

CONCLUSION

The rGO/Co_3O_4 nanocomposites has showed low turn-on field at 0.49 $V\mu m^{-1}$ which is much less than pristine Co_3O_4 (2.99 $V\mu m^{-1}$). This enhancement in the field emission is originating from the band structure of the rGO/Co_3O_4 nanocomposites. Localization of electric field at the sharp edges and surface protrusions of the graphene sheets assist the electron transport and improve the enhancement of the field emission of the nanocomposites This nanocomposite material can be suitable for field emission display application.

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Poster Presentation – PP-08

Isolation and Characterization of Arsenic Hypertolerent Bacteria from Arsenic Contaminated Groundwater of Murshidabad District.

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ABSTRACT

Arsenic contamination of aquifers in Bengal Delta Plain (BDP) is geogenic in origin. The soil and aquifer of Bhagbangola I block of Murshidabad district is highly contaminated with arsenic. Groundwater sample collected from drinking-water well of Notun Madanpur village of Bhagbangola I block shows non-permissible level of total arsenic (0.045 ppm) according to the Bureau of Indian Standards (BIS). Biochemical analysis of the water sample indicated that Iron and Manganese exceed the permissible limit of BIS, although coliform is absent in the water sample. An arsenic hypertolerent bacterium was isolated from the aforementioned arsenic contaminated groundwater sample. These bacterium showed resistant to 14.64 mM of arsenic (As(III)) and121.8mM arsenate (As(V)). 16S rDNA sequencing and Scanning Electron Microscopy (SEM) identified thisbacterium as *Acinetobacter junii* having rod shape with a size ~1.1 µm. This bacterium exhibited unhindered growth at 7.71 mM of sodium arsenite and it could bio-transform arsenite into arsenate (100 times less toxic form). The bioremediation potential of the isolated strain of *Acinetobacter junii* could be explored to combat arsenic toxicity of soil, groundwater and wastewater of Murshidabad district.

Keywords: 16S rDNA sequencing; Scanning Electron Microscopy; Arsenic hypertolerent bacteria; *Acinetobacter junii*; Bio-transformation

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Poster Presentation – PP-09

Sulfamethoxazole-Azo-3-Chloro Phenol, Synthesis, Structural Characterization and DNA Binding Study of Its.

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ABSTRACT

4-((4-chloro-2-hydroxyphenyl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide(HL) has been characterized by the single crystal X-ray structure and 1D supramolecular chain shows intra-molecular H-bonding, One dimensional assembly of monomeric units of L ligand π---π interaction of benzene rings. The extended network is shown in green dotted lines. This assembly is viewed along the b axis.

INTRODUCTION

SMX in combination with trimethoprim in co-trimoxazole (Bactrim DS) is an efficient antibiotic since its approval by FDA in 1961 inhibits bacterial synthesis. Sulfonamides (-SO_2NH-) are antibacterial, insulin releasing, anti-inflammatory, and antitumor**.** 3-chloro phenol is a crystalline solid that is homologues of phenol, but it is more reactive. it has been studied for its potential applications in various fields including medicine, due to its potential for antiseptic for animal . In order to minimize the side effects of SMX, coupling of sulfamethoxazolyl-di-azonium salt is carried out with 3-chloro phenol to synthesize 4-((5-formyl-2-hydroxyphenyl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide (HL) which has been used to synthesize 3d transition metal complexes. Azo dyes of sulfa drugs are well known for their antiseptic activity [1-2].

MATERIALS AND METHOD

Sulfamethoxazole (SMX) was purchased from Sigma-Aldrich Chemical Company and used without further purification 4-hydoxy benzaldehyde was purchased from Merck, India. The acetonitrile used for electrochemical studies was dried with CaH_2 and distilled prior to use. The CT DNA was purchased from Sisco Research Laboratories, India, and dissolved in phosphate buffer (pH ~7.4) containing 120 mM NaCl (AR grade, Merck, Germany). The diazotization of sulfamethoxazole (0.5 g, 1.97 mmol) was carried out at 0-5°C in aqueous solution by adding $NaNO_2$ (1.0 g) solution followed by coupling with 3-choro phenol (1 g) in presence of sodium carbonate (2.0 g) in water according to a general literature procedure [3]. Red precipitate filtered and dried at room temperature. It was then recrystallized by slow evaporation of hot alcoholic solution and purity was checked by TLC; yield: 80%.

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RESULT AND DISCUSSION

Empirical formula of L5	$C_{16}H_{13}ClN_4O_4S$
system	Triclinic
Space group	P-1
a(Å)	7.6746(12)
b(Å)	8.9573(15)
c(Å)	13.603(2)
$\alpha/^0$	98.865(9)
β/°	98.892(7)
$\gamma/^0$	106.943(7)
$V(Å)^3$	863.9(2)
Z	2
θ range	1.55 - 27.16
Total reflections	3814
$R_1{}^a$ [I > 2σ (I)]	0.0541

Table 1. Summarized crystal structure of sulfamethoxazole-azo-3-chloro-phenol.

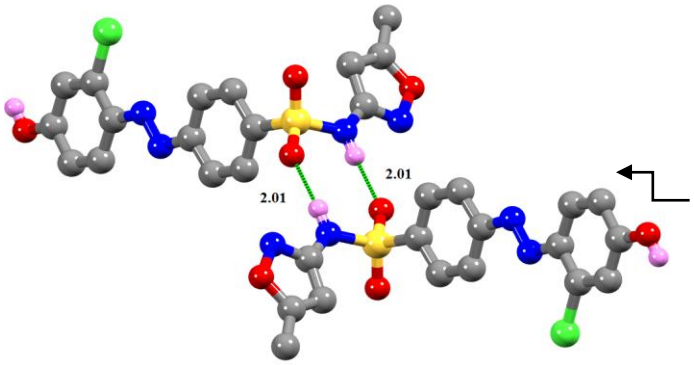

Fig. 1. Formation of 1D tape in ligand through association of inter molecular hydrogen bonding along the b axis. The extended network is shown in green dotted lines.

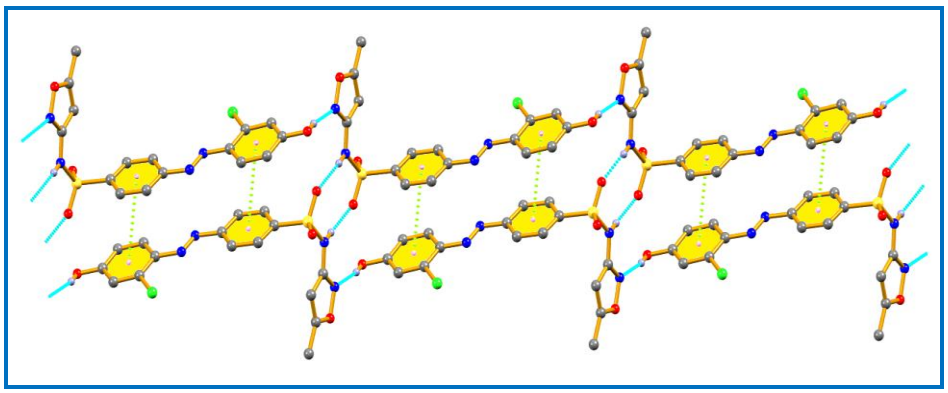

Fig: 2. One dimensional assembly of monomeric units of L5 via π---π interaction of benzene rings. The extended network is shown in green dotted lines. This assembly is viewed along the b axis

CONCLUSION

Single crystal structure of 4-((4-chloro-2-hydroxyphenyl)diazenyl)-N-(5-methylisoxazol-3-yl)benzenesulfonamide (HL) shows 1d supramolecular structure and confirmed by single crystallographic study and mass spectrum .

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