INTERNATIONAL ANALYTICAL SCIENCE CONGRESS - 2025

IASC 2025

METAMORPHOSIS OF ANALYTICAL SCIENCES: INTEGRATING INTERDISCIPLINARY SYNERGIES & AI FOR A SUSTAINABLE FUTURE (MAS : ISAS)

Jointly Organized by

Indian Society of Analytical Scientists (ISAS)
Head Quarters, ISAS Baroda Chapter,
Gujarat & Dept. of Chemistry,
Faculty of Science
The Maharaja Sayajirao University of Baroda,
Vadodara

Co-Organized by

CSIR - Central Salt and Marine Chemicals Research Institute,
Bhavnagar &
Sophisticated Instrumentation Centre for
Applied Research and Testing, Vallabh Vidyanagar, Anand
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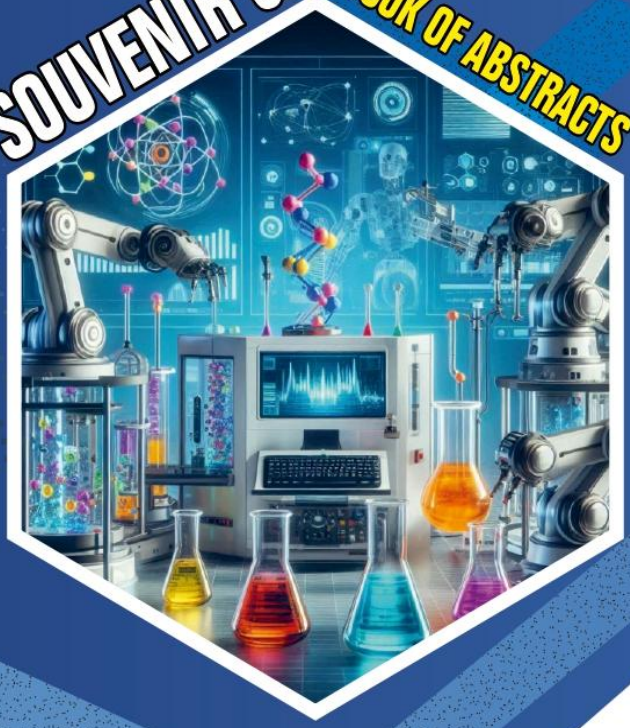

March 6-8, 2025

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INTERNATIONAL ANALYTICAL SCIENCE CONGRESS 2025

SOUVENIR & BOOK OF ABSTRACTS

IASC 2025

Jointly Organized by

Indian Society of Analytical Scientists (ISAS) Head Quarters ISAS Baroda Chapter & Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara

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MESSAGE

Shubhanginiraje Gaekwad
CHANCELLOR

सत्यं शिवं सुन्दरम्
Estd. 1949
Accredited Grade A+ by NAAC

The Maharaja Sayajirao University of Baroda

Message from the Chancellor

I am very glad that the International Analytical Science Congress (IASC-2025) , is set to take place in the cultural capital of Gujarat, Vadodara at The Maharaja Sayajirao University of Baroda during March 6th to 8th 2025. It is heartening to note that the conference, is jointly organized by Department of Chemistry, Faculty of Science and Indian Society of Analytical Scientists (ISAS) Head Quarters, ISAS Baroda Chapter, Gujarat . in collaboration with Central Salt and Marine Chemicals Research Institute, Bhavnagar and Sophisticated Instrumentation Centre for Applied Research and Testing, Vallabh Vidyanagar, Anand .

This three day academic event will provide a platform for analytical chemists that work in academia, research institutes, industries, and laboratories to deliberate on the cutting-edge advancements in analytical technologies and the key developments and applications in the field of analytical sciences. Through this conference, the delegates will get an opportunity to interact with the scientists of their field, industrialists and instrument manufacturers reiterating our commitment to foster academic excellence, students' skill set and universityO industry interactions.

I have great pleasure in welcoming all the delegates, industrialists and exhibitors to the conference and extend my best wishes for the success of IASC-2025.

Rajmata Shubhanginiraje Gaekwad

Chancellor
The Maharaja Sayajirao University of Baroda

Lukshmi Vilas Palace, Jawaharlal Nehru Marg, Vadodara - 390 001, Gujarat, India
Phone : 8511179939 E-mail : chancellor@msubaroda.ac.in

MESSAGE

Prof (Dr.) Dhanesh Patel
Vice Chancellor (I/c)

The Maharaja Sayajirao University of Baroda
(Accredited Grade 'A+' by NAAC)
Maharaja Fatehsinghrao Gaekwad Road, Fatehgunj, Vadodara – 390 002

MESSAGE FROM THE DESK OF VICE CHANCELLOR

It gives me great pleasure to know that the Indian Society of Analytical Scientists (ISAS) Head Quarters, ISAS Baroda Chapter, Gujarat and Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara are jointly organizing the INTERNATIONAL ANALYTICAL SCIENCE CONGRESS 2025 on the theme Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future.

The purpose of the conference is to better understand the role of interdisciplinary concerns and how Machine Learning is enabling complex data analysis facilitating automation of complex tasks

I am sure all of you will enjoy the vibrant academic deliberations with subject experts and industrialists in the conference. This conference provides a very unique opportunity to researchers from all disciplines because of its scope. I heartily extend my warm welcome to all the delegates and participants of IASC-2025.

I wish all success to the organizing committee of the conference and all staff members of the Faculty of Science for organizing this important conference.

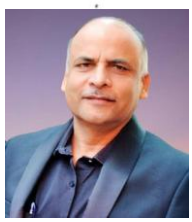
Date : March 3rd,2025

Prof (Dr) Dhanesh Patel
Vice-Chancellor
The Maharaja Sayajirao University of Baroda
Vadodara - 390 002. (Guj.) INDIA

MESSAGE

FACULTY OF SCIENCE
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA
Lokmanya Tilak Road, Sayajigunj
VADODARA-390002
Ph. : (+91-0265) 2795329

Prof. Haribhai Kataria
Dean
Faculty of Science
The Maharaja Sayajirao University of Baroda



MESSAGE

It gives me immense pleasure to lead the team coordinating the **"INTERNATIONAL ANALYTICAL SCIENCE CONGRESS 2025"** jointly organized by Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara and Indian Society of Analytical Scientists (ISAS) Head Quarters, ISAS Baroda Chapter, Gujarat, along with CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar & Sophisticated Instrumentation Centre for Applied Research and Testing, Vallabh Vidyanagar, Anand.

The Faculty of Science has a vibrant research culture in all disciplines with most of the teachers performing research in the thrust areas of their chosen field resulting in a significant number of publications and patents of high impact. We have a close symbiotic interaction with the industries, academic institutions and research laboratories across Gujarat and nearby states utilizing mutual expertise and facilities. I am sure that the conference with the theme "Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future" will provide an inclusive platform for academicians, scientists and industrialists to exchange ideas and foster interdisciplinary research within the thematic areas. I would like to express my appreciation to all committee members of the conference for their hard work, commitment and relentless effort.

I extend my heartfelt best wishes for the grand success of the conference.

Prof. H.R. Kataria
DEAN
Faculty of Science

MESSAGE

Indian Society of Analytical Scientists

Dr. Raghaw Saran
National President, ISAS

MESSAGE

Dear esteemed delegates, distinguished guests, and fellow scientists, As we convene at the international Analytical Science Congress-2025 (IASC-2025), I am honoured to welcome you to this pivotal event poised to shape the future of analytical sciences. Your presence elevates our congress to higher orbit adding a distinct aura and I am excited to share the next three days with you.

We stand at the threshold of a new era in analytical sciences, where interdisciplinary synergies and artificial intelligence converge to shape a sustainable future. The analytical Sciences have long been a driving force for progress and our gathering represents a unique opportunity to share our expertise.

The focal theme of IASC-2025, 'Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future (MAS: ISAS),' reflects our collective aspiration to harness the transformative power of analytical sciences for the betterment of the society.

Over the next three days, we will engage in stimulating discussions, share cutting-edge research, and explore innovative applications of analytical sciences entertwined with advances in AI, machine learning and data analytics. We will delve into the frontiers of interdisciplinary research, where material sciences, life sciences and data science intersect to tackle complex challenges.

As analytical scientists, we have a unique responsibility to drive positive change. We must continue to push the boundaries of innovation, collaborate across disciplines and communicate our findings to the world.

IASC-2025 is more than a conference – it is a celebration of analytical science's power and vibrant dynamism, compelling us to regularly assess the metamorphism transforming our world. It is a platform for us to share our latest discoveries, explore new frontiers and forge partnerships that will shape the future of our field. It is a testament to the boundless potential of human curiosity, creativity and collaboration.

Dr. Raghaw Saran
National President,
ISAS

MESSAGE

Dr. Ashutosh V. Bedekar
Professor and Offg. Head
Email:
head-chem@msubaroda.ac.in

Department of Chemistry
DST FIST Sponsored Department
Faculty of Science
Vadodara 390 002, Gujarat.
(M) 9898530266

The Maharaja Sayajirao University of Baroda, Vadodara

MESSAGE

It gives me a pleasure to welcome you on behalf of the Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda for the International Analytical Science Congress 2025 to be held from 6th to 8th March 2025 in Vadodara. The theme is very appropriate as the field of Analytical Science is undergoing a phase of maturity and becoming a beautiful butterfly. It's truly a multidisciplinary, multidimensional, multifaceted contemporary subject. It encompasses all areas of science, medicine and technology. One can do much better science with the aid of modern analytical techniques. The Analytical Scientists drive and support the technical endeavors of cutting-edge science and technology in academia and industry.

I wish good luck to all the participants and hope these three days of deliberation will be very productive and helpful to all of you.

Ashutosh Bedekar
Offg Head
Department of Chemistry
The Maharaja Sayajirao University of Baroda
Vadodara

MESSAGE

Department of Environmental Studies
Faculty of Science
The Maharaja Sayajirao University of Baroda
Dr. C.V. Raman Building, Vadodara – 390002, INDIA

Prof. P.Padmaja
Vice-Chairman.
Indian Society of Analytical Scientists, Baroda Chapter
Professor, Department of Chemistry
Offg. Head, Department of Environmental Studies,
The Maharaja Sayajirao University of Baroda.

MESSAGE

It is my privilege and honor to welcome you all to the International Analytical Science Congress (IASC-2025) , an esteemed event being jointly organized by **Indian Society of Analytical Scientists (ISAS) Head Quarters, ISAS Baroda Chapter, Gujarat and Department of Chemistry, The Maharaja Sayajirao University of Baroda, Vadodara and co-organized by CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar & Sophisticated Instrumentation Centre for Applied Research and Testing, Vallabh Vidyanagar, Anand**

The three-day conference with the theme "Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future (MAS: ISAS)" will cover the entire scope of Analytical Sciences and its integration with Artificial Intelligence. A technical exhibition has been organized during the conference. Several industries and instrumentation companies will be exhibiting their products. Delegates can interact and collect the information of latest developments in Analytical Instrumentation.

The conference aims to bridge the researchers working in academia and other professionals through research presentations and keynote addresses in current technological trends of Analytical Science.

Together, let us embark on a journey of problem solving, method development, validation incorporating spectroscopy, artificial intelligence and other cutting-edge techniques that transcends boundaries of all branches of science and shapes the future of analytical Science.

Prof. P.Padmaja
Vice-Chairman.
Indian Society of Analytical Scientists, Baroda Chapter
Professor, Department of Chemistry
Offg. Head, Department of Environmental Studies,
Faculty of Science

MESSAGE

Indian Society of Analytical Scientists

Dr. Suneet Kumar Yadav
Chairman,
Indian Society of Analytical Scientists (ISAS), Baroda Chapter,
Gujarat.

MESSAGE

Vadodara is known as the banyan city. Banyan tree symbolises a sustainable growth, not only growing vertically but also expanding its base by transforming it's off shoots as roots. "Indian Society of Analytical Scientists" is an association representing the scientific community. It is expanding like a banyan tree, with at present, a national membership base of more than 3500 scientists through 10 Chapters spread across the country. It is a unique example of leadership where the experienced and renowned scientific leaders keep nurturing and mentoring young researchers which are like off shoots till they grow like another banyan tree.

"International Analytical Science Congress-2025" is a similar conclave where more than a dozen scientific leaders, approx. 50 speakers and more than 200 participants from research institutes, academia, public sectors and industry are participating. This event has been jointly organised by Department of Chemistry, Department of Environmental Sciences, Faculty of Science, The M. S. University of Baroda, Vadodara. CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar and Sophisticated Instrumentation Centre for Applied Research & Testing (SAIF), supported by DST, GOI have joined as co-organisers to make this conference successful. This congress will serve as a platform for meaningful discussions, knowledge exchange, and strategic collaborations across various domains, including pharmaceutical and life sciences, catalysis, material sciences, green chemistry, nuclear science, and nanotechnology.

This landmark event from March 6-8, 2025, promises to be a confluence of knowledge, innovation, and visionary discourse. I am thankful to all academic and research institutes, industrial houses, young researchers and participants for joining this event to make it successful.

On behalf of Indian Society of Analytical Scientists (ISAS), Baroda Chapter, Gujarat, hopes to meet expectations of all dignitaries, speakers, exhibitors, advertisers and participants.

Dr. Suneet Kumar Yadav
Chairman,
Indian Society of Analytical Scientists (ISAS), Baroda Chapter, Gujarat.

MESSAGE

Er. Bhikhubhai B. Patel
CHAIRMAN

CHARUTAR VIDYA MANDAL
P. B. NO. 22, MOTA BAZAR, VALLABH VIDYANAGAR-388 120,
TA & DIST : ANAND, GUJARAT INDIA
PHONE : (O) 02692-238400
Website : www.ecvm.net e-mail : cvmandal@hotmail.com

Message from Chairman, Charutar Vidya Mandal, Vallabh Vidyanagar

It is my great pleasure to extend a warm welcome to all delegates, speakers, and participants of the **International Analytical Science Congress 2025 (IASC-2025)**, an esteemed international gathering dedicated to advancements in analytical sciences. This conference serves as a crucial platform for scientists, researchers, and industry professionals to share knowledge, foster collaborations, and explore emerging trends that shape the future of analytical methodologies and applications.

The field of analytical sciences continues to evolve, playing a vital role in various disciplines, from pharmaceuticals and environmental sciences to material research and beyond. As we navigate an era of rapid technological progress, this conference provides an excellent opportunity to discuss innovative solutions, address contemporary challenges, and inspire the next generation of scientific breakthroughs.

I commend the **ISAS - Indian Society of Analytical Scientists & Conference Co-ordinators** for their dedication in bringing together a distinguished panel of experts and thought leaders. I also extend my best wishes to all participants for fruitful discussions, meaningful connections, and a successful conference.

May this event be a catalyst for new ideas and collaborations that drive the advancement of analytical sciences globally.

With best regards,

25th February, 2025

Er.Bhikhubhai B Patel
Chairman - CVM and
President - CVM University

MESSAGE

सीएसआईआर–केन्द्रीय नमक व समुद्री रसायन अनुसंधान संस्थान
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गिजुभाई बधेका मार्ग, भावनगर – ३६४ ००२, गुजरात, भारत
CSIR-CENTRAL SALT & MARINE CHEMICALS RESEARCH INSTITUTE
(Council of Scientific & Industrial Research)
Gijubhai Badheka Marg, Bhavnagar 364 002, Gujarat, India

डॉ. कन्नन श्रीनिवासन
निदेशक
Dr. Kannan Srinivasan
Director

Message

Dear Participants,

It is with great pleasure that I extend a warm welcome to all of you attending the International Analytical Science Congress (IASC-2025), organized under the aegis of the Indian Society of Analytical Scientists (ISAS) jointly by The Maharaja Sayajirao University of Baroda, Vadodara, CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar and Sophisticated Instrumentation Centre for Applied Research and Testing, Vallabh Vidyanagar. This congress is a major confluence of distinguished scientists, professors, researchers, and industry professionals from multidisciplinary fields and diverse regions to exchange ideas in both fundamental and applied sciences.

The conference will explore transformative topics, including the integration of Artificial Intelligence and Machine Learning in analytical methodologies, green and sustainable chemistry, and other emerging scientific frontiers. These discussions are both timely and essential as we strive to incorporate sustainability, regulatory compliance, and statutory adherence into our practices—playing a pivotal role in shaping the future of science and industry on a global scale.

The congress will feature a rich program of plenary lectures, invited talks, and oral presentations alongside exhibitions showcasing the latest technologies and solutions from leading manufacturers and service providers. I encourage each of you to engage actively, share your insights, and foster collaborations to accelerate the translation of scientific discoveries into real-world applications. I am sure this Congress will provide a platform for students to expose to the latest analytical scientific discoveries and instil enthusiasm to take up challenging problems that could be solved through chemistry sustainably.

I look forward to an enriching experience filled with learning, networking, and innovation.

Wishing a great success for IASC-2025!

Warm regards,

Kannan Srinivasan

Ph. : + 91 - 278 - (O) 2569496 , Fax : + 91 - 278 - 2567562, E-mail : skannan@csmcri.res.in ; director@csmcri.res.in, Website : http://www.csmcri.res.in

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MESSAGE

होमी भाभा राष्ट्रीय संस्थान
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Prof. U. Kamachi Mudali
FNAE, FNASc, FNACE, FASM, FAPAM, FIFHTSE
FICS, FIIM, HFECSI, FIIChE FIE,
FASch, HMIIM, HMUDCTAA
Vice Chancellor

प्रो. यू. कामाची मुदली
FNAE, FNASc, FNACE, FASM, FAPAM, FIFHTSE
FICS, FIIM, HFECSI, FIIChE FIE
FASch, HMIIM, HMUDCTAA
कुलपति

MESSAGE

It gives me great pleasure to know that the Baroda Chapter of the ***Indian Society of Analytical Scientists (ISAS)*** in collaboration with ISAS Head Quarters & Dept. of Chemistry, The Maharaja Sayajirao University, Baroda, is organising an ***International Analytical Science Congress 2025 (IASC-2025)*** at VAdodara during March 6-8, 2025. **ISAC-2025** is co-organized by CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar & Sophisticated Instrumentation Centre for Applied Research and Testing, Vallabh Vidyanagar, Anand, Gujarat. This prestigious event serves as an important platform for exchanging cutting-edge research ideas, innovative research methodologies, and current and emerging trends in analytical sciences and technology. I would like to welcome all distinguished scientists, researchers, academicians, and industry professionals to the International Analytical Science Congress 2025.

Analytical science is undergoing a profound metamorphosis in shaping a sustainable future with more precise, efficient, and eco-friendly analytical solutions (e.g. separations, spectroscopy, detection systems, etc.) driven by the interdisciplinary synergies of diverse disciplines and the rapid advancements in artificial intelligence (AI) and machine learning. Analytical science innovations combined with the use of analytical instrumentation and spectroscopic techniques are revolutionizing how we measure, analyze, and interpret data, and solving complex global challenges - from climate change and environmental sustainability to healthcare, drug discovery, materials design, energy and beyond, etc.

The theme of IASC-2025, "***Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future,***" reflects the transformative role of advanced technologies and the requirement of cross-disciplinary collaborations in redefining analytical techniques, tools and methodologies. In an era where AI witnessed growth in different research areas, automation, and data-driven approaches which are revolutionizing scientific research, it is imperative to explore their integration with traditional analytical techniques for sustainable and impactful outcomes. This conference rightly aims to explore the dynamic convergence of key professionals from multidisciplinary branches of Analytical Sciences and Technology, encompassing different areas of research.

I would like to express my sincere appreciation to the dedicated organizing team for their tireless commitment and outstanding contributions in ensuring the success of this conference. IASC-2025 is set to challenge and inspire all participants, fostering enhanced knowledge, collaborations, and friendships among scholars and professionals alike. Once again, I extend my best wishes for the success of IASC-2025 !

U Kamachi Mudali
(U. Kamachi Mudali) 06/02/2025

MESSAGE

विवेक भसीन
Vivek Bhasin

भारत सरकार
Government of India

निदेशक, भाभा परमाणु अनुसंधान केंद्र
Director, Bhabha Atomic Research Centre
सदस्य, परमाणु ऊर्जा आयोग
Member, Atomic Energy Commission

MESSAGE

I am delighted to extend my warmest greetings to the participants of the International Analytical Science Congress - 2025 (IASC-2025). This premier event brings together esteemed experts from diverse fields to explore the frontiers of analytical sciences. The theme, "*Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future,*" reflects the urgent need for collaboration and innovation in addressing complex global challenges.

I wish the congress all the success in fostering meaningful connections, driving breakthroughs, and shaping a sustainable future for all.

05.02.2025

(Vivek Bhasin)

भाभा परमाणु अनुसंधान केंद्र, ट्रॉम्बे, मुंबई- 400 085, भारत • Bhabha Atomic Research Centre, Trombay, Mumbai 400 085, India
दूरभाष/Phone:+(91) (22) 2550 5300, 2551 1910 • फैक्स/Fax: +(91) (22) 2559 2107, 2550 5151
ई-मेल/E-mail: director@barc.gov.in

MESSAGE

डॉ. अनुपम अग्निहोत्री
निदेशक
Dr. Anupam Agnihotri
Director

जवाहरलाल नेहरु एल्युमीनियम अनुसंधान विकास एवं अभिकल्प केंद्र
(स्वायत्त संसथान, खान मंत्रालय, भारत सरकार के अधीन)
Jawaharlal Nehru Aluminium Research Development & Design Centre
(Autonomous Body under Ministry of Mines, Government of India)
Amravati Road, Wadi, Nagpur - 440023 (India)
Phone : 91-7104-220763 (D), EPABX : 220017, 220476
Email : director@jnarddc.gov.in Website:www.jnarddc.gov.in

Message

As we gather for this momentous event, we proudly celebrate the remarkable journey of the Indian Society of Analytical Scientist and its influential role in shaping a better world. The International Analytical Science Congress 2025 stands as a beacon of innovation and collaboration, uniting diverse disciplines.

The rapid evolution of Artificial Intelligence (AI) and Big Data has ushered in a transformative era for Analytical Sciences, redefining research methodologies, data interpretation, and scientific advancements. The International Analytical Science Congress (IASC) stands as a pivotal platform for fostering collaboration, knowledge exchange, and cutting-edge discussions in multidisciplinary domains of Analytical Sciences.

This year, the conference will delve deeper into the role of AI and analytical instrumentation, underscoring their impact on regulatory and statutory compliance. Attendees will have the opportunity to engage in plenary lectures, invited talks, oral and poster presentations, and exhibitions featuring the latest analytical instruments, software solutions, and laboratory innovations.

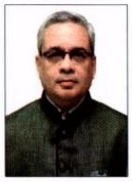
As IASC continues to expand its global reach, it remains committed to fostering excellence, bridging research and industry, and driving the future of Analytical Sciences. We look forward to an enriching and insightful exchange of ideas at this prestigious event.

I WISH ALL THE BEST TO THE CONFERENCE!

(Dr Anupam Agnihotri)

Director

MESSAGE



धीरज पाण्डे
निदेशक
Dheeraj Pande
Director

भारत सरकार
परमाणु ऊर्जा विभाग
परमाणु खनिज अन्वेषण एवं अनुसंधान निदेशालय
Government of India
Department of Atomic Energy
Atomic Minerals Directorate for Exploration and Research

MESSAGE

It is with great pleasure that I extend my best wishes to the International Analytical Science Congress 2025 (IASC-2025), organised by the Baroda Chapter of the Indian Society of Analytical Scientists (ISAS). The theme "Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future", aptly reflects the transformative role of artificial intelligence (AI), automation and interdisciplinary collaborations in redefining analytical sciences. AI's ability to process vast datasets, detect patterns and optimize complex processes has revolutionised research and industry. With machine learning, predictive analytics and real-time monitoring, analytical sciences are evolving toward greater precision, efficiency and sustainability, shaping a smarter and technologically advanced future.

The future of analytical sciences is poised for unprecedented advancements with AI-driven automation, robotics and quantum computing revolutionizing traditional methodologies. These technologies will not only accelerate innovation in critical sectors such as healthcare, energy, space exploration and climate science but also drive sustainability by enabling cleaner and more efficient industrial processes. The incorporation of AI in regulatory frameworks, e-waste management and ecological balance will further strengthen our commitment to a greener, more sustainable future.

As the world transitions towards a future where the human intelligence and AI work in synergy, the role of analytical sciences will play a pivotal role in shaping an interconnected and technologically advanced society. Platforms like IASC-2025 serve as catalysts for knowledge exchange, fostering global collaborations and drive next-generation innovations.

I congratulate the organisers for uniting leading scientists, academicians, technologists and industry experts to deliberate on emerging challenges, breakthroughs and futuristic trends. I am confident that the insights and innovations shared during this congress will contribute to the continued evolution of analytical sciences, ensuring a smarter, more sustainable and technologically empowered world.

I extend my best wishes for the grand success of IASC-2025 and look forward to the pioneering discussions that will shape the future of science and technology.

(धीरज पाण्डे Dheeraj Pande)

1-10-153-156, बेगमपेट Begumpet
हैदराबाद Hyderabad - 500 016
दूरभाष / Telephone : 040-27766791 (O) / +91 7568148978 (M)
फैक्स / Fax: 040-29556972 ई-मेल / E-Mail : director.amd@gov.in

PREFACE

Indian Society of Analytical Scientists
(Baroda Chapter)

Prof. P. Padmaja
Vice Chairman,
ISAS Baroda Chapter, Gujarat

PREFACE

It is an absolute pleasure to welcome you all to the International Analytical Science Congress (IASC) 2025, organized by the Indian Society of Analytical Scientists (ISAS) at The Maharaja Sayajirao University of Baroda, Vadodara. This prestigious event is a milestone in our shared journey of advancing analytical sciences, fostering collaboration, and embracing technological innovations that are shaping the future.

We are currently witnessing a transformative era driven by Big Data, where Artificial Intelligence (AI) is reshaping industries, including the field of analytical sciences. The integration of Big Data analytics with advanced instrumentation and spectroscopic techniques is unlocking new possibilities, enhancing precision, efficiency, and sustainability in both scientific research and industrial applications.

The central theme of this year's conference, **"Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future (MAS: ISAS),"** reflects the evolving landscape of analytical sciences and the crucial role of interdisciplinary collaboration and AI in driving sustainable advancements.

IASC 2025 continues to serve as a premier platform for bringing together eminent scientists, technocrats, academicians, industry leaders, and applied researchers from across the globe. Since its expansion from a National Congress to an International Congress in 2024, the event has garnered significant global recognition, attracting distinguished researchers and experts from diverse scientific domains.

This year's conference will highlight cutting-edge developments across various fields, including Chemical and Material Science, Polymer Science, Life Science, Healthcare, Environment, Pharmaceuticals, Nuclear & Petroleum Industries, Nanotechnology, Biotechnology, and Agriculture. We will place special emphasis on the role of AI, Big Data analytics, and sustainable practices in analytical sciences. Discussions will also cover green analytical chemistry, innovative sample preparation techniques, product development, material characterization, and regulatory compliance.

Indian Society of Analytical Scientists
(Baroda Chapter)

Our scientific program includes Plenary Lectures, Invited Lectures, Oral Presentations, and Poster Sessions, providing a comprehensive outlook on emerging trends and discoveries. Additionally, the conference will feature exhibitions and stalls showcasing the latest innovations from leading analytical instrument manufacturers, laboratory service providers, and AI solution integrators.

We are honoured to have distinguished speakers and experts from academia, industry, and government, whose insights will help us explore how analytical sciences can address global challenges in environmental protection, healthcare, food safety, and energy security.

We express our sincere gratitude to all our sponsors, partners, organizers, committees, volunteers, and attendees. Your dedication and participation make IASC 2025 an intellectually stimulating and enriching experience.

I encourage you to make the most of this platform learn, connect, exchange ideas, and discover new possibilities. Wishing you all an engaging and successful conference!

Sincerely,

Prof. P. Padmaja
Vice Chairman,
ISAS Baroda Chapter, Gujarat

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WHERE COMMITMENT IS CULTURE

THE CONFERENCE

THE CONFERENCE

The Big Data era is a 21st century revolution in Artificial Intelligence (AI). Big Data, coupled with new data analytics, has engendered paradigm shifts across the analytical science discipline. The International Analytical Science Congress (IASC) is being organized periodically by the Indian Society of Analytical Scientists. It aims to bring together eminent scientists, technocrats, professors, industrialists and applied researchers working at the forefront of Analytical Science.

IASC has been well-received by eminent scientists and researchers worldwide and has expanded its scope from a NATIONAL Congress to an INTERNATIONAL Congress since 2024. Several overseas scientists and researchers have endorsed it as a unique platform for analytical sciences by voluntarily offering their participation in this event. The conference will focus on recent developments in multidisciplinary branches of Analytical Sciences, encompassing different areas of research such as Chemical and Material Science, Polymer Science, Life Science, Health, Environment, Pharmaceutical, Nuclear & Petroleum industry, Nanotechnology, Biotechnology, and Agriculture. The program will also deliberate on the latest advancements in the expanding fields of sample preparation, product development & characterization and successful scale up using green analytical chemistry, as embracing sustainability is an important facet of analytical sciences in light of global environmental concerns. The conference further aims to unravel the transformative potential of AI, which, along with the combined use of analytical instrumentation and spectroscopic techniques, has led to the metamorphosis of analytical sciences. The role of analytical sciences in regulatory and statutory requirements and compliances is also gaining prominent focus these days.

The proceedings of the conference will include Plenary lectures, Invited talks, and Oral presentations of research work/theses and posters. The conference will also hold exhibitions, stalls, and presentations from Analytical instrument manufacturers and dealers, laboratory accessory and service providers, and software, digital, and AI solution providers and integrators, showcasing state-of-the-art developments in Analytical instruments.

THE SOCIETY

INDIAN SOCIETY OF ANALYTICAL SCIENTISTS

ISAS, the Indian Society of Analytical Scientists, is a premier scientific body in the country with the sole objective of providing a nodal forum for multidisciplinary Sciences, Technology, R&D, Academia, and Industry to reap the benefits of new Research and Developments for the common populace.

The Society was established in 1983 at the Bhabha Atomic Research Centre as its headquarters, nearly four decades ago, and has over 3500+ members with 10 chapters spread across a wide part of the country. Since its inception, the Society has been involved in realizing the pivotal objective of disseminating science from the grassroots. During the past 40 years, the Society, a professional body of analytical scientists, has been engaged in assessing and analyzing the impact of analytical sciences in almost every walk of life, employing the latest state-of-the-art analytical techniques, including on-site analytical techniques like LIBS. With this objective in view, the Society has organized 18thAnalytical Science Congresses (annually one), over 45 national and international conferences on various relevant topics of interest to the scientific community, keeping the metamorphosis of analysis in mind. These conferences were very well attended by leading professionals from India and abroad. Besides, a large number of workshops, seminars, invited talks, and several student-based activities such as quizzes, essay writing, and debate competitions, etc., were also organized by the Society.

ISAS has organized more than 38 Conferences and 78 webinars to commemorate Azadi ka Amrit Mahotsav, and an e-book titled "Azadi ka Amrit Mahotsav - a few excerpts" was released. The Society publishes the Journal of ISAS, an open-access, peer-reviewed, quarterly e-Journal, free of charge (for both authors and readers) with DOIs, to bring research articles related to analytical and allied fields such as process development, instrumentation, statistical analysis, environmental analysis, and life sciences. The Society also publishes its e-newsletter. The Society has instituted various awards such as Lifetime Achievement awards, Awards of Excellence, Aatmanirbhara awards, etc., for outstanding Scientists and technocrats besides Fellowships of ISAS.

ISAS Baroda Chapter, Gujarat:

The ISAS Baroda Chapter was incepted in 1993 with its head office at the Indian Petrochemicals Corporation Ltd (presently Reliance Industries) in Vadodara. Presently, the head office is located in the Department of Chemistry, The Maharaja Sayajirao University of Baroda. The Baroda Chapter includes several members spanning the entire cross-section of Academic, R&D Institutions, Chemical and Pharmaceutical industries, and Environmental Sciences.

The Baroda Chapter has been at the forefront in popularising Analytical Sciences in the region by organising several activities such as conferences, workshops, industrial visits, invited talks etc and by bringing the sophisticated analytical instruments suppliers, students and scientific community together.

VADODARA

ABOUT VADODARA

Vadodara, formerly known as Baroda, is Gujarat's third-largest city and its cultural capital. The name originates from *Vatpatraka*, meaning the land of Banyan trees, which later evolved into Vadodara. The city has a rich history, once ruled by the Gaekwads, who transformed it into an educational and architectural hub. One of the most iconic landmarks is the Laxmi Vilas Palace, the residence of the royal family, which is four times the size of Buckingham Palace. The Sayaji Garden (Kamatibaug), spread across 113 acres, features a zoo, a planetarium, and the Baroda Museum & Picture Gallery. The Champaner-Pavagadh Archaeological Park, a UNESCO World Heritage Site, offers stunning Indo-Islamic architecture and historic ruins which is just 40 kilometers from the city.

Vadodara is also famous for Navratri Garba, drawing enthusiasts from across the world. The city's bustling markets offer traditional sarees, handicrafts, and exquisite jewelry. With its blend of history, culture, and modernity, Vadodara remains a must-visit destination in Gujarat.

THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

LUKSHMI VILAS PALACE

NAVRATRI FESTIVAL OF VADODARA

SURSAGAR LAKE

BARODA MUSEUM AND PICTURE ART GALLERY

ABOUT MSU, BARODA

The Maharaja Sayajirao University of Baroda

The Maharaja Sayajirao University of Baroda (MSU), originally founded in 1881 as the “Baroda College” and subsequently established on 30th April 1949, is a premier unitary residential university of India. The university has a huge campus with magnificent heritage buildings spread across the city of Vadodara. The university has 14 faculties, 3 constituent colleges, 9 institutions, and 7 centres of specialized study.

The Faculty of Science is a Constituent Institution of MSU, Baroda. With its roots in the year 1881, the faculty comprises twelve departments that offer under-graduate, post- graduate and doctoral programmes in areas encompassing Physical Sciences, Chemical Sciences, Life Sciences as well as Mathematical, Environmental and Computer Sciences.

The largest department of the faculty is the Department of Chemistry which is internationally acclaimed as one of the best centres for teaching and research in various aspects of chemistry in Western India.

Faculty of Science

The Faculty of Science is a Constituent Institution of the Maharaja Sayajirao University of Baroda under the direct management and control of the University. The Faculty of Science comprises twelve departments covering almost all the branches in modern science. It offers B.Sc. (Hons.) and M.Sc. courses in most disciplines. Science research is an activity of utmost importance in the faculty. Almost, all departments are DRS, SAP and FIST recognized. The faculty of science has been a beneficiary of PURSE programme and various departments have been supported by DST, FIST, UGC CAS. DBT Builder etc.

The researchers have been supported by number of individual research projects from various funding agencies such as DST, SERB, CSIR, BRNS, UGC etc. Various departments of Faculty of Science are well equipped with several sophisticated instruments procured under these schemes. The Faculty of Science, with regular academic activities provides a platform for interaction with national and international eminent scientists as well as practical training on Sophisticated instruments to its budding researchers.

Department of Chemistry

The Department of Chemistry was established in 1949. The department offers 3 years B.Sc. Hons. in Chemistry, 2 years M.Sc. Course with specialization in Organic, Inorganic, Analytical, Physical and Polymer Chemistry and Industrial & Sustainable Chemistry and Ph.D. course. The department has a vibrant research culture with support from UGC-CAS and DST-FIST I&II. The researchers of the department have projects funded by various funding agencies- CSIR, DSTSERB, DBT, UGC, UGC-DAE, BRNS, GUJCOST and GSTBM.

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Dr. Raghaw Saran
National President, ISAS & International Analytical Science Congress, 2025
E-Mail: president@isasbharat.in, saranraghav@gmail.com
Mob.: (+91) 937-113-6828

CHAIRMAN

Dr. Suneet Kumar Yadav
E-Mail: s.k.yadav@sud-chemie-india.com, drsuneetyadav@gmail.com
Mob.: (+91) 982-520-6334

VICE-CHAIRMAN

Prof. Padmaja Sudhakar
E-Mail: p_padmaja2001@yahoo.com, padmaja.sudhakar-chem@msubaroda.ac.in
Mob.: (+91) 937-621-4733

CONVENERS

Prof. A. V. Bedekar, Head (Department of Chemistry), The Maharaj Sayajirao University of Baroda, Vadodara
E-Mail: head-chem@msubaroda.ac.in
Mob.: (+91) 989-853-0266

Dr. Sunil Soni, Secretary, ISAS Baroda Chapter, Gujarat & International Analytical Science Congress, 2025
E-Mail: sunil.soni@ril.com
Mob.: (+91) 760-005-3790

COMMITTEE

CO-CONVENERS

Dr. Divesh N. Srivastava,
Chief Scientist, CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar (Gujarat)
E-Mail: dnsrivastava@csmcri.res.in
Mob.: (+91) 987-958-1259

Dr. Shobhit Singh Chauhan, Senior Principal Scientist, CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar (Gujarat)
E-Mail: shobhit@csmcri.res.in
Mob.: (+91) 942-718-1460

Dr. Kaushik Nath, Principal,
G. H. Patel College of Engineering & Technology (GCET) and Dean R & D, CVM University
E-Mail: principal.gcet@cvmu.edu.in
Mob.: (+91) 987-913-9675

TREASURER

Mr. J. J. Makwana,
ISAS Baroda Chapter, Gujarat & IASC, 2025
E-Mail: Jayantibhai87@gmail.com
Mob.: (+91) 999-800-2346

Dr. Sandeep Patil,
Associate Professor, Navrachana University, IASC, 2025
E-Mail: sandeepp@nuv.ac.in
Mob.: (+91) 909-915-9480

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INDIAN SOCIETY OF ANALYTICAL SCIENTISTS
82, Swamy Colony, Phase II
Kotal Road, Nagpur, 440013
webmail : organizer@iasc2025.in
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5	Abstract Book	Prof. Kalpana Gopalakrishnan Ms. Radhika Rao Ms. Hetvi Dave Ms. Arunima Khare Mr. Prerak Pathak Ms. Shruti Chaudhari
6	Certificate	Dr. Rina Soni Dr. Akanksha Bharadwaj Dr. Bidya Rani Mr. Jay Patel Mr. Miraj Patel Ms. Shruti Chaudhari
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8	Food	Dr. Hemant Soni Mr. Sudhir Kataria Mr. Jagrut Rao
9	Poster/Exhibition stalls	Dr. Amar Ballabh Dr. Arun Patel Dr. Shilpi Jain Ms. Jagruti Gurjar Mr. Soumyadeep Choudhury Mr. Prerak Pathak
10	Technical	Prof. Prakash Samnani Dr. Maitrey Travadi Mr. naman Shah Mr. Narottam Priyadarshi
11	Cultural Programme	Faculty of Performing Arts and team Prof. Bhavna Trivedi Ms. Prachi Vyas Ms. Mridu Kulwant Ms. Jagriti Patel

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13	Registration desk & Kit Distribution	Prof. Bhavna Trivedi Dr. Ankita Upadhyay Dr. Uma Hapani Dr. Bidya Rani Mrs. Revathi Ganesh Ms. Yuti Desai Ms. Mridu Kulwant Ms. Grishma Vala Mr. Kashyap Patel Ms. Kinjal Parmar Mr. Ashutosh Rana Ms. Shraddha Kanzariya Ms. Boushra Abboud
14	Photography	Mr. Mukesh Mr. Rohan Peshwani Ms. Shraddha Kanzariya

EDITOR

Dr. Kalpana Gopalakrishnan

Editor

EDITOR

It is with immense pride and great pleasure that I extend my warm greetings to all the eminent speakers, esteemed researchers and young scientists participating in the International Analytical Science Congress 2025 (MAS: ISAS). The theme of this year's congress, *"Metamorphosis of Analytical Sciences: Integrating Interdisciplinary Synergies & AI for a Sustainable Future"*, underscores the dynamic evolution of analytical sciences.

This congress serves as a global platform that fosters collaboration among experts from academia, industry, and research organizations. The diverse technical sessions, including plenary lectures, keynote addresses, invited lectures, oral presentations, and poster presentations, are designed to provide deep insights into pioneering research and technological innovations across multiple disciplines. The discussions will highlight broadly the cutting-edge developments in environmental sustainability, pharmaceuticals and agriculture made possible through the integration of AI-driven analytical tools with advanced spectroscopic and instrumental techniques is redefining precision, accuracy.

As we celebrate the continued expansion of ISAS from a national to an international platform, we take pride in the participation of renowned scientists and researchers from across the globe, who bring forth their valuable expertise and perspectives.

I sincerely thank our esteemed speakers, organizing committee, sponsors, and participants for their unwavering commitment to making this congress a grand success. I am confident that this event will stimulate thought-provoking discussions, foster meaningful collaborations, and pave the way for groundbreaking discoveries that contribute to a sustainable and technology-driven future.

Wishing you all an enriching and intellectually stimulating experience at **MAS: ISAS 2025**.

Kalpana

Dr. Kalpana Gopalakrishnan

Editor

International Analytical Science Congress 2025

CONTENT

PLENARY LECTURES		
Sr. No.	**Title of the talk**	**Presenting author**
1	Affordable Clean Water using Advanced Materials	Thalappil Pradeep
2	Development of Materials, Processes and Products for Nuclear Sector: Role of Analytical Sciences	Dr. A. K. Tyagi
3	Role of Analytical Sciences in Renewable Energy	Dr. S. S. V. Ramakumar
4	Sustainable Product Development	Dr. T Rajmannar

KEYNOTE LECTURES		
Sr. No.	**Title of the talk**	**Presenting author**
1	Innovation Simplified in AI LED World. Fast and Affordable Will be Key to Wealth Generation.	Dr. Ajay Ranka
2	Inventing, Innovating and Implementing Technologies	Dr. R.V. Jasra
3	Sustainable S&T Led Solutions - Recent Case Studies @ CSIR-CSMCRI	Dr. Kannan Srinivasan
4	Data-Driven Insights by Analytical Science for Decarbonisation of Aluminium Sector	Anupam Agnihotri
5	Waste Management in Mining and Milling activities of Uranium Corporation of India Limited	Dr. S. K. Satpati
6	Sustainability and Circular Economy Initiatives in Indian Cement Industry	L.P. Singh
7	Identification and Control of Harmful Impurities Such as Nitrosamines in Pharmaceutical Products	Dr. Mrunal Atul Jaywant
8	Nexus of Nanotechnology, Analytical and Environmental Chemistry for the Production of Hydrogen Fuel and Environmental Remediation	Rengaraj Selvaraj
9	Utilizing Nanotechnologies In The Enhanced Treatment Of Cancer	Dr. Ajay Khopade
10	Strengthening India's Supply Chain for Nuclear Fuel and Critical Minerals to Achieve Net-Zero Emission by 2070	Dr. Dhiraj Pande
11	Challenges in Process Development of Generic Drugs and Case Studies	Dr. Kaptan Singh
12	Structural Rearrangements of the Metalloenzyme for Efficient Catalysis Were Revealed by Electron Paramagnetic Resonance Spectroscopy.	M. Horitani
13	How has the Low-Cost Microwave Plasma Atomic Emission Spectrometry (MP-AES) Changed the Face of Trace Element Analysis in the Global Application Landscape?	V. Balaram
14	Computational Design of Highly Efficient Hydrogen Storage Materials: Carbon Allotropes	Prafulla K Jha

INVITED LECTURES		
Sr. No.	**Title of the talk**	**Presenting author**
1	Exploring Sandstone-Hosted Uranium Resources in India	Ashok kumar Padhi
2	Nanoparticles and their Application in Tissue Engineering and Regenerative Medicine	Raghaw Saran

CONTENT

INVITED LECTURES		
Sr. No.	**Title of the talk**	**Presenting Author**
3	Data Analytics and Modern-Day Computing	Prof. Muralidharan
4	The Role of Analytical Scientists in Strengthening Chemical Security Frameworks	Dr. V.K Jain
5	Bio Synthesized Zinc Nanoparticles for Textile Wastewater Remediation in Mangrove Ecosystems: Techno-Economic Feasibility and Societal Acceptance	Prof. Bhawana Pathak
6	Exploring Microbial Biomolecules for their Functional Capacities: Role of Analytical Techniques in Characterization and Applications and their Future Directions	Dr. K Karthikeyan
7	Nalsun-ng tm solar absorber coating technology as a sustainable renewable energy solution	Dr. Harish C. Barshila
8	Analytical Applications of Thermal Analysis	Dr. Naina Raje
9	Analytical Method Development: An Enhanced Approach with Projectile Additives	Dr. Chitan Dholakia
10	Assessment of Critical Minerals in India: Opportunities and Challenges	Upendra Singh
11	Polydopamine Modified Superparamagnetic Nanoparticles for Enhanced Cellular Uptake and Intracellular Delivery of DTX for Targeted Prostate Cancer Treatment	N. Singh
12	Catalytic Hydrogenation and Methylation Using Methanol	Dr. Sanjay Pratihar
13	Difference Between QC and Discriminatory Dissolution Testing	Dr. Ashutosh Sharma
14	Micro-mesoporous Hierarchical Solid Acid Catalysts for Industrial Applications	Prof. Rajib Bandyopadhyay
15	Bio molecule characterization: Peptide and Protein	Dr. Rohit Jadhav
16	Nitrosamine Impurity Monitoring	Dr. Usmangani K. Chhalotiya
17	Legal Status of Food Safety and Statutory Requirements in India	Dr. Prem Kumar Jaiswal
18	Exploring Material Behavior Under Extreme Conditions through Raman Spectroscopy	Dr. Pallavi Ghalsasi
19	Historical Development of LED-Fluorimeter: A Versatile Portable Instrument for Measurement of Uranium in Water, Rocks, Minerals and other Diverse Matrices	D.P.S. Rathore
20	Targeted Imaging of Estrogen Receptor-Positive Cancer Cells Using Fluorescent Estradiol Probes	Sriram Kanvah Gundimeda
21	Leveraging Catalyst Innovations to Address the Challenges of Refining Industry in an Era of Energy Transition	K. O. Xavier
22	Gelator Free Gelled Microemulsions: Rheology and Structure Property Correlation	Dr. Sandeep Patil
23	Forensic Science in Cosmetics, Jewellery and Criminology- An Analytical Investigation and Findings using X-ray Spectroscopy	Daisy Joseph
24	Addressing Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Contamination in Indian Waters: Risks, Analysis, Challenges, and Biochar-Based Sustainable Remediation Strategies	Prof. Dinesh Mohan
25	Pyrolysis – A Promising Technique for Plastic Waste Management	Dr. Nitin Bhate

CONTENT

Sr. No.	Title of the talk	Presenting Author
26	Nanostructured Materials & Nanocarriers: Implications in Cell Imaging & Stimuli Responsive Drug Release	Dr. Sumit Kumar Pramanik
27	AI-Driven Computational Chemistry: Transforming Medicinal Chemistry for a Sustainable Future	Dr. Prashant R Murumkar
28	Surface Spectroscopy for the Molecular Insights into Reverse Water Gas Shift Catalyst Design	Dr. C P Vinod
29	Atoms 4 Humanity: Non-Power Application of Nuclear Energy	Dr. Pradeep Mukherjee
30	Current Status of Emerging Persistent Organic Pollutants: Fire Retardants (PBDES) and Pesticides (OCIPS)	Neeta Pradip Thacker

SHORT LECTURES

Sr. No.	Title of the talk	Presenting author
1	Interference of Chloride in the Analysis of Chemical Oxygen Demand (COD) a Key Parameter to Identify Organic Pollution Levels	Mr. Babubhai Patel
2	Nanofilm Composite Membranes for Precision Separation	Dr. Santanu Karan
3	Global Leader in Catalyst Characterization Solutions	Mr. Kunal Sharma
4		Dr. Sunanda Borah
5	Horiba Solutions for Advanced Materials and Technology	Horiba
6		Mr. Sumeet Verma
7	Catalyst for Protection of Environment and Sustainabilty	PAES Srinivas
8	Nature or Petrochemistry? Biodegradable Nanocomposite Films for Smart Food Packaging and Biomedical Applications	Kantharaju Kamanna
9	Laboratory quality management system as per ISO IEC 17025.	Dr. Brijesh Parekh
10	Ceria Based Electrolytes for Intermediate-Temperature Solid Oxide Fuel Cells	J. Manjanna
11	Reverse Engineering in Polymer and Petrochemical Using Spectroscopy	Mr. Sandip Jagtap

ORAL PRESENTATIONS

Sr. No.	Title of the talk	Presenting author
1	Efficient Removal of Crystal Violet Dye from its Aqueous Solutions Using Advanced Nanostructured Halide–Free Adsorbent Material	Bharti Gaur
2	Recent Development in the Fabrication of Nanostructured Material-Based Opto-Electrochemical Sensors to Detect Heavy Metals	Jyoti Sharma
3	Microwave-Assisted Synthesis of CQD-Embedded Cu_2O Nanoparticles: Characterization and Potential Applications	Bhimarao M.Patil
4	Accurate & Precise Determination of Rare Earth Elements in Geological Materials by ICPTMS Spectrometry	C. Perumalsamy
5	Measurement of Uncertainties in the Process Control Checks of Solid Propellant Slurry	Sreedevi M S
6	Innovative Analytical Gradient Elution Method on Refractive Index (RI) Detector for Complex Liposome Formulations	Ruturaj K Sutarsandhiya
7	Enviro Friendly, ZDHC Confirmed Modified Starch as Sizing Solutions for Textile Sector	Samir Shah, Mahesh Dalal
8	Sustainable Protocol for the Synthesis of 4h-Chromenes Using Li-Doped Graphitic Carbon Nitride-Based Photocatalysts	Dhavalkumar Bhanderia
9	Synthesis and Characterization of Microporous Carbon from Vinylidene Polymer and its Gas Adsorption Properties	Sangeetha S.
10	Sustainable Hybrid Air Breathing Ion Propulsion for Green Aerospace and Space Applications	MM Rais Saiyed
11	Fingerprinting Profiling of Polyherbal Formulations	Rakhi Mishra

CONTENT

ORAL PRESENTATIONS		
Sr. No.	**Title of the talk**	**Presenting author**
12	Role of the Allosteric Site in Regulating Omega Loop Dynamics in Novel B-Lactamase (TEM-224) and it's Contribution to the Evolution of New IRTEM Variants: Insights from Analytical Computational Chemistry	Prof. Devjani I Banerjee
13	Electrocoagulation as a Sustainable Decentralized Solution for Sewage Treatment	Upasani Riddhi K.
14	Amide-Functionalized Polymer for Efficient Removal of Hexavalent Chromium from Aqueous Solution	Sandipkumar P. Suthar
16	Study of Amine Modified Biochar for Heavy Metal Ions Remediation from Wastewater and Catalysis in C-C Bond Formation Reaction	Archana Rani
17	Studies on Zr Based Mixed-Matrix Membranes for Selective Removal of Color from Waste Water	Meet Patel
18	Valorisation of Ipomoea Batatas Peel as Biochar for the Effective Removal of Heavy Metals and Dyes from Wastewater Solutions	Radhika Rao
19	Digital Transformation of Research Laboratories Using Unified Laboratory Intelligence System (ULIS)	Ravindra Kumar
20	Data-Driven AI/ML Methods for Environmental Science, Materials, and Catalysis: Innovations and Applications	Soujanya Yarasi
21	Modeling Molecular Spectra with Artificial Intelligence Algorithms to Enhance Detection Sensitivity	Debjani Bagchi
22	Quantifying The Morphometric and Surface Runoff Characteristics to Prioritize the Watershed for Flood Scenario	Dhara Kakwani

POSTER PRESENTATIONS		
Sr. No.	**Title of the talk**	**Presenting author**
1	Fingerprint Profiling of Herbal Formulation	Rohit Agrahari
2	Microbial Analysis of Cultivable Bacillus Isolates of Sea Water and Saline Regions of Western India	Krishna Patel
3	Current Regulatory Requirements for Bioequivalence Studies in Pharma Research and Development	Vijay Masiwal
4	Regulatory Requirement and Recent Evolution in Measurement of Liquid Particulate Matter in Pharmaceutical Dosage Form	Mahendra Patel
5	Development and Validation of a Stability Indicating HPLC Method for the Impurity Profiling of Miltefosine: A Non-Chromophoric Drug	Vijay Chavada
6	Synthesis of Novel Bixanthene for Evaluation of their Anticancer Activity against Breast Cancer	Meera Mori
7	Nanostructuring of Mn-Based Superparamagnetic Metal-Organic Frameworks	Saumaya Kirti
8	A Brief Review on Recent Trends in Supercapacitor Nanocomposites	Sumit Lad
9	ZnO/DTPA and ZnO/TMA Nanocomposites: Synthesis, Characterisation and Their Activity for Peroxide Degradation of Dyes and Dye Mixtures	Hetvi Dave

CONTENT

POSTER PRESENTATIONS		
Sr. No.	**Title of the talk**	**Presenting author**
10	Assessing RO Brine Water for Agricultural Sustainability: Effects on Crops and Soil	Shreya Patel
11	Reducing Biuret, Enhancing Sustainability: Eco-Conscious Approaches to Urea Production	Rekha Patel
12	The Use of Zirconium Amino Tris (Methylenephosphonic Acid) (Zr-ATMP) in the Removal of Water Soluble Dye by Adsorption Process	Krishna G Panchal
13	Review on Small Scale Biodiesel Production for Self-Sustainability	Deepakkumar S. Jani, Nikul K. Patel
14	Stability Studies on Opuntia Elatior Mill Fruit Juice: Effect of Natural Preservatives on Betanin Content and Microbial Growth	Dhruvi Patel
15	Biodegradable Polymers for Sustainable Agricultural Applications	Sakshi Nangia
16	Sorption Behaviour of Ti based Hybrid Tetra Valent Metal Acid Salts Towards Rare Earth Metal Ions	Dhara Patel
17	Advancing Biodegradable Plastics from Solanum Tuberosum L. through Method Optimization: A Sustainable Solution to Mitigate Plastic Pollution	Pinaki Parmar
18	Sustainable Methods for Heavy Metal Extraction from Electroplating Effluents	Mr. Brijesh Prajapati
19	Advancing MSWI Fly-Ash Management: Characterization and Chloride Removal Studies	Yuti Desai
20	Sustainable Dye Degradation Using Nanocomposited Cellulose Hydrogel Derived from Typha Angustifolia L.	Nayan Nimavat
21	Enhanced Adsorption Efficiency of Carbon Nanotube through Hydrogen and Chlorine Passivation for Water Purification: A DFT And Molecular Dynamics Perspective	Riddhi D. Sainda
22	High Precision Automated Helium Gas Pycnometer: A Green Method for the Measurement of True Density of Solid Propellant	Soyamol Thomas
23	Comparative Study of Various Poly(D,L-lactic acid) by using Size Exclusion Chromatography with Multiple Detection	Chandan Kumar Karan
24	A Novel Strategy for Mercury Sensing using Nitrogen and Sulphur-Doped Carbon Dots with an On-Off Mechanism	Rahul Chauhan
25	Development and Validation of Rapid and Facile Analytical Method for Determination of Related Substances and Assay of Guanidine By RP-HPLC	Dr. Shardul Bhatt
26	Green Approach for Analytical Method Development and Validation for Quantification of Enzyme by High Performance Liquid Chromatography	Dhruv Gaikwad
27	Spectrophotometric Study of Silver (II) complex with Thiosemicarbazone Derivative in Solution State	Jyoti Ajudiya

CONTENT

POSTER PRESENTATIONS		
Sr. No.	**Title of the talk**	**Presenting author**
28	A Chemodosimeter Approach: Design and Development of "Turn-Off" Anthracene based Fluorescent Molecular Probe for the Detection of Fe^{3+} and OH^- Ions in Aqueous Medium	Jyotsna Bhawar
29	Phospholipids, Polyphenols and Fixed Oil Composition of Pennisetum Glaucum (L.) R. Br. (Pearl Millet)	Pankaj Sharma
30	Solubility Behavior of 1-Nitronaphthalene in H_2SO_4: Effects of Acid Concentration and Temperature	Jay H. Tailor
31	Effect of Diamine and Post Curing on Properties of Polyimides Synthesized via One-Step Route	Roopa Dimple
32	Visible Light Driven Nitro-Mannich Reaction using $CoMoO_4$@G-C_3N_4 Photocatalysts	Shivani Agrawal
33	Synthesis, Characterization and Mesomorphic Behaviour of Furan based Chalcone compounds	Kashyap Patel
34	Biopolymer Stabilized Zero-Valent Iron Nanoparticles as Magnetic Catalyst for Rapid Reduction of Nitroaromatics	Miraj Patel
35	Formation of Δ4-Thiazoline-2-Thiones by Intramolecular Cyclisation of Dithiocarbamate via Michael Substitution and Thiazole by Base Catalysed Unusual Substitution Reaction	Aniket A. Deshmukh
36	Experimental Optimisation of Biodiesel Yield from Nonedible Oil using Response Surface Methodology	Kunal P. Argade
37	Rationally Designed Polymer-Supported Pd (II) Catalyst for Selective ortho-C(sp^2)–H Halogenation of Acetanilide and Aniline Derivatives: Synergistic Experimental and DFT Investigations	Akash V. Gujarati
38	Spin-Symmetry Driven Anisotropies in Altermagnetic Material MnF_2: A Density Functional Theory Study	Apeksha Gauswami
39	Synthesis, Characterization and Application of Polyethylene Terephthalate based Polyester Resin with Jute Fiber Reinforced Composite	Pragnesh Rathva
40	Design and Synthesis of Coumarin Hybrids Based Donor-Π-Acceptor Compounds for Optoelectronic Applications	Jay Patel
41	Synthesis of Fisetin Derivative as a Trk Inhibitor	Tejas R. Parsaniya
42	Curcuminoid Based Supramolecular Vesicles for pH Triggered Sustained Release of Capecitabine	Dr. Arpita Desai
43	Mushroom Biosorbants: A Sustainable Solution for Heavy Metal Removal from Water	Yashashwini Badiger

PLENARY LECTURES

ABSTRACTS

PL-01

AFFORDABLE CLEAN WATER USING ADVANCED MATERIALS

Thalappil Pradeep
Institute Professor
Indian Institute of Technology Madras, Chennai 600 036
pradeep@iitm.ac.in

Sustainable nanotechnology is important for providing contaminant-free water to humanity. I will present the discovery of affordable and sustainable nanomaterials to selectively scavenge arsenate and arsenite ions (and others) in water to bring their concentrations below the drinking water limits and its development into a technology. The solution, popularly called AMRIT (meaning elixir in Sanskrit), is now delivering 80 million litres of arsenic-, iron- and uranium-free water every day, conforming to international standards to 1.3 million people at the cost of 2.1 paise (US$0.00026) per litre, lowest in the world. This technology has been approved for national implementation. We have developed several other technologies for sensing contaminants and their removal. A glimpse into these activities and directions for the future will be presented. All of these activities are deeply connected to advances in analytical sciences.

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[3]Biopolymer reinforced synthetic granular nanocomposites for affordable point-of-use water purification, M. U. Sankar, S. Aigal, A. Chaudhary, Anshup, S. M. Maliyekkal, A. Anil Kumar, K. Chaudhari, and T. Pradeep, Proc. Natl. Acad. Sci., 110 (2013) 8459-8464. DOI: 10.1073/pnas.1220222110

ABSTRACTS

PL-02

DEVELOPMENT OF MATERIALS, PROCESSES AND PRODUCTS FOR NUCLEAR SECTOR: ROLE OF ANALYTICAL SCIENCES

A. K. Tyagi
Homi Bhabha National Institute
Mumbai - 400 094
aktyagi@barc.gov.in

Nuclear technologies rely on specialized materials which need stringent requirements of chemical and thermodynamic stability as well as isotopic purity criteria. Thus, the growth of the nuclear sector is closely dependent on the development of indigenous materials, processes and products, and hence the understanding of analytical science plays an important role in development of specific materials and processes for targeted applications. The concepts of chemistry, thermodynamics, processing, crystallography and defects engineering often play important roles toward the development of such materials. This presentation is intended to showcase some of research activities at Chemistry Group, BARC carried out towards nuclear applications. Several examples of development of materials for nuclear back-end and front-end will be discussed. Nuclear safety is another crucial area where substantial research has been conducted. Efforts towards the development of several important products will also be covered. A few examples of tailored materials for possible application in nuclear extreme will also be discussed. This presentation will be mainly focused to highlight the role of underlying science behind these processes, materials and products, with an emphasis of extensive use of Analytical Sciences.

ABSTRACTS

PL-03

ROLE OF ANALYTICAL SCIENCES IN RENEWABLE ENERGY

Dr. S. S. V. Ramakumar
Executive Vice President-SPG & CTO, AM Green,
Former Director (R&D), Indian Oil Corporation Limited, Faridabad

Renewable energy sources are critical for meeting the growing global energy demand while mitigating the environmental impacts of fossil fuels. India, with its ever-increasing energy demands and commitment to sustainable development, is witnessing a rapid growth in the renewable energy sector (i.e., Solar Energy, Wind energy, Hydel energy and Bioenergy). To ensure the efficiency, reliability, and economic viability of these renewable energy systems, analytical sciences play a crucial role. Analytical sciences provide the tools and techniques needed to develop, optimize, and ensure the quality of renewable energy technologies. The development and optimization of these technologies rely heavily on analytical sciences.

From material characterization to performance evaluation/ monitoring, environmental monitoring, process optimization, analytical tools provide the necessary insights for advancements in solar, wind, hydrogen, and bioenergy sectors. Analytical sciences help in performance optimization by identifying inefficiencies in energy conversion processes, quality control and assurance for renewable energy materials and technologies and enhancing reliability and durability of renewable energy systems through in-depth analysis. Analytical sciences play a key role in monitoring the environmental impacts of renewable energy systems, such as emissions from biofuel production or the potential release of nanomaterials from solar panels
.
Analytical Techniques such as, Spectroscopy, Chromatography, Thermal Techniques, Microscopy and Electrochemistry techniques are widely employed to derive the necessary analytical information on renewable energy materials and processes. By providing detailed insights into the materials, performance, and environmental impacts of renewable energy, along with recent advancements in artificial intelligence and data analytics, analytical sciences are indispensable for driving innovation and ensuring the sustainable development of this critical sector. The status of the renewable energy sector in India and the advancements of analytical sciences will be deliberated.

ABSTRACTS

PL-04

SUSTAINABLE PRODUCT DEVELOPMENT

Rajamannar Thennati
Executive Vice President
Head, High Impact Innovations (HISHS) & Advisor to MD
Sun Pharmaceutical Industries Ltd., Vadodara 390 012

Making affordable medicines is a success story of Indian Pharma. However, designing a process with predictable quality requires a complete understanding of each element of the process at manufacturing scale. Regulatory requirement is, of delivering a product with robust quality attributes and with consistency. As a part of product development strategy, feasibility of technology at an industrial scale, with ease of handling, quick turnaround time, maximal product output with assured quality to be factored. Measuring the metrics of the process shall be discussed with reference to pharmaceutical developments, which is an essential element of business continuity.

ABSTRACTS

KEYNOTE LECTURE

KL-01

INNOVATION SIMPLIFIED IN AI LED WORLD. FAST AND AFFORDABLE WILL BE KEY TO WEALTH GENERATION

Dr. Ajay Ranka

Zydex Industries

KL-02

INVENTING, INNOVATING AND IMPLEMENTING TECHNOLOGIES

Raksh Vir Jasra
R&D Centre, Reliance Industries Limited
Vadodara, 391 346
rakshvir.jasra@ril.com

The talk will be largely centered around various tenants of innovation such as difference between invention and innovation; why innovating is necessary in an organization, different dimensions and drivers of innovations.

KL-03

SUSTAINABLE S&T LED SOLUTIONS - RECENT CASE STUDIES @ CSIR-CSMCRI

Dr. Kannan Srinivasan
CSIR- Central salt and marine chemical research institute

Sustainable solutions would be the central focus for this century where resources/processes will be scrupulously, optimally and judiciously used/deployed while protecting our environment and ecosystem. United Nations Sustainable Development Goals (UN SDG) is a major step in this direction. It gave countries, including our own, to ponder and undertake programs with an endeavour to achieve these goals, to some extent. Central Salt and Marine Chemicals Research Institute (CSMCRI) is a national laboratory under the Council of Scientific and Industrial Research is one of the largest public-funded national laboratories in the world, with its vision to explore, harness and transform marine resources for the good of people of India and beyond. CSMCRI has been earnestly pursuing R&D programs to develop sustainable solutions/products/processes that has significant implications on food, water, energy and chemicals. In this lecture, I will to try to cover such case studies to demonstrate the progress we have been able to achieve in recent times to emphasize this endeavour. I shall briefly touch upon how interdisciplinary approach including analytical sciences, the focus of this international conference, is helping us while discovering such solutions. The intention/objective of this presentation is to inspire young researchers to brood and develop sustainable S&T solutions in whatever the problems they are currently engaged with.

ABSTRACTS

KL-04

DATA-DRIVEN INSIGHTS BY ANALYTICAL SCIENCE FOR DECARBONISATION OF ALUMINIUM SECTOR

Anupam Agnihotri
Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur, India
director@jnarddc.gov.in

The aluminium sector, a significant contributor to global carbon emissions, requires innovative strategies for decarbonization. Data-driven insights powered by analytical science play a crucial role in optimizing production processes, enhancing material efficiency, and reducing emissions. Advanced analytical tools provide real-time monitoring of energy-intensive operations like the Hall-Héroult process, enabling precise control over energy consumption and operational efficiency. Machine learning models and predictive analytics help identify inefficiencies, allowing for timely interventions that further reduce emissions.

Analytical techniques also improve recycling by optimizing raw material usage and ensuring accurate alloy sorting through spectroscopic methods, thereby decreasing reliance on primary aluminium production. Additionally, analytical science supports the development and implementation of low-carbon technologies, such as inert anode technology and direct reduction methods, which significantly cut carbon emissions. Life cycle assessments (LCA) and carbon footprint modelling provide comprehensive insights into environmental impacts, facilitating targeted emission reduction efforts across the supply chain.

By integrating these analytical approaches, the aluminium sector can transition toward more sustainable practices, improving energy efficiency, reducing waste, and achieving its decarbonization goals. Ultimately, analytical science serves as a cornerstone in advancing environmentally responsible aluminium production while supporting global sustainability initiatives.

KL-05

Waste Management in Mining and Milling activities of Uranium Corporation of India Limited.

Dr.Santosh Kumar Satpati
Uranium Corporation of India Limited

Uranium is the basic starting element in nuclear energy program in India and uranium mining and milling activities of Uranium Corporation of India (UCIL), DAE are dedicated for the self-reliance of India, Atmanirbhar Bharat. Though grade is poor, based on available total quantity of ore, UCIL is committed to extract ore from the earth crust for sustainable Atmanirbhar. Uranium is mined from underground following defined approved and statutory procedures and taken up to the ground for processing, upgrading and converting to commonly call yellow cake in the mill following well approved standard operating procedures. In the mining and milling activities, generated wastes are managed and delt with at-most care under strictly monitoring of the regulatory authorities, following the spirit of 3R principle, “Reduce, Recycle and Reuse”, as well as DAE’s ALARA pathway. It is worth to relook and review the present methodology of waste management of uranium mining and milling facilities. In the presentation, adaptation and practice of 3R principle in the facilities is elaborated as initiated by UCIL utilising support of analytical science. Scientific and technological upgradation activities in the facilities are also been illustrated.

KL-06

SUSTAINABILITY AND CIRCULAR ECONOMY INITIATIVES IN INDIAN CEMENT INDUSTRY

L.P. Singh
Director General
National Council for Cement and Building Materials,
Ballabgarh- 121004, Haryana, India
dg@ncbindia.com

In the fast-growing infrastructure of our country, use of sustainable materials is the key in the circular economy. Environment-friendly materials (also known as green building materials) are those in which, for their production, placing and maintenance, actions of low environmental impact have been performed. They have to be durable, reusable or recyclable. These materials also have to be natural and must not be spoilt by cold, heat or humidity. Concrete is the most widely used man-made material on earth and approximately, 2.0-2.5 m^3 of concrete is used. Though concrete is not a natural material but due to its superiority features it's a material of choice for infrastructure development. It forms the foundations of cities and connects communities and without it, many of the elements of modern life wouldn't be possible. The basic ingredient of concrete is cement and 7-8% of total CO_2 emission in the world is by the cement production only. Due to the increasing concerns of climate change, cement industries are on the radar of policy makers to lower their carbon foot-prints. Cement industries have been asked to be carbon neutral by 2050. There is a significant challenge involved in achieving sustainability by the cement industry. India is the second largest producer of cement after China and therefore, to meet the target of 2050 innovative indigenous efforts are required. The present talk will provide an overview of the Research & Development efforts being undertaken in achieving concrete sustainability.

KL-07

IDENTIFICATION AND CONTROL OF HARMFUL IMPURITIES SUCH AS NITROSAMINES IN PHARMACEUTICAL PRODUCTS

Dr. Mrunal Atul Jaywant

Presence of harmful Impurities in medicines, even at trace levels can put patients at risk. Since 2018, some commonly prescribed blood pressure medicines, antacids, and other drugs were found to contain unsafe levels of impurities called nitrosamines. While they're naturally found in water and some foods, regular exposure to some nitrosamines over long periods of time can increase the risk of cancer.

In response to the risks and increased incidents of detection of nitrosamines in pharmaceuticals, regulatory agencies around the world, such as European Medicines Agency (EMA) and the U.S. Food and Drug Administration (FDA), developed guidelines for manufacturers to monitor, quantify, and control their presence in pharmaceutical products. Guidelines include the implementation of robust risk assessment strategies, conducting thorough investigations into the root causes of impurities, enhancing analytical methods for detection, and implementing corrective actions to prevent future occurrences. Even pharmacopoeias such as USP, EP, IP responded quickly to help manufacturers address the challenge. In my talk, I will share details of standards and other resources developed by USP for identification, testing and control of nitrosamine impurities in pharmaceutical products, that help assure availability of safe medicines for patients.

ABSTRACTS

KL-08

NEXUS OF NANOTECHNOLOGY, ANALYTICAL AND ENVIRONMENTAL CHEMISTRY FOR THE PRODUCTION OF HYDROGEN FUEL AND ENVIRONMENTAL REMEDIATION

Rengaraj Selvaraj
Department of Chemistry, College of Science,
Sultan Qaboos University, P.O. Box 36.,
P. C. 123., Al Khoudh, Muscat, Sultanate of Oman
rengaraj@squ.edu.om; srengaraj1971@yahoo.com

Nexus of nanotechnology, analytical and environmental chemistry for the generation of hydrogen fuel and wastewater treatment according to solar-driven catalysis possesses considerable prospective for establishing a carbon-neutral and ecologically sound power infrastructure. Water splitting and catalytic purification of wastewater employing solar illumination have recently been recognized as two of the most practical methods for producing H_2. Nowadays 2D nanostructures are gradually attracting significant interest from researchers because of their excellent physicochemical and optoelectronic properties. However, the efficient fabrication of 2D nanosheets with high crystallinity and ultrathin thickness still faces huge challenges. Metal free semiconductor has attracted a lot of attention due to its exceptional electron mobility properties. These semiconductors exhibit a 2D nanostructure with high surface area and often combined with other nanomaterials to enhance their photocatalytic performance. Recently, in our laboratory we have developed 2D/2D heterojunction nanohybrids by modifying the g-C_3N_4 with the CoAl-LDH nanosheets in response to the preceding study of photocatalytic H_2 production and photodegradation of dye pollutant. In order to produce green hydrogen and treatment of wastewater we have adopted a simple impregnation method, a customized association of CoAl-LDH and graphitic carbon nitride (CN), a visible light active narrow and wide band gap semiconductors. Several characterization approaches were implemented to understand the CoAl-LDH@g-C_3N_4 (CACN) composites physio-chemical and optical features. The CACN hetero structural forms exhibited significantly improved solar light-induced photocatalytic H_2 generation and dye pollutants decomposition in contrast with pristine materials. The most effective catalyst 5 wt.% CoAl-LDH@g-C_3N_4 (5-CACN) generated the highest hydrogen (~ 430.7 $\mu molg^{-1}h^{-1}$), which is 11.9-fold H_2 production efficiency compared with CN and depicted significant Brilliant black dye removal efficacy via photocatalytic degradation (up to ~79%). This was primarily ascribed to the development of better heterojunctions, which promoted the separation of charges and expanded the abundance of surface-active sites while absorbing the visible spectrum of solar light.Also, our research group applied these materials for the effective removal and degradation of pharmaceuticals, VOC's, EDC's and other contaminants present in water and wastewater [1-4].

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KL-09

UTILIZING NANOTECHNOLOGIES IN THE ENHANCED TREATMENT OF CANCER

Ajay Jaysingh Khopade
Sun Pharmaceutical Industries Ltd
ajay.khopade@sunpharma.com

The talk covers

•Innovative nano strategies - assembling the nanostructure within the drug itself vs. the delivery system
•Understanding the therapeutic & clinical benefits of novel nano-structure assembly
•Tackling unfavourable PK profiles Enhancing safety & efficacy and Maximising targeted delivery of anticancer therapies
•Exploring the broad platform of potential applications to multiple drug candidates

ABSTRACTS

KL-10

STRENGTHENING INDIA'S SUPPLY CHAIN FOR NUCLEAR FUEL AND CRITICAL MINERALS TO ACHIEVE NET-ZERO EMISSION BY 2070

Dheeraj Pandey
Director
Atomic Minerals Directorate for Exploration and Research,
Hyderabad-500 016
director.amd@gov.in

At the 29th United Nations Climate Change Conference (COP29) in Baku, Azerbaijan, India reiterated its commitment to achieve 500 gigawatts (GW) of non-fossil fuel energy capacity and source 50% of the nation's energy requirements from renewable sources by 2030. These objectives are pivotal in attaining net-zero carbon emission by 2070 and emphasize the need for adequate climate finance to support mitigation and adaptation efforts.

Nuclear energy is recognized as a key player in global decarbonization. The International Atomic Energy Agency (IAEA) highlighted the importance of three-fold increase in nuclear capacity by 2050, reinforcing India's strategy to expand its nuclear power infrastructure as a reliable, clean energy source. India's three-stage Nuclear Power Programme (NPP) requires increased production of uranium (U) and thorium (Th) to sustain its long-term energy goals.

The transition to clean energy technologies is largely dependent on a secure supply of critical minerals, including lithium (Li), Rare Earth Elements (REE), scandium (Sc), yttrium (Y), niobium (Nb), tantalum (Ta), copper (Cu), chromium (Cr), cobalt (Co), nickel (Ni), molybdenum (Mo), vanadium (V), titanium (Ti), lead (Pb), zinc (Zn), silver (Ag) and indium (In). Many of the critical minerals do not occur as standalone deposits, but are found associated with major mineral deposits, such as Ni and PGE with chromite deposits or Nb, Sr, and V in carbonatite-hosted REE deposits.

India is focussing on building a resilient supply chain by leveraging indigenous resources and intensifying systematic exploration, resource augmentation of critical minerals within the diverse geological domains of the country and exploring opportunities to acquire critical mineral assets overseas.

Furthermore, developing a robust critical materials value chain requires strengthening the key segments: exploration and mining (upstream), processing and refining (midstream), advanced manufacturing and recycling (downstream). While India has made significant strides in exploration and mining, focussed efforts are needed to enhance processing, refining, and manufacturing capabilities to reduce reliance on imports and establish a self-sustaining clean energy industry. The expertise and contributions by the scientific fraternity of the country will be instrumental in defining the way forward to achieve India's climate commitments and energy security goals.

KL-11

CHALLENGES IN PROCESS DEVELOPMENT OF GENERIC DRUGS & CASE STUDIES

Dr. Kaptan Singh
Sun Pharma R&D Centre, Gurugram (Haryana)

The last decade has seen a major change in the area of process development in the pharmaceutical industry. Indeed, it opens an opportunity to explore the use of process development as an attractive tool in drug manufacturing organizations. Chemical process development is generally not taught as part of any degree courses of higher education. The transformation of a synthetic route used for making mg/gm quantities of a chemical into a process for manufacturing multi kilogram and tones quantities is typically learnt “on the job” by chemists in industries. First of all, it is very important to understand the generic drug development, stages of process development and scale up and generic approval requirements. I sense an all-pervasive mood of optimism and buoyancy as process development is reflecting increasingly scientific talent in its use in large scale manufacturing. Worldwide companies are struggling with the competing priorities of rising customer’s low-cost expectations, ever-increasing safety and Regulatory burden. Only insightful process development will bring the lower affordable cost and can make the Pharmaceutical Industries profitable. Cost Reduction has become a tool for sustaining into the market.

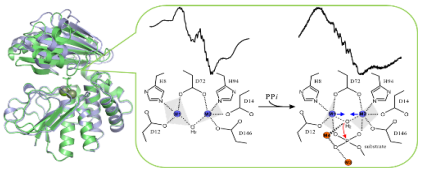
ABSTRACTS

KL-12

STRUCTURAL REARRANGEMENTS OF THE METALLOENZYME FOR EFFICIENT CATALYSIS WERE REVEALED BY ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY

M. Horitani
horitani@cc.saga-u.ac.jp

Inorganic pyrophosphatase (PPase) catalyses the hydrolysis reaction of inorganic pyrophosphate to two phosphates and plays an essential role for all living organisms. Family II PPase requires Mg and divalent transition metals such as Mn^{2+} and Co^{2+} ions for the maximum activity. We previously have succeeded in the purification of PPase from *Shewanella* sp. AS-11 (Sh-PPase), lives in the Antarctic Ocean [1,2]. We utilized electron paramagnetic resonance (EPR) spectroscopy to investigate the solution of Mn-activated Sh-PPase. EPR analyses confirmed that the active site consists of di-Mn^{2+} centre in Sh-PPase. Di-Mn^{2+} site yields a total spin S = 0 system in the ground state, which is EPR inactive, and has S = 1, 2…5 as second, third… excited states, which are all EPR active and whose splitting are 2J, 4J… higher than the ground state whose J is Heisenberg exchange coupling constant. Our EPR analysis determined the isotropic exchange coupling constant, J = -0.85 cm^{-1} and axial zero-field splitting (ZFS) parameters, D = ±0.25 cm^{-1} and -0.058 cm^{-1} for S = 1 and S = 2, respectively. The axial ZFS for S = 2 and Mn-Mn distance was known to have an empirically linear correlation[3], and this gave Mn-Mn distance 3.57 Å for Sh-PPase. Crystallographic studies revealed a bridged water placed at a distance from the di-Mn centre in Mn-Sh-PPase without substrate. And the water came closer to the metal centre when the substrate was bound. EPR analysis of Mn-Sh-PPase without substrate revealed considerably weak exchange coupling, whose magnitude was increased by binding of substrate analogues. The EPR data indicates that the bridged water has weak bonds with the di-Mn centre, which suggests a ‘loose’ structure, whereas it comes closer to di-Mn centre by substrate binding, which suggests a ‘well-tuned’ structure for catalysis. Thus, we propose that Sh-PPase has loose structure in absence of substrate and changes the tight structure for efficient catalysis by bound of substrate. I will present our detailed analysis and proposal of enzymatic reaction mechanisms for Sh-PPase.



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KL-13

HOW HAS THE LOW-COST MICROWAVE PLASMA ATOMIC EMISSION SPECTROMETRY (MP-AES) CHANGED THE FACE OF TRACE ELEMENT ANALYSIS IN THE GLOBAL APPLICATION LANDSCAPE?

V. Balaram
CSIR-National Geophysical Research Institute
(NGRI), Hyderabad -500 007, India
balaram1951@yahoo.com

Microwave plasma atomic emission spectrometry (MP-AES), a new and emerging multi-elemental analytical technique completed only a decade after it was invented by Michael Hammer, an Australian scientist who successfully obtained a sustainable microwave plasma [1]. MP-AES offers substantial advantages in its smaller size, lower cost, and reduced running costs due to the replacement of argon with nitrogen, and this technique is in use to routinely determine elemental concentrations from ng/ml (*ppb*) to %wt levels in different materials ever since commercial instruments were introduced in 2011 by an Australian firm. MP-AES demonstrated operational advantages over other techniques like ICP-OES and AAS in using nitrogen gas drawn from the surrounding air to create plasma and doesn't require the use of gas cylinders [2]. The detection limits offered for various elements are much superior to those obtainable by flame atomic absorption spectrometry (F-AAS) and comparable to those obtainable by inductively coupled plasma optical emission spectrometry (ICP-OES). The technique is also showing promising performance in a variety of fields such as geological, environmental, food, health, energy, agricultural, pharmaceuticals, and waste electrical and electronic equipment regulation (WEEE)/restriction of hazardous substances (RoHS) compliance [3-5]. MP-AES is a promising method for the analysis of heavy metals in water, offering valuable insights for water quality assessment and management [6]. Over this period, the instrument was also hyphenated to cold vapor (CV), hydride generation (HG), photochemical vapor generation (PVG), gas chromatography (GC), and high-pressure liquid chromatography (HPLC) techniques for the sensitive and accurate determination of elements like Hg, As and Se. One of the striking applications of this technique is the determination of the geographical origin of fruits. Hidalgo et al. [7] determined the elemental composition (~ 18 elements like Ca, Cd, Co, Cr, Cu, Sr, and Zn) of 183 orange samples from four production regions in northeastern Argentina to identify their origin to safeguard the consumer protection against fraud. The elemental profiling measured by MP-AES was employed to designate the geographical origin of sweet orange fruits produced in Argentina.

KL-14

COMPUTATIONAL DESIGN OF HIGHLY EFFICIENT HYDROGEN STORAGE MATERIALS: CARBON ALLOTROPES

Prafulla K Jha
Department of Physics, Faculty of Science, The M. S. university of Baroda, Vadodara-390 002, India
pk.jha-phy@msubaroda.ac.in

The increasing energy demands and diminishing traditional fuels necessitate alternative solutions, especially in transportation. Hydrogen fuel is a promising option due to its abundance, eco-friendliness, and high energy density. However, efficient hydrogen storage remains a critical challenge due to its low density and high diffusivity. Among various storage methods, solid-state storage offers safety, stability, and high-density potential. For efficient solid-state hydrogen storage, the U.S. Department of Energy (DOE) recommends an average binding energy of 0.2–0.7 eV/H_2 and a gravimetric weight percent of at least 4.5%. This talk presents advanced carbon-based hydrogen generation and storage systems using Density Functional Theory (DFT) and Ab initio Molecular Dynamics (AIMD) simulations, focusing on material design, metal decoration, and strain engineering to overcome current limitations. Transition metals enhance hydrogen storage through the Kubas interaction, facilitated by the presence of d-orbitals, while alkali and alkaline earth metals promote storage via polarization, transferring electrons to the host material and inducing a partial positive charge. Strain engineering enhances hydrogen storage in 2dpa under compressive strain, with the system adsorbing 10 H_2 molecules at -0.24 eV and achieving 6.9 wt.% under 4% biaxial strain, with a desorption temperature of 209.73 K at 12 bar. These results highlight the potential of optimized carbon-based and polymer systems, alongside strain engineering, as promising approaches for advancing hydrogen storage technologies in sustainable energy applications.

INVITED LECTURE

ABSTRACTS

IL-01

EXPLORING SANDSTONE-HOSTED URANIUM RESOURCES IN INDIA

Ashok kumar padhi
173, Swamy colony, Nagpur
ashokpadhi58@gmail.com

Nuclear industry has to play a major role in the future energy perspective of a country for sustainable energy requirements. Uranium is the most essential element for the Nuclear Industry. At present Uranium resource of India in RAR category is 2,20,900 tonnes and identified in situ resource of 2,92,900 tonnes along with inferred resource of 10500 tonnes (<USD 260/kgU category) [1]. Sandstone-hosted resources dominate all cost categories. In the lowest cost category deposits (<USD 40/kgU category) sandstone hosted resources essentially stand alone in the world because they are of high grade and are comparatively easier to explore and exploit. Therefore sandstone hosted U resources should be a Prime target for mineral exploration. Sandstone-type uranium deposits (later on classified as resources) are defined as epigenetic concentrations of uranium minerals occurring as uneven impregnations and minor massive replacements primarily in fluvial, lacustrine, and deltaic sandstone formations [2]. Uranium is soluble in natural condition only in its hexavalent state (+6 valence). Uranium is transported in oxidising solution and is precipitated in tetravalent state (+4 valence state) under reducing conditions caused by a variety of reducing agents within the sandstone, for example, carbonaceous material, sulphides (pyrite), hydrocarbons and ferro-magnesium minerals (chlorite) etc [3]. Rock should be porous and permeable enough to enable transportation of oxidizing fluid and retardation of flow is caused by intercalated impervious rocks viz, shale and wacke. Sandstone uranium deposits are amenable to conventional open-pit and underground mining methods or by in-situ leaching and heap leaching. They show a prominent time-bound feature to the Phanerozoic, especially the Mesozoic and Cenozoic, when land plant debris and the humates generated from them became a potential reductant in continental sediments [4].

The Phanerozoic basins of India mainly comprise – Mahadek Basin in Meghalaya, Gondwana basins in Central India and Siwaliks in the foothills of Himalayas. In the upper Cretaceous Mahadek basin Uranium deposits occur as clusters around Domiasiat, Wahkyn and Tyrnai [5]. Uranium mineralisation occur as peneconcordant lensoidal bodies within medium to coarse-grained, felspathic, pyritiferous sandstones with carbonaceous matter, deposited in a continental fluvial or marginal marine sedimentary environment over Precambrian granitic basement. At Domiasiat and Wahkyn 9500 tonnes and 5300 tonnes U_3O_8 respectively have been deciphered with average grade of ore around 0.1% U_3O_8. Leachability of 72-92% has been obtained. Uranium mineralisation is recorded in Siwalik sediments of lower Miocene to lower Pliocene age with more promising zones along the contact of middle and upper Siwaliks.

The host sandstone contains pyrite, organic matter and clay pellets. The controls of uranium mineralisation are redox interface, porosity/permeability barriers and abundant reductants. Neo-tectonic activity causes the unstable groundwater regime and the mineralisation process is thus dynamic. Important U occurrences in Middle-Upper Siwalik Contact are (a) Asthotah-Khya-Loharian tract (b) Loharkar-Sibal-Andalada-Galot tract and (c) Ambtilla-Rajpura-Polian tract, Himachal Pradesh. The Rajpura Occurrence of Una district, Himachal Pradesh has been drilled and a low tonnage, low grade deposit has been established [6]. The area has further potential and occurrence of a prominent shale bed below the mineralized zone is favourable for in situ leaching. Satpura Gondwana Basin Motur Formation of Lower Gondwana and Denwa Formation of Upper Gondwana are identified as favourable horizons for uranium exploration. Uranium mineralization confined to a paleochannel bounded by two dolerite dykes is the area identified deciphered [7]. Because of the vast extent and thickness of Gondwana sediments of Palaeozoic age it requires more exploration inputs. Similarly, exploration inputs in Mahadeks and Siwaliks will certainly enable it to add more uranium resources for the country.

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IL-02

NANOPARTICLES AND THEIR APPLICATION IN TISSUE ENGINEERING AND REGENERATIVE MEDICINE

Raghaw Saran Ph.D. Fic, Fics, Fisas, Lm Iancas, Lm Reai
Former Adjunct Professor, RCOEM, Nagpur
Former Senior Scientist, AMD/DAE
82, Swamy Colony, Phase II, Katol-Road, Nagpur-440013
saranraghaw@gmail.com

Tissue engineering (TE) an interdisciplinary amalgamation of engineering, material science and medical biology focuses on developing biological substitutes to repair, replace, retain or improve tissue and organ level functions. Tissue engineering and regenerative medicine (TERM) are gaining significance due to lack of donor availability, reducing immune system and non- adaptability of organ transplant. Ability of Nanoparticles to mimic the three- dimensional extracellular composition of tissue matrix for cells with suitable mechanical strength enables them to be used in the biomedical field. Their characteristic features control bone remodelling based on their size, shape, composition and charge besides low toxicity, contrasting agent properties, tailorable features, targeted/ stimuli response delivery ability and at times precise control over behaviour via an external stimulus such as magnetic field. Functional tissues and organ replacements need a high degree of spatiotemporal regulation. This necessitates deep research to investigate suitable nanoparticles to cure bone related diseases. The nanoparticles may be produced from materials such as polymers, metals, ceramics, and their different composites depending on the application in TERM including tissue targeting and imaging, bioactive agent delivery, modulating mechanical properties of scaffold providing antimicrobial and antitumor properties. This review deals with the development of nanoparticles aiding in bone tissue engineering with focus on cell labelling, drug delivery and gene delivery. Besides, the paper deals with the status of research on the interaction of nanoparticles with bone cells, osteoblasts, osteoclasts and focuses on bone marrow mesenchymal stem cells, and the underlying mechanism. Finally, with a view that nanoparticles may reveal new therapeutic strategies of more effective bone regeneration therapy or other bone diseases, detailed study was taken up to provide an outlook for present challenges and directions of future research.

IL-03

DATA ANALYTICS AND MODERN-DAY COMPUTING

K Muralidharan
Department of Statistics, Faculty of Science,
The Maharaja Sayajirao University of Baroda,
Vadodara. 390002. India.
muralidharan.k-stat@msubaroda.ac.in

Data Analytics is the process of examining, cleaning, transforming, and interpreting data to extract meaningful insights, identify patterns, and support decision-making. It combines statistics, programming, and modern computing technologies to analyze large datasets efficiently. This presentation will facilitate the understanding of how data analytics help to characterize a scientific phenomenon in an informed way. This is illustrated through the Brownian motion of particles associated with a physical or chemical process.

IL-04

THE ROLE OF ANALYTICAL SCIENTISTS IN STRENGTHENING CHEMICAL SECURITY FRAMEWORKS

Prof. V. K. Jain
National Association for Chemical Security, India
nachemsec@gmail.com

Chemical safety aims to protect people from hazardous substances, whereas chemical security focuses on preventing the intentional misuse of chemicals by malicious actors. In an era of rapid industrialization and global trade, securing dual-use chemicals—substances with legitimate industrial applications that can also be exploited for harmful purposes—has become a pressing international concern. The ability of terrorist organizations, criminal networks, and rogue entities to acquire and repurpose such chemicals underscores the need for enhanced security measures.

This talk will provide a clear distinction between chemical safety and chemical security, emphasizing how evolving threats from adversaries, proliferators, and non-state actors necessitate a robust security framework. Several real-world incidents of dual-use chemical misuse will be highlighted, demonstrating the risks posed by inadequate chemical security. Cases such as the use of ammonium nitrate in improvised explosives and the 1995 Tokyo subway sarin attack illustrate how industrial chemicals can be weaponized, reinforcing the urgency for stringent monitoring, regulation, and enforcement.

A crucial aspect of strengthening chemical security lies in the role of analytical scientists in detecting, tracking, and regulating hazardous chemicals. Advanced analytical techniques, including mass spectrometry, chromatography, spectroscopy, and forensic chemical analysis, play a pivotal role in identifying suspicious activities, monitoring chemical supply chains, and ensuring compliance with security protocols. These tools are indispensable in detecting chemical weapons precursors, toxic industrial chemicals, and explosives, thereby mitigating potential threats before they materialize.

The talk will also explore regulatory frameworks, industry best practices, and technological innovations, such as AI-driven monitoring systems and digital tracking mechanisms, that can significantly enhance chemical security. By integrating analytical sciences with policy, industry standards, and law enforcement efforts, we can establish a comprehensive and proactive chemical security framework that not only safeguards public safety but also facilitates legitimate industrial and research activities without disruption.

ABSTRACTS

IL-05

BIO SYNTHESIZED ZINC NANOPARTICLES FOR TEXTILE WASTEWATER REMEDIATION IN MANGROVE ECOSYSTEMS: TECHNO-ECONOMIC FEASIBILITY AND SOCIETAL ACCEPTANCE

Bhawana Pathak & Supriya Vaish
School of Environment and Sustainable Development
Central University of Gujarat, Kundhela, Vadodara, Gujarat, India
bhawana.pathak@cug.ac.in

Rising wastewater pollution from textile industries near ecologically sensitive mangrove ecosystems, creates significant environmental and social challenges. An urgent need for innovative and sustainable remediation technologies to mitigate the impact of textile effluents. Present study highlighted on the techno-economic feasibility of biosynthesized zinc oxide nanoparticles (ZnO-NPs) for textile wastewater remediation. A techno-economic analysis were performed to determine the cost-effectiveness of scaling ZnO-NPs for industrial applications. A baseline survey conducted in areas adjacent to textile clusters and mangrove zone to evaluate public awareness, community perception, and stakeholder preparedness for adopting nanotechnology-based remediation solution. ZnO-NPs demonstrated high stability with superior photocatalytic and adsorption properties, and this technology may transferred from lab to industry with low-cost expenditure as an eco-friendly alternative to conventional methods. The findings support the adoption of ZnO-NPs for textile wastewater remediation, demonstrating environmental sustainability, cost efficiency, and potential for mitigating ecological stress on mangrove ecosystems. The economic analysis showed lower operational costs and sustainable metrics, reinforcing their feasibility for large-scale implementation. Societal acceptance study revealed varied societal acceptance, influenced by environmental awareness, perceived benefits, and socio-economic considerations. Result findings emphasize the importance of public engagement and policy support to facilitate widespread acceptance and implementation of bio-nano-technological approaches for environmental Sustainability.

IL-06

EXPLORING MICROBIAL BIOMOLECULES FOR THEIR FUNCTIONAL CAPACITIES: ROLE OF ANALYTICAL TECHNIQUES IN CHARACTERIZATION AND APPLICATIONS AND THEIR FUTURE DIRECTIONS

Karthikeyan, K
Assistant Director,
Gujarat Institute of Desert Ecology,
Bhuj, Dist: Kachchh, Gujarat – 370001, India.

Extremophiles are microorganisms that thrive in extreme environmental conditions such as hyper salinity, acidity, temperature, and various other pressures. But at the same time, they are a rich source of unique biomolecules with remarkable stability and functional properties. These biomolecules, including proteins, enzymes and various other secondary metabolites, exhibit exceptional catalytic activity, thermal stability, and resistance to harsh conditions, making them ideal candidates for applications in biotechnology, pharmaceuticals, agriculture, and environmental remediation. This abstract explains the role of analytical techniques in characterizing the functional capacities of microbial biomolecules derived from extremophiles, highlighting their potential applications, the challenges associated with their utilization, and the promising future directions of research in this field.

The rapid advancements in analytical technologies have significantly enhanced the identification, structural elucidation, and functional characterization of biomolecules from extremophiles. Techniques such as mass spectrometry (MS), nuclear magnetic resonance (NMR) spectroscopy, X-ray crystallography, and high-performance liquid chromatography (HPLC) have been instrumental in deciphering the intricate molecular structures of extremophile-derived biomolecules. Despite these technological advancements, several challenges remain in exploiting extremophilic microbial biomolecules. The complex and diverse nature of extremophilic environments complicates the isolation and production of these biomolecules in large quantities. Additionally, the need for efficient expression systems, the optimization of conditions for large-scale biomolecule production, and the lack of robust methods for assessing the stability and activity of these biomolecules under industrial conditions are significant obstacles. Overcoming these challenges requires the integration of advanced analytical techniques with synthetic biology, metabolic engineering, and bioprocess optimization.

The future of extremophilic biomolecule research is poised for exciting advancements. The integration of artificial intelligence (AI) and machine learning (ML) algorithms with analytical techniques promises to accelerate the discovery and characterization of novel biomolecules, predict their functional potential, and guide the design of more efficient production processes. Moreover, the growing field of genome mining and the use of bioinformatics tools offer new opportunities for discovering untapped microbial diversity and associated biomolecules with untapped industrial and therapeutic potential.

To conclude, the exploration of microbial biomolecules from extremophiles, supported by continued advancements in analytical techniques, holds significant promise for a wide range of applications, including sustainable biotechnology, novel drug development, and environmental solutions and addressing the current challenges will open new frontiers in biotechnological innovation and applications, driving the future of microbial biomolecule research.

IL-07

NALSUN-NG TM SOLAR ABSORBER COATING TECHNOLOGY AS A SUSTAINABLE RENEWABLE ENERGY SOLUTION

Harish C. Barshilia

Surface Engineering Division,
CSIR-National Aerospace Laboratories
HAL Airport Road, Kodihalli, Bangalore - 560 017
E-mail: harish@nal.res.in

Solar energy is an unlimited source of renewable energy, which can be utilized in energy production to generate both heat and electricity. Solar thermal conversion is the simplest and most direct method of harnessing solar energy, in which solar energy is converted to heat. This heat can be used as such or can be used to generate electricity. In the late 1980s, CSIR-NAL developed NALSUN solar absorber coating technology for domestic water heater applications using the electrodeposition method. However, due to the presence of hexavalent chromium, the coating bath is carcinogenic and its disposal is a challenge. In addition, there was a need to develop a cost-effective, eco-friendly, and easily scalable coating technology that is not available in the country.

Toward this, CSIR-NAL has developed an eco-friendly sprayable spectrally selective coating for domestic solar water heater applications based on graphene, trade named as NALSUN-NG. The coating process is RoHS and REACH-compliant. Furthermore, no volatile organic compounds are used in the process. The raw materials used in the coating process are cost-effective, and the coating process can be easily scaled up with near-zero chemical waste. The spectrally selective coating consists of two layers: an absorber layer and an inorganic protective layer. The coating can be sprayed on various metal substrates like aluminum, copper, mild steel, galvanized iron, and stainless steel at a substrate temperature of 150□C. A sprayable formulation was prepared to deposit directly on metal substrates without any pre-treatment. These coatings exhibit a high solar absorptance in the range of 0.91- 0.93 and thermal emittance in the range of 0.25 - 0.30 at 82□C. The coating displays good thermal stability up to 175□C in air for longer durations. The coating has qualified stringent environmental tests such as humidity, condensation, accelerated aging, UV, and corrosion resistance as per the ASTM and International Energy Standards. This presentation will discuss in detail the properties and applications of NALSUN-NG coating technology.

IL-08

ANALYTICAL APPLICATIONS OF THERMAL ANALYSIS

Naina Raje
Analytical Chemistry Division,
Bhabha Atomic Research Centre,
Mumbai nraje@barc.gov.in

Thermal analysis has played a transformative role in the evolution of modern analytical chemistry. As a collection of techniques used to study material properties as a function of temperature, thermal analysis has facilitated the advancements in material science, pharmaceuticals, environmental studies, and industrial quality control. The suite of thermal techniques, including thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), differential thermal analysis (DTA), and dynamic mechanical analysis (DMA), among others, have been pivotal in understanding thermal stability, phase transitions, and compositional analysis. Over the last five decades, these methods have evolved to include high- resolution instrumentation, automated systems, and hyphenated techniques. This presentation provides an overview of the development and applications of thermal analysis, emphasizing its critical contributions to analytical chemistry by providing feasible solutions to the challenges faced by various industries.

Hyphenated techniques in Thermal analysis follow the multipronged approach and thus are efficient and provide a more comprehensive picture about the sample behavior. It can simultaneously provide the information regarding the intermediates formed, gases evolved, decomposition behavior, impurities present besides the kinetic and thermodynamic parameters. Here the analytical applications of thermal analysis will be discussed.

ABSTRACTS

IL-09

ANALYTICAL METHOD DEVELOPMENT: AN ENHANCED APPROACH WITH PROJECTILE ADDITIVES

Prof. Dr. Chintan S. Dholakia
General Manager-ADL,
Zydus Lifesciences Ltd-Vadodara
Chintan.Dholakia@zyduslife.com

Analytical method development is a critical process in a pharmaceutical industry. It involves the creation and refinement of techniques used to identify, quantify, and analyse compounds in complex matrices. The aim is to establish methods that are accurate, precise, selective, sensitive and robust as per ICH Q2 guideline; while ensuring they are cost-effective and suitable for the intended purpose. The process begins with selecting the appropriate analytical technique based on the nature of the sample and the analyte of interest. Techniques such as chromatography (liquid, gas, or ion-exchange), spectroscopy (UV-Vis, IR, NMR), and mass spectrometry (MS) are commonly employed.

Method development involves several key stages, such as sample preparation, method optimization, and validation. Sample preparation is crucial to concentrate the target analytes, removing potential interferences to develop accurate method. Validation ensures that the method meets predefined criteria for accuracy, precision, linearity, specificity, sensitivity, and robustness.

Challenges in analytical method development include dealing with complex sample matrices, minimizing detection limits, and addressing interference from co-eluting substances. Furthermore, as regulatory frameworks become more stringent, analytical methods must also comply with good manufacturing practices (GMP), quality control standards. Ultimately, the goal is to provide reliable, reproducible, and high-throughput methods that support decision-making across scientific, regulatory, and industrial applications.

IL-10

ASSESSMENT OF CRITICAL MINERALS IN INDIA: OPPORTUNITIES AND CHALLENGES

Upendra Singh* and Anupam Agnihotri**
*Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur, India
singhu@jnarddc.gov.in, *upendra1970@gmail.com.*

The value chain of minerals begins with exploration and ends with the sale of the final product, with a small percentage of minerals being recycled through recovery. Some of these minerals are considered critical due to their usefulness to certain sectors of the economy, demand-supply mismatch, high risk of supply chain disruption, and the long lead times of mines.

Critical minerals are also significant to India, whose requirements are expected to increase significantly as it undertakes the energy transition across most of its sectors. Critical minerals are essential for economic development and national security. Lack of availability of these minerals or concentration of extraction or processing in a few geographical locations may lead to supply chain vulnerabilities and even disruption of supplies. Future global economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements. These are essential for the advancement of many sectors, including high-tech electronics, telecommunications, transport, and defence. They are also vital to power the global transition to a low carbon emissions economy, and the renewable energy technologies. Hence, it has become imperative to identify and develop value chains for the minerals that are critical to our country.

The Ministry of Mines accordingly constituted a committee to identify the list of minerals critical as our country is import dependent of many critical minerals. The technical committee has identified a set of 30 critical minerals. These are Antimony, Beryllium, Bismuth, Cobalt, Copper, Gallium, Germanium, Graphite, Hafnium, Indium, Lithium, Molybdenum, Niobium, Nickel, PGE, Phosphorous, Potash, REE, Rhenium, Silicon, Strontium, Tantalum, Tellurium, Tin, Titanium, Tungsten, Vanadium, Zirconium, Selenium and Cadmium.

To build competitive value chains in India, identification and investigation of mineral wealth and identifying areas of its potential by use of advanced technologies is very important. Identification of critical minerals will help country to plan for acquisition and preservation of such mineral assets considering the long-term needs of the country. This will also in turn reduce the import dependency as India is 100% import-dependent for certain elements. Hence identification and extraction of these critical minerals from industry wastes, tailings, dumps, by-product residues, slags and ashes etc, are very important for the economy.

ABSTRACTS

IL-11

POLYDOPAMINE MODIFIED SUPERPARAMAGNETIC NANOPARTICLES FOR ENHANCED CELLULAR UPTAKE AND INTRACELLULAR DELIVERY OF DTX FOR TARGETED PROSTATE CANCER TREATMENT

N. Singh[#1], N. Millot[a‡], C. Mirjolet[b‡] and R. Kumar[#]
[#]Department of Applied Chemistry, S.V. National Institute of Technology, Surat, India.
[‡]Laboratoire Interdisciplinaire Carnot de Bourgogne (ICB)
UMR 6303 CNRS/Université Bourgogne Franche- Comté,
[b‡]Radiotherapy Département, Centre Georges-François Leclerc, Dijon,France.

Polydopamine modified superparamagnetic core shell nanoparticles (NPs) are highly robust and biocompatible MRI contrast agents for the detection of tumors. Reactive quinone on the surface enhances the binding efficiency of various enzymes and biomolecules for targeted delivery. Glutathione disulphide (GTH) was thus immobilized on the surface to treat prostate cancer by carrying docetaxel (DTX) drug. To achieve maximum accumulation of the developed therapeutics at the targeted site, GTH immobilised NPs can manifests a successful biomarker for selecting tumors potentially responsive to chemotherapeutic regimens.[1] The NPs were sequentially characterised using FTIR, XPS, TGA, zeta potential, UV, and Raman spectroscopies. Thus, the developed NPs offers dual anticancer mode as NO release using GTH and by DTX release which is also analysed using *in-vitro* studies.

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IL-12

Catalytic Hydrogenation and Methylation Using Methanol

Sanjay Pratihar

Academy of Scientific and Innovative Research (AcSIR), Ghaziabad-201002, India
Inorganic Materials and Catalysis Division, CSIR-Central Salt & Marine Chemicals Research Institute, G.B. Marg, Bhavnagar 364002, Gujarat, India
E-mail: spratihar29@gmail.com spratihar@csmcri.res.in

The catalytic dehydrogenation of methanol to formaldehyde or formic acid, followed by its use in transfer hydrogenation (TH) and tandem (de)hydrogenation, offers advantages such as milder conditions, improved safety, and enhanced sustainability.[1] Methanol is an abundant, cost-effective hydrogen source with high hydrogen capacity (~12.5 wt%) and is derived from CO_2, natural gas, and biomass.[2] However, its use in TH is limited due to its less favorable redox potential. DFT calculations show a ΔG of +4.4 kJ/mol for acetophenone hydrogenation with isopropanol at 40 °C, underscoring methanol's thermodynamic challenges in catalytic TH.[3] Furthermore, the catalytic dehydrogenation of primary alcohols like methanol generates aldehydes, which are more reactive than ketones. This higher reactivity can lead to undesired side reactions, such as α-alkylation under basic conditions, and can potentially poison the catalyst by forming metal carbonyl species from formaldehyde. The development of homogeneous transition metal catalysis has transformed chemical synthesis, leveraging single-site catalysts where transition metals are surrounded by carefully designed ligands.[4] These ligands play a critical role in controlling the reactivity, selectivity, and stability of catalytic intermediates. Specifically, the steric and electronic properties of ligands influence the activation of methanol and its transformation into desired products.[5] The efficiency of these reactions depends on several factors, including (i) the geometry and oxidation state of the active metal center, (ii) the reversible formation and consumption of intermediates within the catalytic cycle, and (iii) the kinetic stability of intermediates to prevent degradation into undesirable byproducts. To optimize catalyst performance, various bi-, tri-, tetra-, and penta-dentate ligands containing donor atoms such as nitrogen, oxygen, sulfur, and carbon have been employed. Recently, N-heterocyclic carbene (NHC)-based ligands have gained attention for their superior ability to stabilize catalytic intermediates.[4] In this presentation, we will showcase recent advancements in the development of catalysts featuring proton-responsive ligands. These catalysts are designed for the efficient dehydrogenation of methanol and its simultaneous utilization in the hydrogenation of unsaturated substrates and the methylation of carbonyl compounds through tandem (de)hydrogenation processes.[6-9]

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IL-13

DIFFERENCE BETWEEN QC AND DISCRIMINATORY DISSOLUTION TESTING

Dr. Ashutosh Sharma
AVP, Analytical Department, R&D Centre, Sun Pharmaceutical Industries Limited
ashutosh.sharma@Sunpharma.com

Quality control and monitoring play a crucial role in ensuring the consistent safety and effectiveness of drug products during and after manufacturing. These controls are typically achieved through release testing followed by once the batch is manufactured with the help of set process and measurement system. For orally administered drug products in solid-dosage form, it is necessary to conduct a test to confirm proper release of the drug in accordance with the proposed release mechanism. Dissolution testing, an in vitro test used to characterize the release of drug product, is a critical quality control assessment due to its potential correlation with clinical performance.

Dissolution testing offers a way of projecting how and when the drug will release in vivo, based on an understanding of the drugs physicochemical properties and its dissolution performance under various dissolution conditions. Even if an in vitro/in vivo correlation cannot be established, having an in vitro dissolution method capable of discriminating against formulation variability is still crucial, as it helps identify potential discrepancies in clinical performance caused by unexpected formulation or process variations.

By addressing the Challenges and implications of discriminatory dissolution this work aims to promote rigorous and equitable standards in establishing a good discriminatory framework that can be adopted at QC. Dissolution testing has been a challenge with testing laboratories and best practices adopted are being discussed in this work.The work also examines regulatory guidelines and frameworks established by authorities such as the FDA and EMA to ensure fair and unbiased dissolution testing.

IL-14

MICRO-MESOPOROUS HIERARCHICAL SOLID ACID CATALYSTS FOR INDUSTRIAL APPLICATIONS

Prof. Rajib Bandopadhyay
Department of Chemistry,
School of Energy Technology,
Pandit Deendayal Energy University,
Gandhinagar, Gujarat, 382426, India
rajib.bandyopadhyay@sot.pdpu.ac.in

Solid acid catalysts such as zeolites and related molecular sieves have been used for decades in petrochemicals, fine chemicals and petroleum reefing in addition to their various other applications. However, steric and/or diffusional restrictions make their applications limited using bulkier organic molecules. To overcome this, hierarchical zeolites can be prepared and used that exhibit improved catalytic properties. Additionally, secondary porosity provides an excellent setting for the deposition of additional active phases as well as for functionalization using organic molecules.

Our current research focuses on studying features that govern partial dissolution of zeolite frameworks, in order to generate hierarchy in the sample with a particular focus on the fabrication of novel zeolite materials capable of processing heavy molecules than their traditional counterparts.

Following are the approaches that makes the present research meaningful: (a) Enhance properties of zeolite through post-synthesis modification, (b) Identify the appropriate post-synthetic method for generating hierarchy (c) Identify the role of physico-chemical properties in synthesized zeolites, (d) Identify the most effective Friedel-Craft reaction type with optimization, (e) Investigate and establish correlations between experimental results with theoretical findings.

The alkylation of toluene with benzyl alcohol using these hierarchical zeolites resulted in mono-benzylated toluene. The results demonstrated that all the zeolite samples were catalytically active. The catalytic activities of the parent (H-form) and acid-treated zeolites were compared to those of alkali-treated zeolites. The performance of the alkali-treated materials was superior to those of the acid-treated and H-form materials. A benzyl alcohol conversion of 98% was achieved using alkali-treated Beta, whereas 91% and 82% conversions were achieved using acid-treated and H-Beta, respectively. The introduction of mesoporosity into microporous zeolites was found to have a significant effect on their catalytic activity.

IL-15

BIO MOLECULE CHARACTERIZATION BY HIGH END ORTHOGONAL ANALYTICAL TECHNIQUES INCLUDES IMPURITY PROFILING, PROTEOMICS, HIGHER ORDER STRUCTURE, AND IN VITRO DRUG RELEASE TO DEMONSTRATE THERAPEUTIC EFFICACY AND OBTAIN COMMERCIAL APPROVAL FOR COMPLEX GENERICS THAT REDUCE PATIENT PRESCRIPTION COSTS FOR THE BRAND (INNOVATOR DRUG)

Rohit Jadav
Sr. General Manager - Analytical R&D, NCE,
Amneal Pharmaceuticals
rohit.5580957@gmail.com

IL-16

NITROSAMINE IMPURITY MONITORING

Dr. Usmangani K. Chhalotiya
Indukaka Ipkowala college of pharmacy

IL-17

LEGAL STATUS OF FOOD SAFETY AND STATUTORY REQUIREMENTS IN INDIA

Dr. Prem Kumar Jaiswal, D. Phil, D.Sc.
Former Director of Laboratories, Central Agmark Laboratory,
Min. of Agriculture, Govt. of India
Former Chairman, Scientific Panel; member Scientific Committee;
Lead Expert;
FSSAI
Food Safety Adviser
prem1948@yahoo.co.in

Food Safety is the mandate of Government of India to provide safe, nutritious and wholesome food to a consumer. After independence, Food Safety was being implemented by the Ministry of Health enacted under "Prevention of Food Adulteration Act 1954, Rules 1955, besides other food laws with multiplicities of enforcement by several Government organisations, thus making it complicated for the food business operators for their compliances. Hence, this was decided by the Government to make a unified consolidated food law in the country. The integrated food law came into existence and was named as "The Food Safety and Standards Bill, 2005, which was passed by the Parliament and thus Food Safety and Standards Act, 2006 (Act no 34 of 2006) was made as a unified food law surpassing other food laws in the country. Thereafter, for implementation of the food law, a new organisation was created by the Government named as Food Safety and Standards Authority of India (FSSAI). FSS Act was followed by the Food Safety and Standards Rules, 2011. Several Food Safety and Standards Regulations were made for implementation of the Act and Rules through the entire food chain right from manufacturer, storage, wholesaler, distributor, dealer, retailer, transporter and any other food business being carried out by the Food Business Operators. Implementation of Food safety is being done by Central Government and state Govt. / UT as well.

Food Business has been defined as any activity whether for profit or not by any agency / individual / public / private related to manufacturing, processing, packaging, storage, transportation, distribution of food, import and includes food services, catering services, sale of food or food ingredients. Licensing has been made as one of the important mandatory tools for implementation of food safety in food business with different type of licenses under different food categories issued either by the Central government or state government /UT/other Govt. departments depending upon the criteria and quantum of the business.

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Special emphasis has been given to provide nutritious food to human beings through implementation of various regulations like fortification of food; health supplements, nutraceuticals food for special dietary use, food for special medical purpose and prebiotic and probiotic food; and Ayurveda food.

With a view to focus on safety of the food and in view of the limitation of government laboratories to perform all the tests i.e. Quality, safety, contaminants, microbiological etc. a number of private laboratories have been approved to perform the function of testing at par with the government laboratories through the notification. Technical laboratory persons have been trained. NABL accreditation has been made as a benchmark for evaluating technical competency of laboratories and personnel as well, and for ensuring that tests performed by such laboratories are reliable and acceptable. These test reports are the criteria for judging the quality and safety of a food.

Due to liberalisation of food trade worldwide, imported food has grown enormously in the country. With a view to ensure that only safe food is imported for consumption, Dedicated Food Import regulations have been implemented by the FSSAI and under normal courses the imported food is tested and then released in the country. Certain food relaxations have been given to Food Importers to facilitate quick and fast release of the imported food and a number of centres have been made at the import point by air / sea / land and testing facilities have been developed to enable tests to be done on priority. Alcoholic Beverages have also been covered under purview of food safety and several standards have been made to judge their quality before being marketed for human consumption.

Standardisation of the food and formulating new standards of food coupled with the revision of old standards have been a priority area of FSSAI. These are being implemented by formation of different Panels and committees composed of experts to work as an independent body to advise government standards based on the scientific data. This activity has been carried out by constitution of different scientific panels, scientific committee, and Food authority for the proposed standards. This is given a legal shape through public consultation by obtaining the comments through a process of draft notification and then final notification. Standards formulation is a transparent system and is done after consultation of food industries / manufacture / food business operators/other stakeholders involved in the system.

The process of prosecution has been liberalised as compared to earlier Act i.e. Prevention of Food Adulteration Act. Now, misbranded / sub-standard food are punishable by imposing fines depending upon the nature of the offenses making simplified process in the ADM court through a system of adjudication and food safety appellate tribunal, whereas in case of unsafe food only prosecution punishable with imprisonment is being done in a regular competent Court.

FSSAI issues advisory for implementation of the food safety amongst FBOs and facilitates the FBOs to properly follow the Act, Rules and Regulations. Third party Audit systems approving the private certifying bodies for the purpose of inspection and audit have been implemented by the FSSAI besides carrying out the inspection / audit by food safety officers of state government / central government. This is done to ensure that conditions of food licences are being scrupulously followed. These are FSMS, Sanitary and hygienic conditions and this is ensured that all good practices like hygienic / manufacturing / storage / transportation are followed in the entire food chain so that ultimately the consumer could get safe food.

Labelling has been given due importance to ensure that a consumer/ purchaser of the food do get adequate information before purchasing any food. These are manufacture / packer details batch no., net weight / expiry date / use by / ingredients / veg / non veg / nutrition value. Allergen, storage / condition etc.

This can be concluded that FSSAI have been very dynamic and there have been continuous improvements to achieve goal of providing a safe and nutritious food to a consumer in the food safety ecosystem of the country, in spite of the facts that several new foods are regularly being manufactured/imported with new technologies /new packing materials and placed in the market. Food Frauds and online sale of food especially perishable/prepared food/ ready to eat is a big challenge at present to FSSAI, nevertheless, this is expected that the consumers have to be equally careful and responsible while purchasing any food and consuming them.

ABSTRACTS

IL-18

EXPLORING MATERIAL BEHAVIOR UNDER EXTREME CONDITIONS THROUGH RAMAN SPECTROSCOPY

Pallavi Ghalsasi
School of Science, Navrachana University,
Vadodara- 391 410, Gujarat, India
pallavig.nuv.ac.in

In recent years, Raman spectroscopy has emerged as a highly versatile analytical technique, capable of providing distinct molecular vibrational signatures to characterize materials non-invasively. With advancements in laser technology, micro-Raman optics, and instrument miniaturization, this technique has vast applications across various fields, including physics, chemistry, biology, material science, pharmaceutical science, agriculture, geophysics, architecture, and archaeology.

I have established a High-Pressure Raman Spectroscopy laboratory, where diamond anvil cells serve as a valuable tool for examining material's behavior under *in situ* high-pressure—an extreme condition—by observing changes in molecular vibrations. Additionally, temperature variations, both high and low, provide insights into phonon anharmonicity effects in the sample.

In my presentation, I will begin with an introduction to Raman spectroscopy as a spectroscopic method. I will then discuss my research, focusing on the applications of Raman spectroscopy in single-walled carbon nanotubes, organic-inorganic hybrid compound (OIHC) materials and negative thermal expansion (NTE) materials. Raman spectra of OIHC materials demonstrate a unique display of Jahn Teller distortion and associated changes when subjected to pressure. NTE materials demonstrate uncommon behavior of phonons responsible for the NTE behavior. Through these examples, I aim to demonstrate how Raman spectroscopy serves as an effective and accessible tool for probing compounds and/or material behavior, offering valuable insights and unique information on structural and vibrational dynamics with minimal sample preparation.

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IL-19

HISTORICAL DEVELOPMENT OF LED FLUORIMETER: A VERSATILE PORTABLE INSTRUMENT FOR MEASUREMENT OF URANIUM IN WATER, ROCKS, MINERALS AND OTHER DIVERSE MATRICES

D.P.S. Rathore*
Atomic Minerals Directorate for
Exploration and Research,
Department of Atomic Energy, Jaipur-302033,
Rajasthan, India
dpsr2002@yahoo.com

This paper describes the historical development and potentiality of versatile portable LED-Fluorimeter available in the market in the world as on today for reliable measurement of uranium in water, rocks, minerals, concentrates and other diverse matrices. Pulsed LED-fluorimetry is highly sensitive, versatile and a well-documented field technique for the direct determination of uranium in water samples at µgL-1levels.

A high level of total dissolved solids (TDS) in water samples results in greater variation in the major cations and anions, and uranium content with respect to the time interval between sample collection and analysis. The physico-chemical and biological changes continue inevitably after sample collection due to changes in dynamic equilibrium. The presence of fluoride and diverse humic substances in arid regions results in changes in the content of uranium, major cations and anions, if there is a time interval between sample collection and analysis, and this disrupts the reliable analysis of uranium in natural waters using LED-fluorimetry. This is made more challenging due to the wide variety of types of water samples, which differ in total dissolved salts found, and these include saline water, diverse humic substances and fluoride content, especially in hot arid regions as well as due to the practical impossibility of preserving natural water samples. Therefore, it is the time interval between sample collection and analysis that is the most critical factor for the reliable analysis of uranium in hot arid regions. Thus, the use of a mobile geochemical laboratory for on the spot/quick analysis of water samples, preferably on the same day, is required.

The potential of pulsed LED-fluorimetry has been utilized to assess uranium in a variety of matrices, including mineralized rocks, ores, beneficiation products, and other matrices, without the need for any kind of separation method.

Using the high sensitivity of pulsed LED-fluorimetry, interferences from related and auxiliary elements are removed by a straight forward one-step dilution of the sample aliquots using push-button microliter pipettes, bringing the uranium concentration within the instrument's operating range. In order to improve fluorescence precision, the measurement is carried out using the differential technique method, which makes use of a more appropriate acidic buffer mixture of H3PO4-NH4H2PO4 (pH ~2.5, with, H3PO4 at 1 M and NH4H2PO4 at 2.17 M). In fact, it is the designing of whole experimental procedure in such a way that for very diluted sample solutions, prefilter (species absorbing at the laser wavelength, 337 nm, LED wavelength of excitation at 400 nm) and postfilter (species absorbing at the maximum fluorescence wavelengths, 480-560 nm) effects are negligible (which is verified by spectrophotometry). The method of differential technique is a self-standardized methodology traceable to international standards.

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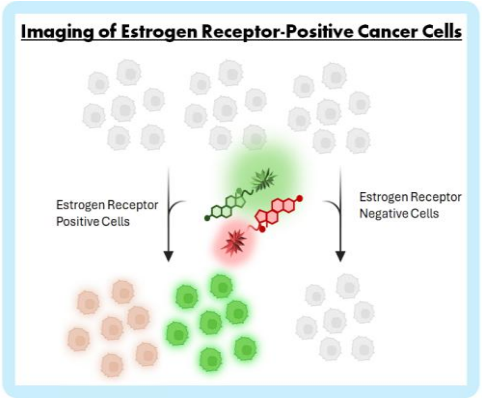
IL-20

TARGETED IMAGING OF ESTROGEN RECEPTOR-POSITIVE CANCER CELLS USING FLUORESCENT ESTRADIOL PROBES

Sriram Kanvah Gundimeda
Department of Chemistry,
Indian Institute of Technology Gandhinagar,
Palaj, Gandhinagar
sriram@iitgn.ac.in

Donor-acceptor (D-π–A) conjugated organic molecules exhibit versatile chemical, optical, electrical, and biological properties, making them a promising platform for the development of innovative functional materials. These conjugated systems, characterized by low-energy emission and charge-transfer behaviour, hold significant potential for diagnostic and analytical applications. Our research focuses on the synthesis and photo responsive properties of such fluorophores for advanced biological imaging. By modulating auxochromes, we have developed a series of fluorophores capable of selectively staining sub-cellular organelles, including the plasma membrane, lipid droplets, endoplasmic reticulum, lysosomes, and mitochondria. These fluorescent probes also enable real-time monitoring of physiological processes, such as viscosity changes and inter-organelle interactions, thereby expanding their applicability in medical diagnostics. Furthermore, this presentation will highlight our design strategies and findings in sub-cellular imaging, as well as recent advancements in receptor-mediated targeting and imaging of estrogen receptor-positive (ER+) breast cancer cells, paving the way for targeted therapeutic interventions.



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IL-21

Leveraging catalyst innovations to address the challenges of refining industry in an era of energy transition

K.O. Xavier, K.V. Karthikeyani and Alex C Pulikottil

Indian Oil Corporation Limited
Research & Development Centre
Sector 13, Faridabad 121 006, Haryana, India
Email: xavierko@indianoil.in

In the current era of energy transition, the social and environment driven mandates are shaping the way in which the oil refining operations need to be carried out. The refineries that primarily focused on fuels production, are now looking at options to increase the petrochemical intensity in its operations. Further, the process units need to run at maximum efficiency while meeting the regulatory requirements for both product quality and environmental performance. There is also a need to adapt and respond to changes in feedstock availability and product slate shifts for flexible and profitable operation of a refinery. Catalysts are the heart of major refining processes and innovations and breakthroughs in catalyst science have fueled the growth of modern refining industry. Refining catalysts are also considered as a drop in tool to enable refinery to navigate towards the sustainability goals. The challenges of energy transition open new opportunities for refining catalyst development, for which the insights on catalyst science and characteristics are crucial and the presentation will highlight such aspects.

IL-22

GELATOR FREE GELLED MICROEMULSIONS: RHEOLOGY AND STRUCTURE PROPERTY CORRELATION

Sandeep R. Patil*, Vinayak Valodkar
School of Science, Navrachana University
sandeepp@nuv.ac.in

Gelled microemulsions serve as versatile templates in various scientific and industrial applications due to their unique properties, viz. stability and structure, versatility, rheological behaviors. Fine-tuning the composition and conditions of microemulsions facilitates precise control over the structure and size of the domains. Formulation and characterization of gelator free ternary gelled microemulsion systems composed of Water, Non-ionic surfactants, and Hydrocarbon solvents (oil) was carried out. Specifically, the systems included combinations of water, non-ionic surfactants Plantacare-810®: Triton X-100 (1:1) with various hydrocarbons: Hexane, Octane, Decane, Dodecane, and Tetradecane. Phase transitions were monitored as a function of temperature, and microstructural changes were observed using polarization microscopy. Clear isotropic gel formation was observed in these systems at a specific surfactant mass fraction, where the hydrocarbon solvent (C_8 to C_{14} chain) acts as a critical determinant in the gelation process. Gel formation was further explored through T_{gel} determination (ascertaining sol-gel transition) and rheological measurements, especially amplitude sweep, and temperature sweep to establish structure-property correlation. Our findings shed light on the factors influencing gel-formation and provide insights into potential applications of these gelled microemulsion systems.

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IL-23

FORENSIC SCIENCE IN COSMETICS, JEWELLERY AND CRIMINOLOGY – AN ANALYTICAL INVESTIGATION AND FINDINGS USING X-RAY SPECTROSCOPY

Daisy Joseph
Nuclear Physics Division, EX-BARC,
Trombay, Mumbai
josephdaisy583@gmail.com

There are a large number of cases in India and globally where a parallel industry exists and survives and does a flouring business in duplicating original jewelry, gems, costly and genuine cosmetics, Xerox toners and simple beverages like tea powders. Analytical science and forensic science can be used to analyze jewelry in a variety of cases, including to detect counterfeit and artificial jewelry or to help identify cheap cosmetics, reused toners, tea powders, migrant and refugees in criminal cases using elemental analysis. These techniques include Scanning electron microscope (SEM) and Energy dispersive X-ray analysis (EDAX), Energy Dispersive X-ray Fluorescence (EDXRF), Proton Induced X-ray Emission (PIXE) and EXAFS using synchrotrons as probes to determine the presence of trace elements including gold, copper, and zinc.

Forensic analysis of jewelry and other personal belongings can help to identify and humanize the stories of migrants and refugees using X-ray spectroscopy. Cosmetic analysis helps crack mysterious murder cases in this presentation, I will elucidate, summarize and compile my analytical studies, on gold, printing inks, drugs, cosmetics, toners, firecrackers and gems.

IL-24

ADDRESSING PERFLUOROALKYL AND POLYFLUOROALKYL SUBSTANCES (PFAS) CONTAMINATION IN INDIAN WATERS: RISKS, ANALYSIS, CHALLENGES, AND BIOCHAR-BASED SUSTAINABLE REMEDIATION STRATEGIES

Dinesh Mohan
School of Environmental Sciences,
Jawaharlal Nehru University, New Delhi 110067, India
dm_1967@hotmail.com

Since the 1940s, per- and polyfluoroalkyl substances (PFAS), or "forever chemicals," have been extensively used in industrial and consumer products due to their resistance to heat, water, and grease. These synthetic compounds, exceeding 4,700 in number, are persistent and bioaccumulative. Among them, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are the most studied. PFAS are broadly classified as short- or long-chained, but their precise structural distinction remains uncertain. PFAS exposure poses severe health risks, including liver toxicity, cancer, infertility, Increased cholesterol, developmental disorders, immune dysfunction, and chronic diseases.

They are widely found in firefighting foams, vehicle coatings, cookware, textiles, and personal care products. These chemicals continuously enter the environment through landfills and wastewater treatment plants (WWTPs). In textiles, paper, and leather, PFAS are used as water-, stain-, and oil-resistant coatings, with precursor compounds degrading into persistent pollutants.

Despite growing evidence of their ecological and health hazards, research on PFAS presence in Indian environments remains limited. However, recent studies are making efforts to quantify their occurrence across various media. Additionally, no permissible or desirable limits for PFAS in drinking water have been established in India. Given their toxicity and persistence, urgent regulatory measures and large-scale monitoring are essential.

Biochar-based remediation offers a promising, sustainable solution for PFAS removal. Derived from biomass pyrolysis or gasification, biochar is a cost-effective adsorbent capable of capturing pollutants in water and soil. Its application not only aids in environmental cleanup but also contributes to long-term carbon sequestration, making it a viable strategy for mitigating PFAS contamination.

IL-25

PYROLYSIS – A PROMISING TECHNIQUE FOR PLASTIC WASTE MANAGEMENT

Nitin Bhate
Department of Chemical Engineering,
The Maharaja Sayajirao University of Baroda

Plastic waste has become a grave issue on the global front. Millions of tons of plastic waste make way to the oceans and landfills creating grave concerns for the marine ecosystem as well as ground water. Typically, four techniques are used in plastic waste management, namely, Primary, Secondary, Tertiary and Quaternary. The first two techniques are associated with mechanical recycling and the last one is associated with harnessing energy from waste. In tertiary technique, plastic waste is converted to either liquid or gaseous products using pyrolysis in the presence or absence of catalysts. Pyrolysis is the thermal decomposition of polymers in an oxygen-free environment which transforms long-chain plastic molecules into shorter, energy-rich compounds. The on-going research in our laboratory involves pyrolysis of various plastics including expanded polystyrene (EPS), high-density polyethylene (HDPE), polypropylene (PP), multilayer plastics, and reverse osmosis filter threads. The temperature conditions were maintained in the range of 400 – 600 ^{0}C and the catalysts used were spent FCC and Co-Mo. It was observed that PP gives the maximum yield up to 85% with respect to liquid product as compared to other polyolefins which range between 40 - 60%. EPS can be successfully converted into its precursors by pyrolysis. The physical properties along with the calorific values of the liquid fuel obtained are in line with the conventional fuels. Thus, with appropriate purification, pyrolysis certainly can prove to be a viable option for converting plastic waste into fuel.

IL-26

NANOSTRUCTURED MATERIALS & NANOCARRIERS: IMPLICATIONS IN CELL IMAGING & STIMULI RESPONSIVE DRUG RELEASE

Sumit Kumar Pramanik, Principal Scientist
Central Salt and Marine Chemicals Research Institute,
Bhavnagar, Gujarat, India.
sumitpramanik@csmcri.res.in

This abstract explores the development and application of stimuli-responsive nanocarriers in the fields of bioimaging and drug delivery. A wide variety of nanocarriers have been developed with the ability to undergo physicochemical changes in response to both external and internal stimuli. External stimuli include ultrasound, heat, light, and magnetic fields, while internal stimuli encompass factors such as pH levels, redox potential, hypoxia, and enzymatic activity. These nanocarriers are designed to react to specific conditions within tumor microenvironments or inside cancer cells, enabling on-demand drug delivery and accumulation, controlled release of therapeutic agents, activation of bioactive compounds, probes, and targeting ligands, as well as transformations in size, charge, and conformation. Such capabilities facilitate sensing and signaling, help overcome multidrug resistance, and enhance the accuracy of diagnosis and precision of treatment. This presentation will discuss the general strategies for designing stimuli-responsive nanocarriers, highlight recent advancements in the field, and explore their applications in drug delivery, tumor imaging, therapy, and theranostics. Additionally, it discusses the progress made in clinical translation and offers insights into future prospects.

IL-27

AI-DRIVEN COMPUTATIONAL CHEMISTRY: TRANSFORMING MEDICINAL CHEMISTRY FOR A SUSTAINABLE FUTURE

Dr. Prashant R Murumkar

Artificial Intelligence is revolutionizing medicinal chemistry and computational chemistry, reshaping drug discovery with sustainable and efficient methodologies. This talk explores the integration of AI with computational techniques to accelerate lead identification, optimize molecular design, and enhance predictive modeling. By leveraging machine learning algorithms, AI-driven molecular docking, quantitative structure-activity relationship modeling, and deep learning-based de novo drug design, researchers can reduce experimental costs and environmental footprints, fostering sustainability in pharmaceutical research. A key aspect of AI in medicinal chemistry is its ability to predict ADMET properties with high accuracy, reducing late-stage drug attrition rates. Furthermore, AI-powered molecular dynamics simulations and quantum computing applications offer profound insights into protein-ligand interactions, enabling rational drug design. The synergy between AI and multi-omics technologies further enhances target identification and validation, paving the way for personalized medicine. While AI presents remarkable opportunities, challenges such as model interpretability, data bias, and ethical considerations must be addressed for its responsible implementation. This presentation will highlight case studies where AI-driven computational chemistry has successfully contributed to drug discovery, emphasizing its role in sustainability by optimizing chemical synthesis routes and repurposing existing drugs. This talk aligns with the theme of International Analytical Science Congress (2025), “Metamorphosis Synergies and AI for a Sustainable Future,” by demonstrating AI’s transformative impact on medicinal chemistry.

IL-28

SURFACE SPECTROSCOPY FOR THE MOLECULAR INSIGHTS INTO REVERSE WATER GAS SHIFT CATALYST DESIGN

Dr. C P Vinod
Catalysis and Inorganic Chemistry Division
CSIR- National Chemical Laboratory
Pune

Global CO_2 emissions are having catastrophic effects on our climate and weather patterns with other looming socio-economic issues. With a worldwide population of 7.8 billion in 2020 and expected to touch 9.9 billion by 2050, the goal of achieving net C-neutrality by this time will take a humungous effort by science and technologists alike. With increasing emissions expected from the rising population and the demands met in food, energy and social security, several options are available to reduce global CO_2 emissions. Switching to renewable energy is one of the options where wind, solar and water can be used to meet energy demands. Until alternate viable renewable technologies are developed, coal and oil will still be our main sources of energy. In this scenario, there is an urge to decarbonize the CO_2 to the levels where global warming temperature can be kept below 1.5 deg C. The scientific community has intensely pursued CO2 capture and utilization strategies to accomplish this goal.[1-3] In this talk, I will show how surface spectroscopy can be utilized for unravelling molecular-level insights of the catalyst design for RWGS reaction. It should be noted that the production of CO through RWGS reaction is an excellent feed for several downstream industrial applications.[4,5]

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IL-29

Atoms 4 Humanity: Non-Power Application of Nuclear Energy

Pradip Mukherjee
Board of Radiation and Isotope Technology, BRIT
Department of Atomic Energy

The non-power application of Nuclear energy is a diversified field and is less well-known. The technologies based on Radio-isotope (RI) and radiation finds its various societal application particularly in healthcare, industry, agriculture and food preservation. Department of Atomic Energy (DAE), particularly, Bhabha Atomic Research Centre (BARC) is carrying out R&D work on it for more than six decades. Board of Radiation & Isotope Technology (BRIT), another independent organisation under the aegis of DAE, truncated from BARC in 1989 commercialise and proliferates this technology towards the benefits of humanity.

The application of radioisotopes in health care has been one of the earliest demonstrated valuable, practical benefits of the atomic energy programme and associated developments in most countries. In India under the exemplary and visionary leadership of H.J. Bhabha, the Apsara Reactor was commissioned in 1956, which marks the beginning of the R&D activities related to the RI at BARC Trombay campus. The commissioning of CIRUS Reactor in 1960 gave a thrust to the RI programmes in general and healthcare applications in particular to produce a variety of RI and in larger quantity. Research reactors (RR) and particle accelerators, mostly, cyclotrons (especially the compact medical cyclotrons, MC), are the major sources for RI production, accomplished by irradiating a suitable target material either by neutron or by any charged particle of high energy. Health care application of Radiation and Radioisotope has grown to a substantial extent in recent years particularly for cancer care. Popularly known as nuclear medicine the radio pharmaceuticals produced at BRIT are extensively used for both diagnostic and therapeutic purpose. Radio Isotopes produced in the Research Reactors or in the Cyclotron are converted into Radio pharmaceuticals in BRIT laboratories and are supplied to hospitals and medical institutions through its logistic networks across the country. SPECT radiopharmaceutical such as high specific Mo-99/Tc -99m generators and PET radiopharmaceuticals like [18F]-FDG, [18F]-FLT, [18F]-NaF, [18F]-FET and [18F]-FMISO are widely used for diagnosis. I-131, Lu-177 DOTA-TATE, Lu-177 PSMA, finds its application in therapeutic application in treating cancer patients. Ir-192 Brachytherapy sources and Co-60 teletherapy sources are used for radiation treatment of cancer (Radiation oncology). Ru-106 plaques developed at BARC are also used as a safe and effective treatment option for ocular tumours. I-125 seeds are used as brachytherapy sources in treating early-stage prostate & breast cancer and in ocular tumour also.

Blood Irradiators, produced by BRIT are used to irradiate blood and blood products to reduces the risk of T-Graft versus Host disease in immune deficient patients. Cobalt 60/ Caesium 137 are used as the radiation source in it. Sterilisation of Medical products by gamma irradiation to kill micro-organisms to sterilise various healthcare products such as disposable syringes, surgical sutures, cotton dressing, drugs and related products etc is another important application of radioisotopes.
Food irradiation is the process of exposing food items to gamma rays or electron beam radiation to give a specific dose to reduce microbial load and eliminates pathogens. In addition to inhibiting spoilage, irradiation can delay ripening of fruits and vegetables to give them longer shelf life. The first Radiation processing plant for agro product (Spice) irradiation was established 25 years ago in 2000 at BRIT, Vashi complex. Till then the technology has been proliferated and with the active involvement of the department nearly 38 radiation plants are established in different parts of the country by private and semi government entities. Irradiators with specific application and with custom specification are also offered by the department. "Low Temperature Gamma Irradiator" for irradiation of fish and meat product, Mobile food Irradiator (MFI) the irradiator on wheels are such examples.

Towards the industrial application of Radiation Technology BRIT has developed radiographic exposure devices to support the NDT industry. ROLI-2, ROLI-3, ROTEX-I, COCAM-120 are some of those devices designed, manufactured and marketed by BRIT. Radioisotope such as Ir-192, Co-60 etc are used in these devices. These devices are not only reliable but also cost effective and designed to operate with minimal maintenance ensuring safety during operation. Radiation and radioisotopes are also used for scanning of process column, distillation column in process industries (viz refineries). Injecting short half-life Radio isotopes like Mo-99 as Radiotracer are used extensively to detect leak in heat exchanger, underground pipe line etc. It is also used in flow measurement, sediment transport studies, leakage detection in dams, oil reserve analysis and fly-ash disposal studies etc.

To study the effect of radiation on various materials in universities and research organization BRIT offers Gamma Chambers (GC 5000 and GC 1200) which uses Co-60 radioisotope as radiation source. One of the important applications is in agriculture where seeds or cuttings of plants can be irradiated to cause mutation and get desired traits. Other application such as radiobiology, preservation of tissue grafts, food preservation, sterile male insect technique, study of biological and genetic effects of radiations, radiation chemistry, radiation effects on materials, radiation disinfection, modification of material properties under radiation can also be studied using these Gamma chambers.

In recent times, radiation technology finds its application of preserving cultural heritage and converting microplastic into more recyclable products. However, these are still in the R&D stage. The non-power application of nuclear energy is diversified and countless. Its societal benefits are immense to mankind.

IL-30

CURRENT STATUS OF EMERGING PERSISTENT ORGANIC POLLUTANTS: FIRE RETARDANTS (PBDES) AND PESTICIDES (OCIPS)

Neeta Pradip Thacker*, Kavita Gandhi and DilluSingh*****

*Former Chief Scientist and Head Analytical Instruments Division,

** Principal Scientist, Pesticide Residue Laboratory, SEAF

*** Project Associate, Pesticide Residue Laboratory, SEAF

CSIR-National Environmental Engineering Research Institute, Nagpur, India

neetathacker9@gmail.com

It is of utmost concern to recognise the importance of manufacturing and import of persistent organic pollutants (POPs) and similar toxic chemical substances due to their implications on our ecosystem. New chemicals are regularly entering into our day-to-day life. The advancement of our social media has led to improved general awareness in our society and growing concern to the general population about the associated health risk from the exposure to these substances. India is a signatory to various international treaties such as Stockholm Convention (control POPs), Basel Convention (manage transboundary movement of hazardous wastes), Rotterdam Convention (procedure for certain chemicals trade). Aim of implementation of these treaties is to manage POPs and similar toxic chemicals through proper legislation in the country. In-spite of various regulations to ban or control the use of POPs, many of these chemicals are detected in various environmental matrices. The retrospective approach to pollution management needs to be replaced with that based on risk assessment for some of these toxic chemicals. Environmental quality assessment with reference to these toxic chemicals has to be regarded as an important national priority in our country.

In the present talk the recently banned toxic POPs current status of polybrominated diphenyl ethers (PBDEs) used as fire retardants and organochlorine pesticides (OCIPs) has been elaborated with reference to Indian environmental conditions.

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ABSTRACTS

SHORT LECTURES

SL-01

INTERFERENCE OF CHLORIDE IN THE ANALYSIS OF CHEMICAL OXYGEN DEMAND (COD) A KEY PARAMETER TO IDENTIFY ORGANIC POLLUTION LEVELS.

Mr. Babubhai Patel
Chairman
Nandesari Industries Association,
GIDC, Nandesari
niacetp@gmail.com

Hydrochloric acid (HCl) is widely used in industries, leading to high chloride concentrations in wastewater. Chemical Oxygen Demand (COD) is a critical parameter to measure organic pollution, but chloride interference can lead to inaccurate results. The standard methods published by American Public Health Association (Method no. 5220b) states that the method prescribed in the book should not be used for samples with chloride levels above 2,000 mg/L. In the analysis method for samples with high chloride, the Chloride ions (Cl^-) react with potassium dichromate ($K_2Cr_2O_7$) and sulfuric acid (H_2SO_4), producing chlorine gas (Cl_2) and consumes the oxidizing agent i.e. $K_2Cr_2O_7$. This reaction leads to overestimation of COD, as the oxidant is used to oxidize chloride instead of organic matter.

To mitigate the effect of chloride, APHA suggests Mercury Sulfate Addition ($HgSO_4$), which is used to complex chloride ions, but it does not fully eliminate interference. This has been shown in the NIA sponsored study carried out by National Environmental Engineering Research Institute (NEERI), Nagpur. The study was carried out in 2016. The second method is the dilution method which **r**educes chloride concentration but in turn also dilutes organic matter, affecting sensitivity. NIA and its R&D facility had been working for many years to find a solution to the interference of chloride in the COD analysis, since it was affecting the growth of the chemical industry. NIA sponsored a study with NEERI (2016) to address chloride interference in COD measurements for highly saline industrial wastewater. Despite efforts, regulatory authorities did not respond to the findings. In 2019, NIA approached the publishers of Standard methods for a solution. After considerable correspondence and submission of work carried out by NIA, Standard Methods asked NIA for a proposed method for the chloride correction.

NIA developed a **Back Titration Method** to correct for chloride interference. Measure chloride concentration and prepare a surrogate NaCl sample. Calculate actual COD by subtracting COD of NaCl sample from COD of actual sample without adding mercuric sulphate. A graph correlating chloride concentration to COD was developed for accurate adjustments. Standard Methods accepted the method proposed by NIA and it was published in the Standard Methods in the 24th Edition, January 2023. However, there are still regulatory challenges that chemical industry is facing. Despite publication of new method in the 24th edition of *Standard Methods* (2024), regulatory authorities have not adopted it. Industries face closures and hefty fines due to non-compliance with COD standards, caused by inaccurate measurements. It is important to highlight that the developed method provides a scientifically valid solution to chloride interference in COD analysis. NIA urges regulatory authorities to adopt this method to prevent unjust penalties and support the chemical industry.

SL-02

NANOFILM COMPOSITE MEMBRANES FOR PRECISION SEPARATION

Dr. Santanu Karan, Principal Scientist
Membrane Science and Separation Technology Division, CSIR-Central Salt and Marine Chemicals Research Institute, G.B. Marg, Bhavnagar, Gujarat 364002, India.
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, Uttar Pradesh 201002, India.
santanuk@csmcri.res.in

Composite nanofiltration membranes with ultrahigh ion selectivity and liquid permeance are desirable to increase water recovery and process efficiency in nanofiltration and water desalination [1]. Liquid transport through a composite membrane is known to be inversely proportional to the thickness of its separation layer [1 – 3]. While the scalable fabrication of ultrathin polymer membranes is sought for their commercial exploitation, there is an indispensable need to understand the ion-sieving property of ultrathin polymer films [3]. The narrow pore size distribution and controlled surface charge in the separation layer of nanofiltration membranes significantly improve the ion selectivity through molecular sieving and Donnan exclusion of co-ions [1]. The ultraselective and highly water-permeable nanofilm composite membranes were fabricated via interfacial polymerization with precise control of the kinetics of the interfacial polymerization reaction by maintaining the stoichiometric equilibrium of the monomers at the interface and by a post-solvent-washing and post-heating of the nascent nanofilm formed at the interface [1, 3]. The kinetically favorable stoichiometric equilibrium condition prohibited the formation of aggregate pores in the nanofilm and formed narrow network pores with a high surface negative charge [1]. Nanofilms were designed with a controlled degree of crosslinking and made as thin as ≈ 4.5 nm to achieve increased water permeance [1,3]. The ultraselective membranes exhibit up to 99.99% rejection of divalent salt (Na_2SO_4) and demonstrate monovalent to divalent ion selectivity of >4000 [1]. The selectivity of these nanofilm composite membranes is beyond the permeance–selectivity upper-bound line of the state-of-the-art nanofiltration membranes and one to two orders of magnitude higher than the commercially available membranes with pure water permeances of up to 23 L m^{-2} h^{-1} bar^{-1} [1]. The fabrication process of different polymer nanofilm composite membranes (polyamide [1,3], polyimine [2,4], polyester [5], etc.) and their separation property, including nanofiltration and molecular separation, will be presented.

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SL-03

GLOBAL LEADER IN CATALYST CHARACTERIZATION SOLUTIONS

Mr. Kunal Sharma
Micromeritics
BUSINESS TALK

SL-04

Dr. Sunanda Borah
JDM Research
BUSINESS TALK

SL-05

HORIBA SOLUTIONS FOR ADVANCED MATERIALS AND TECHNOLOGY

Dr. Namrata Jain & Dr. Vikas Sharma

Advancements of analytical instrumentation and characterization tools have been subject of significant interest in the field of science and technology. The HORIBA Group provides a wide range of cutting-edge technologies for applications ranging from automotive R&D, process and environmental monitoring, in-vitro medical diagnostics, materials and semiconductor characterization tools, for broad range of scientific R&D and QC measurements. This presentation focuses on the latest metrology solutions on Particle Size Analyzer (PSA), Raman Spectroscopy, to address the key issues in materials. Application examples of materials like suspensions, emulsions, powders, pastes, creams, and gels will be shown. Raman characterization techniques to analyze crystallinity, defects, particle size, will also be discussed with real examples.

SL-06

Mr. Sumeet Verma
Thermofischer
BUSINESS TALK

SL-07

CATALYSTS FOR PROTECTION OF ENVIRONMENT AND SUSTAINABILITY

Mr. P.A.E.S. Srinivas
Sud Chemie India Pvt. Ltd.

SL-08

NATURE OR PETROCHEMISTRY? BIODEGRADABLE NANOCOMPOSITE FILMS FOR SMART FOOD PACKAGING AND BIOMEDICAL APPLICATIONS

Kantharaju Kamanna*
*Professor, Department of Chemistry, Rani Channamma University, Belagavi, Karnataka, India

The environmental impact on the solid waste from petroleum-based packaging materials can be overcome by replacement with biodegradable polymer materials in the recent trends. Hence, development of nontoxic and eco-friendly films with antimicrobial properties for food packaging application is highly promising. PVA (polyvinyl alcohol) is a highly biocompatible and nontoxic synthetic polymer with high water solubility due to the hydroxyl group, and it has been used in food packaging membrane, medicine, and other materials manufacturing. These wider applications prompted material scientists to exploit further by designing novel nanocomposite materials, which are derived from nature and biodegradable. In search of new material and keeping an eye on the goal of sustainable sourcing, production and consumption, bioplastics have several advantages. Overall, my presentation focusing on recent development on various polymer nanocomposite films employing inexpensive and eco-friendly methods developed by our lab is discussed (selected publications given in the reference). Also, various analytical techniques employed for the polymer blend nanocomposite films properties studies like mechanical strength, hydrophobicity, water retention, biodegradation, water vapor barrier and more will be discussed in the talk.

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SL-09

LABORATORY QUALITY MANAGEMENT SYSTEM AS PER ISO IEC 17025.

Dr. Brijesh Parekh
SICART
BUSINESS TALK

SL-10

CERIA BASED ELECTROLYTES FOR INTERMEDIATE-TEMPERATURE SOLID OXIDE FUEL CELLS

J. Manjanna*, Naeemakhtar Momin, Mubeen H Jakati
Dept. of Chemistry, Rani Channamma University, Belagavi 591156, Karnataka, India
jmanjanna@gmail.com

It is necessary to replace the high temperature electrolyte such as yttria-stabilized zirconia (YSZ, $Zr_{0.92}Y_{0.08}O_{2-\delta}$) for upcoming intermediate temperatures solid oxide fuel cells (IT-SOFC), having operating temperature in the range of 500 to 800 ^{0}C. Solid electrolytes having conductivity around 0.1 S cm^{-1} at intermediate temperatures with cost-effectiveness are required [1]. Thus, the proposed materials must have enhanced ionic conductivity, lower activation energy and ionic transport number. Therefore, lanthanum and alkaline earth metals co-doped ceria-based nanoparticles have been investigated here as potential electrolytes.

The different compositions viz., $Ce_{1-x}M_xO_{2-\delta}$ ($0 \le x \le 0.2$) and $Ce_{1-x-y}La_xM_yO_{2-\delta}$ ($0 \le x/y \le 0.1$) where M = Ba, Ca, Mg and Sr are obtained by auto-combustion method wherein citric acid acts as fuel and metal nitrates as oxidants. These oxides were heated to 700 ºC to enhance homogeneity [2], and characterized by XRD, Raman, XPS, UV-Vis, SEM-EDX, ac-impedance and chronoamperometry techniques. The formation of single phase solid solutions and doping is confirmed. The $Ce_{0.9}La_{0.05}Ca_{0.05}O_{2-\delta}$, $Ce_{0.8}La_{0.1}Ca_{0.1}O_{2-\delta}$ (**LCDC20**), $Ce_{0.9}La_{0.05}Mg_{0.05}O_{2-\delta}$, $Ce_{0.8}La_{0.1}Mg_{0.1}O_{2-\delta}$ and $Ce_{0.8}La_{0.1}Ba_{0.1}O_{2-\delta}$ exhibited conductivity values of 3.85×10^{-2}, 1.06×10^{-1}, 1.31×10^{-2}, 1.39×10^{-1} and 1.50×10^{-2} S cm^{-1}, respectively at 1073 K. For a typical case of LCDC20, the Nyquist plots (Fig. 1) and Arrhenius plots (Fig. 2) are given below. The corresponding activation energies were found to be 0.87, 1.02, 0.93, 0.97 and 0.69 eV, respectively. Wagner's polarization technique at 773 K confirmed the charge transport is predominantly ionic [2]. Thus, we have developed a series of novel solid electrolytes having enhanced ionic conductivity and other characteristics suitable for IT-SOFC.

SL-11

REVERSE ENGINEERING IN POLYMER AND PETROCHEMICALS USING SPECTROSCOPY

Sandip Jagtap
LABINDIA Analytical Instruments Pvt Ltd
sandip.jatap@labindia.com

Reverse Engineering of Polymers is important aspect in terms of modernization of indigenous products like toys, solar panels, biopolymer for new drug delivery, renewable energies. Spectroscopy helps identify the type of polymer, additives, and fillers present in the material, Techniques like FTIR, NMR, EDXRF and MS provide information on the chemical composition, molecular structure, and bonding. Spectroscopy also helps to determine the physical and mechanical properties of the polymer, such as molecular weight, crystallinity, and thermal stability. Based on Spectroscopic data new formulations can be devised, and their stabilities also can be checked as per the accelerated stability testing

ORAL PRESENTATION

OP- 01

EFFICIENT REMOVAL OF CRYSTAL VIOLET DYE FROM ITS AQUEOUS SOLUTIONS USING ADVANCED NANOSTRUCTURED HALIDE–FREE ADSORBENT MATERIAL

Bharti Gaur, Jyoti Mittal and Alok Mittal
Department of Chemistry
Maulana Azad National Institute of Technology
Bhopal 462 003 (India)
jyalmittal@yahoo.co.in , aljymittal@gmail.com , gour.bharti22@gmail.com

A halide-free nanostructured material, Ordered Mesoporous Carbon (OMC), was used in this study to remove Crystal Violet (CV) dye from its aqueous solutions due to the potential health risks associated with CV exposure. Key variables, including pH, dosage of OMC, contact time between CV and OMC, and initial dye concentration, were systematically analysed to obtain the factors for maximum adsorption of CV. The experimental results were validated using various isotherm models, including the Langmuir, Freundlich, and Dubinin–Radushkevich isotherms, which provided information about thermodynamic parameters such as changes in Gibbs free energy (ΔG°), Enthalpy (ΔH°), and Entropy (ΔS°) and revealed the adsorption nature of OMC, that is, how CV adsorbs at the surface of OMC with the confirmation of the reaction's favorability, feasibility, energy utilisation in the adsorption, and randomness of the CV–OMC system. The kinetics of the adsorption process were studied using two models: the pseudo–first–order and the pseudo–second–order kinetic models. Results indicated that CV adsorption onto the OMC surface followed pseudo-second-order kinetics, suggesting that chemisorption was the dominant mechanism. This investigation highlights the effectiveness of the OMC as a potential adsorbent for removing the toxic dye Crystal Violet from an aqueous solution, providing valuable insights into adsorption behaviour and its associated thermodynamic and kinetic properties.

ABSTRACTS

OP-2

SUSTAINABLE METHODS FOR HEAVY METAL EXTRACTION FROM ELECTROPLATING EFFLUENTS

Mr. Brijesh Prajapati, Dr. Khyati Shah
Petrochemical Technology Department, Polytechnic, The M.S. University of Baroda
pb277933@gmail.com

The rapid pace of urbanization and industrialization has unleashed a large number of harmful substances, including toxic chemicals, pesticides, petroleum products, and heavy metals, contaminating our vital resources - water, soil, and air. There is a constant effort to improve the use-reuse cycle of water and to protect water resources through legislation, which is the driving force for research and innovation. In addition to numbers and statistics, there is the health factor that cannot be quantified when it comes to people. Water pollution with heavy metals is one of the most harmful pollution throughout the globe due to their nondegradable properties. Massive amounts of dangerous metallic ions are discharged toward ecosystems by industrial wastewater in various sectors, including electrolysis and electroplating processes, metals related industries and dyes manufacturing. The release of these dangerous elements poses a big threat to human health, living things, and ecosystems. Heavy metals tend to cause genotoxic implications, immediate as well as long-lasting toxic consequences, development and generation toxicity impacts, and cancer-causing capability on living beings.

conventional treatment technologies, including chemical precipitation, ion flotation, ion exchange, coagulation/flocculation, adsorption, and electrochemical removal, have been employed to remove heavy metals from industrial effluents. While these methods offer cost-effectiveness, they are often compromised by significant limitations and drawbacks, such as incomplete heavy metal removal, high energy consumption, and generation of toxic sludge, highlighting the need for more efficient and sustainable solutions. Several studies have been made on the development of a cheaper and more efficient technology. Substantial achievements have already been made on different types of membrane separation processes such as ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO). Solvent extraction is considered an effective technique for the treatment of heavy metals in contaminated water from chemical and electronic industries. Research is carried out using D2EHPA extractants of various concentrations (5%, 10%, 15%, 20%) to carry out efficient extraction of zinc from electroplating wastewater and to investigate maximum extraction at an equilibrium pH. It was observed that 85.01, 86.236, 98.47 and 99% of zinc is extracted using 5,10,15 and 20% D2EHPA, respectively at an equilibrium pH of 2.3, 2.3, 2.2, and 2.15. Similar experiments were carried out using 10,15, and 20% Aliquat 336 and it was observed that 88.53, 97.706, and 97.89 extraction was achieved using 10,15 and 20% of Aliquat 336, respectively at an equilibrium pH of 2, 2.3, and 2.3. It also observed that no co-extraction of iron is observed during the experiment.

OP-03

MICROWAVE-ASSISTED SYNTHESIS OF CQD-EMBEDDED Cu_2O NANOPARTICLES: CHARACTERIZATION AND POTENTIAL APPLICATIONS

Bhimarao M.Patil

Department of Chemistry, The Institute of Science, Dr. Homi Bhabha State University, 15-Madam Cama Road, Mumbai-400032

bmpatilisc77@gmail.com

Carbon quantum dots (CQDs) have emerged as promising nanomaterials due to their excellent optical, electronic, and catalytic properties. Copper(I) oxide (Cu_2O) nanoparticles, on the other hand, exhibit remarkable photocatalytic and antibacterial capabilities. The integration of CQDs with Cu_2O nanoparticles can lead to synergistic effects, enhancing their functional properties for various applications. In this study, we report a rapid and efficient microwave-assisted synthesis method for embedding CQDs into Cu_2O nanoparticles. This approach offers several advantages, including reduced reaction time, uniform heating, and enhanced crystallinity of the synthesized nanostructures. The synthesized CQD-embedded Cu_2O nanoparticles were systematically characterized using X-ray diffraction (XRD) for phase identification, transmission electron microscopy (TEM) and scanning electron microscopy (SEM) for morphological analysis, and Fourier-transform infrared spectroscopy (FTIR) to confirm functional group interactions. Additionally, UV-Vis spectroscopy and photoluminescence (PL) analysis were employed to investigate the optical properties, revealing enhanced absorption and emission characteristics due to CQD incorporation. The results indicated a uniform distribution of CQDs within the Cu_2O matrix, significantly modifying its bandgap and electronic properties. The potential applications of CQD-embedded Cu_2O nanoparticles were further explored in photocatalysis and antibacterial activity. Photocatalytic experiments demonstrated that the CQD-Cu_2O nanocomposite exhibited superior degradation efficiency of organic pollutants under visible light irradiation compared to pristine Cu_2O, attributed to improved charge separation and reduced recombination rates facilitated by CQDs. Moreover, antibacterial studies against Escherichia coli (E. coli) and Staphylococcus aureus (S. aureus) showed enhanced bactericidal activity due to the generation of reactive oxygen species (ROS), leading to effective microbial inhibition. This study underscores the effectiveness of microwave-assisted synthesis in fabricating high-performance CQD-embedded Cu_2O nanoparticles with tunable properties. The enhanced photocatalytic and antibacterial of the synthesized nanocomposite make it a potential candidate for environmental remediation and biomedical applications. The findings highlight the importance of CQDs in modifying metal oxide nanoparticles to achieve superior functionalities, paving the way for further research and industrial applications.

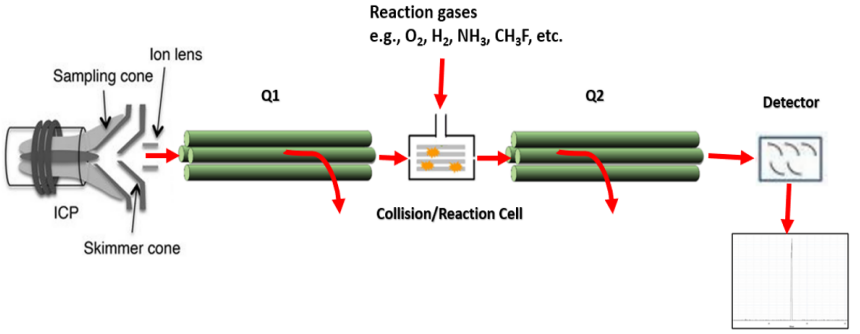
ABSTRACTS

OP-04

ACCURATE AND PRECISE DETERMINATION OF RARE EARTH ELEMENTS IN GEOLOGICAL MATERIALS BY INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETRY

C. Perumalsamy*[1], Pratap Chandra Sethy and V. Balaram[2]
[1]Wadia Institute of Himalayan Geology, Dehradun, India.
[2]CSIR – National Geophysical Research Institute, Hyderabad 500007, India
peruc@wihg.res.in

The TQ-ICP-MS 8900 is a leading-edge analytical instrument capable of meeting the rare earth element (REE) determination with high precision and accuracy. Its triple-quadrupole configuration, combined with an advanced collision/reaction cell (CRC), provides an efficient solution for mitigating spectral interferences in complex matrices. This streamlined approach enhances analytical sensitivity, precision, and accuracy, especially for REE and trace element analysis in complex geological matrices.



This study incorporates the measurement of different level elemental concentrations (0.01 ppb, 0.1ppb, 1ppb, 10 ppb, 100 ppb) CRM standards (Multi-component Rare Earth standard) and matrix standards use for (10 fold diluted geological reference materials) the batch calibration and validation by using MassHunder 5.2 software. By utilizing tuning gas cell modes, including on-mass and mass-shift modes, we demonstrate the effectiveness of He, H_2, and O_2 in interference mitigation. The use of ^{103}Rh as an internal standard further corrected for matrix suppression and signal drift, significantly enhancing data reliability and reproducibility. The objective of this study includes, i) The accurate determination of REEs including Li, and Th with reduced interference removal, ii) The validation of geological materials through CRMs and across diverse geological matrices, and iii) Demonstration of the robustness of ICP-MS/MS for routine REE analysis.

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OP- 05

MEASUREMENT OF UNCERTAINTIES IN THE PROCESS CONTROL CHECKS OF SOLID PROPELLANT SLURRY

Sreedevi M S, Ramya P R, Soyamol Thomas, Lajith K, Sreelatha L K, B Rani Mathammal, Cherian Thomas

Process and Quality Control Division, Aero Space Ordnance Entity,
Vikram Sarabhai Space Centre, Thiruvananthapuram-695022

ms_sreedevi@vssc.gov.in

Solid propellants are energetic materials extensively used in various launch vehicle applications. These chemical substances provide sufficient kinetic energy for propulsion on burning. The most commonly used ingredients in the Composite Solid Propellant (CSP) are binder; HTPB, fuel; aluminium powder, oxidiser; ammonium perchlorate along with curing agents, process aids, burn rate modifier etc. in minor quantities. In the manufacturing of solid propellant rocket motors, propellant mixing is a critical process stage. Propellant mixing is carried out in horizontal sigma blade kneaders or vertical mixers. Here different materials are mixed to form a homogeneous propellant that is suitably cast to the desirable shape. The propellant mixing is carried out mainly in two steps. The first step is the premixing stage which involves mixing liquid ingredients and solid powders as per the specified composition. During this phase, wetting of entire solid particles by liquid binder happens and forms a homogeneous semi-solid propellant. In the second step, curing agent (diisocyanate) is added and mixing is carried out at a definite temperature for definite time. At this stage, the curing reaction is initiated where the polymer binder reacts with the curing agent to form a three dimensional network of polyurethane linkage, leading to the final defined solid shape with specified propellant properties. The mixing schedule and sequence of raw material addition is the most critical to get a homogeneous mixture. The uniform distribution of all the materials is essential to achieve the consistent propellant properties. As a quality control measure to ensure the homogeneity, a chemical analysis is carried out in the propellant samples after the premix stage before the addition of curing agent. The samples are collected from various locations of the mixer/ kneader and the percentage of aluminum and ammonium perchlorate are evaluated. In addition, moisture check is also done as it also reacts with the curing agent, leading to insufficient curing. The measurement of uncertainties in test methods is a well debated point in analytical chemistry. Along with the accuracy and precision of test results, uncertainty in the method of analysis is also playing a role in validating the method. Uncertainty is often mistaken as the error associated with the test method. Error is the difference between the true value and the experimental value.

The test value can be corrected if the error is known. But uncertainty is a parameter or range, which could be attributed for the dispersion of test results for a specific method with specific samples. This paper deals with the quantification of uncertainty in quality control check of homogeneity and moisture analysis of solid propellant slurry. A systematic study was carried out in the determination of uncertainty of the test method. The probable source of uncertainty is identified by considering various steps of analysis, purity of reagents, uncertainty of equipment etc. The uncertainty in each step is quantified and the combined uncertainty in the method is estimated by using the law of propagation of uncertainty components. The theoretical data is validated by repeated analysis and it is now proven that the actual values of test results are lying within the limits of uncertainty. The results of the study substantiate that method for the homogeneity analysis in solid propellant processing is accurate and acceptable.

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OP- 06

INNOVATIVE ANALYTICAL GRADIENT ELUTION METHOD ON REFRACTIVE INDEX (RI) DETECTOR FOR COMPLEX LIPOSOME FORMULATIONS

Ruturaj K Sutarsandhiya[1], Dr. Gautam R. Chauhan[2]
Sophisticated **I**nstrumentation **C**entre for **A**pplied **R**esearch and **T**esting (SICART)
CVM university, Vallabh Vidhyanagar, Anand, 388120.
Ruturaj143@gmail.com

High-performance analytical techniques are essential for the accurate detection and quantification of non-chromophoric compounds in pharmaceutical, biotechnological, and food science applications. Traditional detection methods, such as ultraviolet (UV) and fluorescence spectroscopy, are often inadequate for analysing substances like lipids, carbohydrates, and certain polymers due to their lack of chromophores. To address these limitations, a novel analytical method with gradient elution by using a refractive index (RI) detector has been developed to enhance sensitivity, resolution, and applicability across a wide range of sample matrices. This method employs high-performance liquid chromatography (HPLC) with an optimized gradient elution strategy, significantly improving the separation and quantification of non-UV-absorbing analytes. Unlike conventional isocratic methods, which often result in poor resolution and extended run times, the gradient approach provides enhanced peak differentiation and faster analysis of complex mixtures. A key innovation of this study is the optimization of mobile phase composition and gradient conditions, effectively mitigating RI baseline fluctuations, a common limitation of RI detection in gradient elution. Furthermore, advanced temperature control and mobile phase equilibration techniques were implemented to improve RI signal stability and reproducibility. To assess the method's versatility, a range of sample types of liposomal formulations were analysed. The RI-based gradient method successfully quantified lipid impurity offering comprehensive impurity profiles crucial for quality control and regulatory compliance. Comparative studies with conventional UV detection further underscored the superior sensitivity of RI detection, particularly for excipients and formulation components lacking chromophores.

The method was also evaluated for its reproducibility and stability-indicating capabilities, ensuring its effectiveness in long-term formulation assessments. In conclusion, this innovative analytical gradient method using RI detection provides a highly sensitive, reproducible, and versatile solution for the quantitative analysis of non-chromophore compounds. Its ability to improve resolution, enhance detection accuracy, and expand analytical scope establishes it as a valuable tool for pharmaceutical, biotechnological, and food science applications. The advancements in RI gradient compatibility presented in this study pave the way for reduced analysis time, cost saving, simplification in impurity quantification, stability testing, and quality control of complex formulations widely. Future research may explore hyphenation with mass spectrometry for enhanced molecular characterization and broader analytical applications.

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OP-07

ENVIRO FRIENDLY, ZDHC CONFIRMED MODIFIED STARCH AS SIZING SOLUTIONS FOR TEXTILE SECTOR

Samir Shah[1], Mahesh Dalal[2*]

[1]QA Manager, Sayaji Industries, Unit Maize Products, Kathwada, Ahmedabad 382430, India

[2*2]Head-Trainings, Sayaji Industries, Unit Maize Products, Kathwada, Ahmedabad 382430, India

mkdalal@sayajigroup.in

Sayaji Industries Ltd. (SIL) Unit Maize Products is an 84 year young Ahmedabad based company engaged in manufacture of Starches and Sweeteners for various applications [1]. The innovative Company always strives to remain at the forefront of new developments and remain updated. Sayaji Industries conforms to the recent global voluntary movement by The Netherlands based organization: ZDHC (Zero Discharge of Hazardous Chemicals) foundation. Sayaji Industries Ltd. among several products manufacture modified starches under brand name Fabrilose A and Fabrilose Special used in the textile sector as sizing auxiliaries which are conforming to ZDHC MRSL version 3.1 [2-5]. Thus no hazardous chemicals are involved in the manufacturing cycle of these chemical products. The manufacturing site of Sayaji Industries-Unit Maize Products at Ahmedabad follows ZDHC and ZLD (Zero liquid discharge) in endeavour to protect the environment against pollution and climate change. Present paper discusses ZDHC confirmed products for sizing in textile.

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ABSTRACTS

OP-08

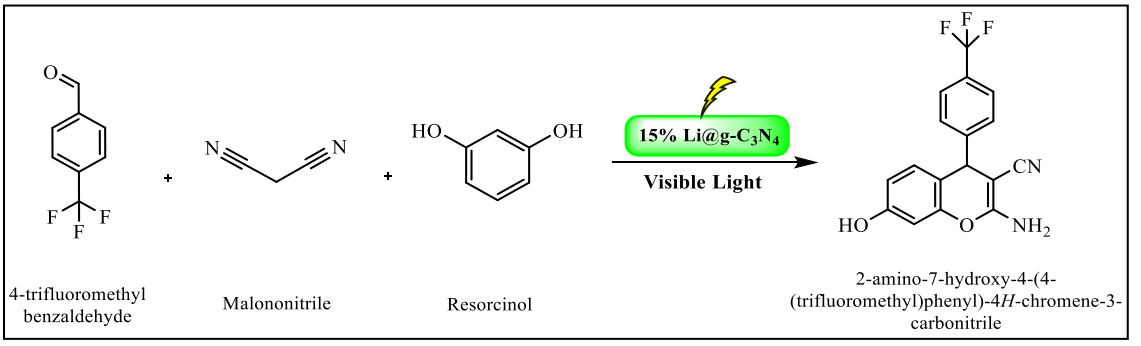
SUSTAINABLE PROTOCOL FOR THE SYNTHESIS OF 4*H*-CHROMENES USING LI-DOPED GRAPHITIC CARBON NITRIDE-BASED PHOTOCATALYSTS

Dhavalkumar Bhanderi[a], Chetan K. Modi*[,a]

[a]Department of Applied Chemistry, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, Gujarat, India

chetanmodi-appchem@msubaroda.ac.in

In the present work, we developed visible-light-responsive photocatalysts based on lithium doped graphitic carbon nitride (g-C_3N_4) with varying % loading of Lithium, i.e., 5%, 10%, and 15%, resultant samples were named as a 5%Li@g-C_3N_4, 10%Li@g-C_3N_4 and 15%Li@g-C_3N_4 catalysts. These catalysts demonstrated exceptional photocatalytic performance in the synthesis of 4*H*-chromenes under visible light (60 W LED) conditions. Comprehensive characterization of the photocatalysts was conducted using numerous techniques such as FT-IR, XRD, XPS, TEM, EIS, Mott-Schottky analysis, photocurrent density measurements, UV-Vis DRS, and SEM analysis. Among the various catalysts, the 15%Li@g-C_3N_4 achieved the highest efficiency, yielding 96% of 2-amino-7-hydroxy-4-(4-(trifluoromethyl) phenyl)-4H-chromene-3-carbonitrile. Additionally, this catalyst was also checked with assorted benzaldehyde derivatives, yielding effectual results. The catalyst also exhibited excellent stability, with minimal loss in activity after five consecutive runs.



Synthesis of 4H-Chromene using 15% Li@g-C_3N_4 as a photocatalyst

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OP-09

SYNTHESIS AND CHARACTERIZATION OF MICROPOROUS CARBON FROM VINYLIDENE POLYMER AND ITS GAS ADSORPTION PROPERTIES

Sangeetha S.*[a], Sruthi C [a], Sananth H Menon [a], Sreenivas N[a]

Ammonium Perchlorate Experimental Plant, Vikram Sarabhai Space Centre, ISRO, Aluva, India

sangeetha_sivanath@vssc.gov.in

Natural gas (NG) is considered the second cleanest fuel next to hydrogen because it produces lower carbon dioxide (CO_2) emissions and other harmful components when burned compared to all other carbon-based fuels [1]. Methane is the primary component of natural gas [2-4]. Though it contains methane as main constituent, it also contains impurities such as nitrogen, carbon dioxide, low molecular weight hydrocarbons such as ethane and propane. Technologies for purification of natural gas include cryogenic distillation, membranes, absorption and adsorption [5]. Cryogenic distillation [6] is an expensive and energy-intensive process. Despite the continuous growth in membrane technology applications in gas separation processes [7-9], membrane technology is not effective to remove impurities from natural gas due to competing and counterproductive separation permeability.

Adsorbent-based separation technology opens up an effective avenue for separation of impurities and upgradation of low-grade natural gas [10]. In this work we report a strategy to prepare carbon adsorbent with uniform micropore structure using Polyvinylidene Fluoride as the precursor. Carbon adsorbent prepared at pyrolysis temperature of 800°C featured a well-developed micro porosity with a BET specific surface area of 900m^2/gram. The adsorption capacity of the porous carbon for CH_4, CO_2 and N_2 were evaluated by volumetric sorption method. At 298K and 1 bar pressure, the adsorption capacities were 14.32 mmol/g CO_2, 1.6 mmol/g CH_4 and 0.5mmol/g N_2. Based on the findings and sorption results, it was found that PVDF has a great potential for use as a polymeric precursor for preparation of carbon adsorbents with outstanding characteristics such as high specific surface area, large pore volume, controlled micro porosity and gas adsorption properties.

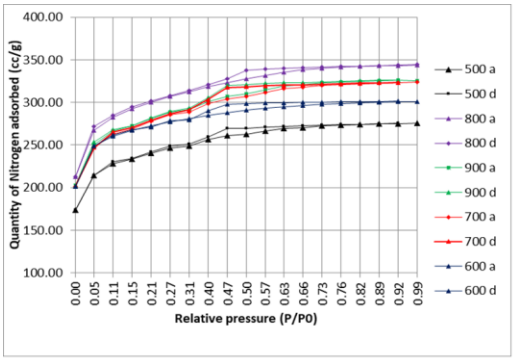


Figure S3. Nitrogen adsorption and desorption isotherms at 77K for the PVDF-derived porous carbon adsorbents at different temperatures

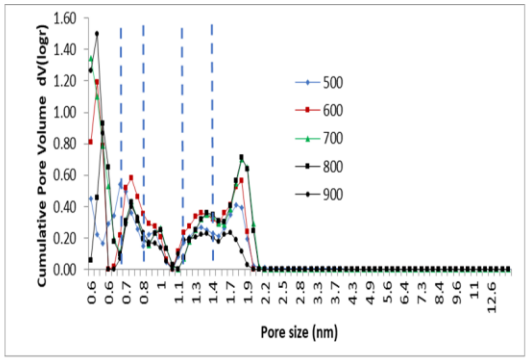


Figure S4. Pore-size distribution of the PVDF-derived porous carbon samples carbonized at different temperatures.

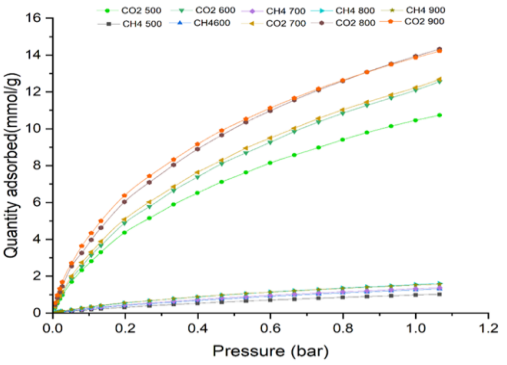


Figure S5. Static adsorption isotherms for CH_4 and CO_2 of PC-T at 298K

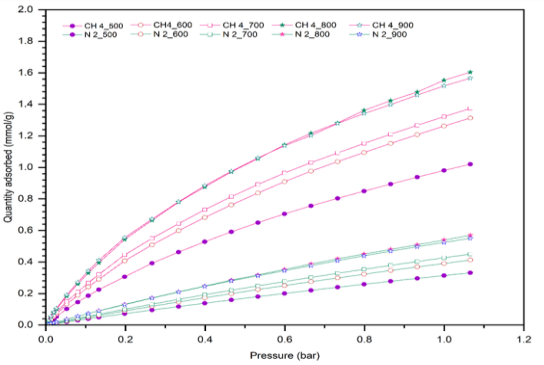
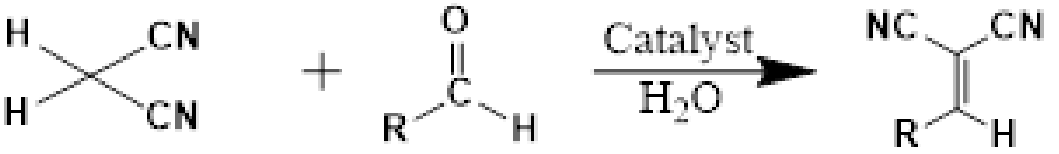


Figure S6. Static adsorption isotherms for CH_4 and N_2 of PC-T at 298K



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OP-10

SUSTAINABLE HYBRID AIR BREATHING ION PROPULSION FOR GREEN AEROSPACE AND SPACE APPLICATIONS

Mustakim Mohammad Rais Saiyed[1] **Niyati Moulinkumar Shah**[2]
[1]P.G. scholar, Institute of Technology,Nirma University, Ahmedabad.
[2]Assistant Professor, Sardar Vallabhbhai Patel Institute of Technology,Vasad
niyatishah.aero@svitvasad.ac.in

The development of sustainable and environmentally friendly propulsion technologies is critical for the future of space exploration and aerospace systems. This research presents an innovative Hybrid Air-Breathing Ion Propulsion System (HABIPS) that integrates the principles of air-breathing jet engines and ion thrusters to enable efficient satellite operation in Very Low Earth Orbit (VLEO) (150–200 km). The system leverages a three-stage ion grid system and an advanced fuel cycle to achieve an exhaust velocity exceeding 7 m/s, enhancing propulsion efficiency while minimizing fuel consumption. By utilizing atmospheric air as a partial propellant source, the proposed system significantly reduces the dependency on conventional chemical fuels, leading to lower emissions, reduced operational costs, and higher energy efficiency. This makes it a promising alternative for sustainable satellite propulsion, with applications in weather monitoring, military surveillance, and high-speed communication. Additionally, its potential integration into aircraft and missile propulsion systems can contribute to cleaner aviation technologies. Compared to traditional propulsion methods, this hybrid approach offers significant environmental benefits, including lower greenhouse gas emissions and reduced space debris accumulation, aligning with global efforts toward green and sustainable aerospace technology. The findings of this study highlight the feasibility of HABIPS as a next-generation propulsion solution for environmentally responsible space missions and high-efficiency aerospace systems.

ABSTRACTS

OP- 11

FINGERPRINTING PROFILING OF POLYHERBAL FORMULATIONS

Rakhi Mishra[1], G S Chakraborthy [2], Rohit Agrahari [3]

[1]Research Scholar, Faculty of Pharmacy, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat391760

[2] Principal and Professor, Faculty of Pharmacy, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat391760

[3]Research Scholar, Faculty of Pharmacy, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat391760

rakhimishra1278@gmail.com, g.chakraborthy19159@paruluniversity.ac.in, rohitagrahari710101@gmail.com

Various medicinal plants have a rich amount of phytochemical constituents in them, which are used in the development of various drugs. For the development of drugs that provide beneficial effects for various diseases, the right identification of and selection of drugs is very important because every drug has different and unique phytochemical constituents. Nowadays in the market, various adulterated drugs are being sold, which are not providing any benefit. HPTLC is an analytical method that is an easy and vigorously used method to identify and quantify the amount of phytochemical present in the drugs and herbs. This allows us to execute and develop a quick, simple method of high-performance thin-layer chromatography for the hydroalcoholic extract of liquorice and cinnamon to confirm the standardization of these herbs. The method that was developed is authenticated by the quantification of components, *Cinnamaldehyde* and *Glycyrrhizic acid*, against tests in different batches of *liquorice and cinnamon*. The analytes of these herbs were identified by visualization at 254 nm by comparing them with the validated standard and retention factor. The method that we have developed is authenticated as per the guidelines recommended by the International Council for Harmonization for parameters such as limit quantification, precision, linearity, and limit of detection. The developed high-performance thin-layer chromatographic method is applied for quick standardization of *liquorice* and *cinnamon. These* two substances have a broad spectrum in curing various diseases such as anti-inflammatory, anti-microbial.

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OP-12

Role of the Allosteric Site in Regulating Omega Loop Dynamics in Novel β-Lactamase (TEM-224) and it's Contribution to the Evolution of New IR-TEM Variants: Insights from Analytical Computational Chemistry

Prof. Devjani I Banerjee[1]* and Siddhi A Darji[1]
[1] Department of Life Sciences, GSFC University, Vadodara, Gujarat, India
devjani.banerjee@gsfcuniversity.ac.in

The rise of antimicrobial-resistant (AMR) pathogens poses a significant healthcare challenge in clinical settings, particularly with the emergence of new β-lactamase variants that can hydrolyze β-lactam antibiotics and inhibitors.

In this study, we identified a novel TEM β-lactamase variant, TEM-224 (P251L), from clinical Escherichia coli isolates derived from the urine sample of a 72-year-old female patient in Vadodara, Gujarat, India (Bio project: PRJNA1158954). The antimicrobial susceptibility testing (AST) of clinical sample assessed using the VITEK system and was classified as a possible XDR-high-priority pathogen based on its AST profiles. Further species confirmation was achieved through MALDI-TOF-MS and whole-genome sequencing (WGS). AMR gene identification was conducted utilizing ResFinder, AMRFinder, and CARD databases.

Our findings identified a novel single mutation – P251L in TEM β-lacatamase, which has not been previously classified or reported. To better understand the impact of this mutation, we modelled using Modeller, followed by energy minimization using YASARA. We then employed AutoDock Vina to dock TEM-224 with the β-lactamase inhibitor, Clavulanic acid. Additionally, we conducted 100 ns molecular dynamics simulations in GROMACS to investigate the structural dynamics of the interaction. We analysed key structural parameters, including hydrogen bonding, radius of gyration, RMSD, and RMSF. The study suggested that the P251L mutation significantly influence the resistance profile of TEM-224 by controlling the activity of the omega loop, similar to 2br and 2ber. Where we were able to find out that other than binding site, the allosteric sites also plays a crucial role in Omega loop dynamics and can be used to develop effective therapeutic strategies against AMR.

OP-13

ELECTROCOAGULATION AS A SUSTAINABLE DECENTRALIZED SOLUTION FOR SEWAGE TREATMENT

Upasani Riddhi K.

Research scholar, Department of Chemical Engineering, The M.S. University of Baroda

Electrocoagulation (EC) is an emerging wastewater treatment technology that offers an efficient and sustainable alternative for decentralized sewage treatment. Electrocoagulation is a process that employs electrical currents to induce coagulation and removal of contaminants and presents a promising technology for decentralized sewage treatment systems. This paper explores the potential of electrocoagulation as an environmentally sustainable, cost-effective, and decentralized solution for treating sewage particularly in areas with limited infrastructure and resources. Electrocoagulation operates on the principle of passing electrical current through electrodes submerged in wastewater. This current causes metal ions to dissolve and react with pollutants in the water and resulting in the formation of metal hydroxides that destabilize and agglomerate contaminants into flocs. These flocs can then be easily removed through sedimentation or filtration. One of the key advantages of EC is its ability to treat a wide range of contaminants including suspended solids, organic matter, oils, and heavy metals without the need for external chemicals, making it a highly attractive solution for decentralized systems. The application of EC in decentralized sewage treatment systems offers numerous benefits over conventional centralized methods. In urban and rural areas lacking centralized treatment infrastructure, decentralized systems can be implemented in localized treatment units reducing the need for extensive pipelines and centralized facilities. This approach can significantly lower capital and operational costs, while also addressing the unique wastewater treatment needs of small communities, industries, or isolated regions. Moreover EC systems are easily scalable, offering flexibility to adapt to varying treatment capacities based on population size or wastewater volume. Sustainability is a core advantage of electrocoagulation. The technology's ability to operate without the addition of large quantities of chemicals reduces environmental pollution and avoids the secondary pollution often associated with traditional coagulation and flocculation methods. Furthermore, the process can be powered by renewable energy sources, further enhancing its environmental credentials. In addition to its eco-friendly nature, electrocoagulation generates a relatively low amount of sludge compared to conventional methods, minimizing disposal challenges and reducing the environmental footprint of the treatment process. However, despite its potential, the application of electrocoagulation in decentralized sewage treatment systems presents certain challenges. Energy consumption remains a significant concern, particularly in areas with limited access to electricity. Additionally, electrode wear and the need for regular maintenance can impact the long-term feasibility of electrocoagulation systems. These challenges must be addressed through technological advancements in electrode materials and optimization of operational parameters, such as current density and electrode configuration. This paper presents a comprehensive analysis of electrocoagulation as a decentralized solution for sewage treatment, highlighting its environmental, economic, and operational advantages, as well as the challenges and future opportunities for improvement. By examining case studies and experimental data, we demonstrate the efficacy of electrocoagulation in various sewage treatment contexts and propose strategies for overcoming its limitations. The integration of electrocoagulation into decentralized systems represents a promising step towards achieving sustainable, efficient, and scalable wastewater treatment solutions in diverse settings.

OP-14

AMIDE-FUNCTIONALIZED POLYMER FOR EFFICIENT REMOVAL OF HEXAVALENT CHROMIUM FROM AQUEOUS SOLUTION

Sandipkumar P. Suthar, Dr. Ran Bahadur Yadav*

Applied Chemistry Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat 390 001, India

ranbahadur-appchem@msubaroda.ac.in

Hexavalent chromium (Cr(VI)) in wastewater is associated with severe environmental and ecological risks. Chromium exists in multiple oxidation states, with the most commonly encountered forms being Cr(III) and Cr(VI) [1]. Cr(VI) is highly toxic and poses significant threats to human health and the environment due to its high solubility and mobility.[2] The presence of Cr(VI) in aquatic environments constitutes a substantial hazard to both human health and ecological systems. Furthermore, Cr(VI) is widely classified as a carcinogenic agent, with serious implications for public health [3].

In the present study, an Amide-functionalized polymer was synthesized via suspension polymerization, followed by amidation modification, for efficient Cr(VI) removal from simulated wastewater. The polymer was characterized using EDX, SEM, and FTIR spectroscopy. Batch adsorption studies assessed the effects of initial Cr(VI) concentration, adsorbent dose, pH, and temperature. Adsorption performance was influenced by pH, solid-to-liquid ratio, and Cr(VI) concentration. At pH 2, 6, and 8 Cr(VI) removal efficiencies of AN-DMAPA polymer were 97.70%, 96.80% and 94.50%, respectively. The polymer exhibited excellent regeneration capabilities, with efficiencies exceeding 92% after three adsorption-desorption cycles. Adsorption followed the Langmuir isotherm and pseudo-second-order kinetic models. Additionally, 5% sodium chloride solution was employed to effectively recover and extract Cr(VI) quantitatively. These results demonstrate the significant potential of AN-DMAPA polymer for environmental remediation, providing an efficient solution for Cr(VI) removal from wastewater and addressing critical environmental challenges.

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ABSTRACTS

OP-16

STUDY OF AMINE MODIFIED BIOCHAR FOR HEAVY METAL IONS REMEDIATION FROM WASTEWATER AND CATALYSIS IN C-C BOND FORMATION REACTION

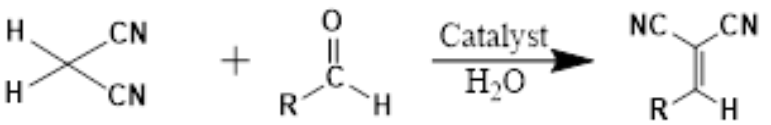
Archana Rani,[a] Akeki S. Jimo,[a] Meenu Arora [b] and J. Nagendra Babu [a*]

[a]Department of Chemistry, Central University of Punjab, VPO Ghudda, Bathinda, Punjab -151 401 INDIA

[b]Department of Chemistry, Maharaja Ranjit Singh Punjab Technical University, Bathinda, Punjab – 151 001 INDIA

nagendra.babu@cup.edu.in

Biochar is a carbon enriched material derived from the slow pyrolysis of waste biomass in the absence of oxygen. Due to easy availability of raw materials and ease of production, biochar is a sustainable value added product that has been extensively explored for its utility in various fields such as energy storage, wastewater treatment, soil amendment and catalysis. To improve the performance of biochar, surface modification by using various organic synthons can be a promising approach. Organic modification of biochar improves the physicochemical characteristics of biochar and enhances its surface activity. The present study aims at the synthesis and characterization of functionalized biochar derived from rice straw and its utility as adsorbent and heterogeneous catalyst. Rice straw biochar was synthesized at pyrolytic temperature 400°C which is further condensed with Ethylenediamine (EDA) on the carboxylate functional groups of biochar to furnish EBC. The modified biochar was characterized by DATR-FTIR, FESEM, EDX, DLS and XPS. EBC was studied for Cr(VI) remediation from aqueous solution. Results showed that the redox reaction and the electrostatic attraction between EBC and Cr(VI) at acidic pH is responsible for the adsorption of Cr(VI) with adsorption capacity 132 mg/g. The modified amine enriched biochar was analysed for heterogeneous catalytic behaviour in Knoevenagel condensation reaction in aqueous medium. The product formation was confirmed by ^{1}H-NMR and EI-MS and purity of products was monitored by using GC-MS.



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OP-17

STUDIES ON Zr BASED MIXED-MATRIX MEMBRANES FOR SELECTIVE REMOVAL OF COLOR FROM WASTE WATER

Meet Patel and Kalpana Maheria*
Department of Chemistry, Sardar Vallabhbhai National Institute of Technology, Ichchhanath, Surat - 395 007, Gujarat, India
kcm@chem.svnit.ac.in

Organic dyes, commonly found in industrial effluents, pose severe ecological and health risks due to their persistence and toxicity [1]. Conventional treatment methods are often hindered by cost limitations and insufficient efficacy. Hybrid salts of tetravalent metal acid (TMA) salts, particularly zirconium aminotris(methylenephosphonate) (ZrATMP), have emerged as promising sorbent materials for selective contaminant separation [2]. Herein, mixed-matrix membranes (MMMs) were fabricated via the incorporation of a varied amount of ZrATMP into a polyvinylidene fluoride (PVDF) matrix using the nonsolvent-induced phase separation method. The resultant ZrATMP@PVDF MMMs were characterized and further studies have been carried out to assess their ability to remove organic dyes [methylene blue (MB), Azure A (AZA), Crystal violates (CV), and Malachite green (MG) and Rhodamine B (RHB)] via membrane filtration. The membrane contains 20 Wt. % ZrATMP demonstrated exceptional performance, achieving >99% removal in all cases, except, RHB dye. The results obtained from the studies of selective removal of dyes from binary systems (MB^+/RHB^+ and MB^+/MO^-) reveal pronounced selectivity for MB, underscoring the membrane's potential for targeted pollutant removal. Further, isothermal and kinetic analyses have been attempted to study the adsorption behavior of membranes in case of dye mixtures. Studies were performed to know the water stability, regeneration capability, and durability of the membrane. The research findings of this study highlight the promise of ZrATMP@PVDF MMMs as scalable, cost-effective solutions for advanced wastewater treatment, thereby offering high efficiency and selectivity in complex contaminant environments.

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ABSTRACTS

OP-18

VALORISATION OF *IPOMOEA BATATAS* PEEL AS BIOCHAR FOR THE EFFECTIVE REMOVAL OF HEAVY METALS AND DYES FROM WASTEWATER SOLUTIONS

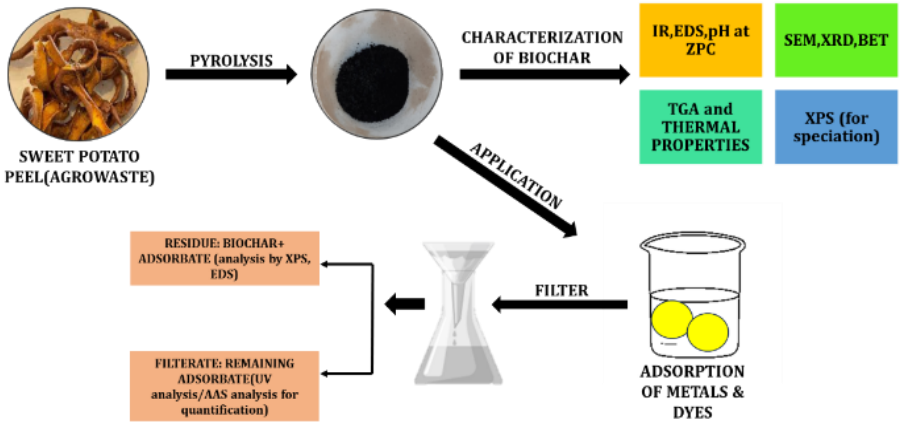
Radhika Rao[a], P. Padmaja [a,b*]

[a]Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, India

[b]Department of Environmental Studies, Faculty of Science, The Maharaja Sayajirao University of Baroda, India

rads1610@gmail.com

Heavy metals, dyes as well as other persistent contaminants released from industrial effluents are a global threat to the ecosystem. Some of the technologies used for pollutant removal are adsorption, photocatalysis, chemical precipitation, ion exchange, electrochemical methods, and membrane filtration. Among them, adsorption is considered a viable and environmentally friendly method, widely used today. Biochar is a cheap and environmentally friendly carbon neutral adsorbent derived from agrowaste that is readily available. The extensive application of biochar is due to their microporosity, a structured carbon matrix, elevated cation exchange capacity, and numerous polar functional groups. In this study we used biochar produced from agricultural waste through pyrolysis as an effective adsorbent for lead, cadmium, uranium and methylene blue. The biochar was prepared from *Ipomoea batatas* peel which is an integral part of the diet for Asia and Africa and the peels account for a large part of the agro waste generated. The biochar was characterized by Fourier Transformed Infrared Spectroscopy, Scanning Electron Microscopy, X-ray Diffraction, Thermogravimetric analysis and Brunauer-Emmett-Teller, X-ray photoelectron Spectroscopy techniques. The characterization studies revealed the presence of functionalities such as hydroxy, carboxy, ester and ether linkages which are often present in lignocellulosic compounds. The surface area was calculated to be 22.72 m^2/g whereas from XRD the average particle size was found to be 62.78nm. The pH at ZPC for the material was found to be 7.2 and SEM images confirmed the porosity present in the material. Comprehensive batch experiments were undertaken to optimize pH, adsorbent dose, agitation time, adsorbate concentration and temperature on the adsorption process. Post adsorption XPS analysis was performed, revealing the various species in the different systems studied. Various isotherm models namely Langmuir, Freundlich, Temkin and Elovich were applied and kinetic models such as Pseudo-first order, Pseudo-second order, Intra-particle diffusion and Elovich were applied and it was seen that with respect to all adsorbates Langmuir and Pseudo-second order models were found to be the best fit with a $r^2$of >0.9999.The maximum adsorption capacities (Q_{max}) of lead, cadmium, uranium and methylene blue were determined to be 126.58, 82.64, 106.38 and 62.89 mg/g respectively. The material was further extended to real time samples and interference studies were also carried out.



Schematic of the synthesis of biochar, characterization and its applications

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OP-19

DIGITAL TRANSFORMATION OF RESEARCH LABORATORIES USING UNIFIED LABORATORY INTELLIGENCE SYSTEM (ULIS)

Ravindra Kumar*, Sujit Mondal, Alex C Pulikottil, Alok Sharma
Indian Oil Corporation Limited, Research & Development Centre, Sector-13, Faridabad-121007, India
kumarr88@indianoil.in

Digital technology is reshaping every aspect of R&D, from design to experimentation. Researchers are using advanced modelling to design new molecules, identify the strongest candidates prior to costly experiments, and generate richer data, which help lower the costs of chemicals and develop environmentally friendly products. Science-based companies are placing big bets on digital transformation with executive sponsorship and major infrastructure investments. Leading pharmaceutical and chemical companies have organization-wide strategies that include investments in data architecture, informatics, artificial intelligence, and, eventually, quantum computing.

Unified Laboratory Intelligence (ULI) is a scientific approach to R&D informatics that collects and unifies chemical, structural, and interpreted analytical data. This digital transformation is reshaping every aspect of R&D, from designing molecules and products to facilitating predictive analytics that can sometimes replace “wet” lab experiments entirely. In this paper we introduce how the fundamentals of a Unified Laboratory Intelligence technology approach can be applied to enhance and accelerate the characterization of ingredients at Indian Oil R&D centre for fuel and lubricants and also discuss two case studies in detail each one from the fuel and lubricants area. ULIS has been used for identification of adulteration in diesel and studied the interactions in oxygenated fuels. In the first case study, the diesel adulteration problem resolved and identified & quantified the adulterated compounds present in HSD. No analytical techniques were able to identify the structure of compounds. Preliminary investigation by WDXRF indicated presence of a significant amount of Chlorine in the HSD indicating presence of some chlorinated compounds in HSD. HSD and various chlorinated compounds used in various industries were analyzed by NMR spectroscopy. The structure of chlorinated paraffins was derived by simulation and ULIS software and confirmed by NMR spectroscopy. The adulterated components were then identified as chlorinated paraffins by NMR and their structure was derived.

The second study identified interactions by understanding their diffusion behavior between alcohols (Ethanol & Methanol) in E20 Gasoline and MD15 and addressed the loss of fuel efficiency in E20 gasoline. Significant differences in the diffusion behavior of ethanol molecules before and after the treatments were observed.

OP-20

DATA-DRIVEN AI/ML METHODS FOR ENVIRONMENTAL SCIENCE, MATERIALS, AND CATALYSIS: INNOVATIONS AND APPLICATIONS

Soujanya Yarasi

Department of Polymer & Functional Materials, CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad 500007, India.

yarasi@iict.res.in

The integration of Artificial Intelligence (AI) and Machine Learning (ML) has significantly enhanced the data analysis, enabling precise interpretation and predictive insights across diverse scientific domains. This talk explores the transformative role of AI/ML tools in environmental science, materials science, and catalysis. Key applications include catalyst design and CO_2 capture studies. In catalysis, AI-driven models facilitate real-time reaction monitoring and active site characterization, optimizing catalyst design and performance. Case studies will highlight ML techniques such as deep learning, principal component analysis (PCA), and regression models in handling complex datasets. However, the path to successful implementation of AI/ML is not without its challenges. We will address critical issues such as noise reduction in experimental data, the importance of dataset standardization, and the crucial role of incorporating domain expertise in the crucial step of feature selection. These considerations are essential for building robust and reliable models. This talk aims to inspire and inform, demonstrating the immense potential of AI/ML to reshape the landscape of environmental science, materials science, and catalysis.

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OP- 21

MODELING MOLECULAR SPECTRA WITH ARTIFICIAL INTELLIGENCE ALGORITHMS TO ENHANCE DETECTION SENSITIVITY

Manali Pancholi[1], S. S. Roy[1], Kashyap Vasani[1], Aayushi Raval[1], Debjani Bagchi[1*]

[1]Department of Physics, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat 390002.

debjani.bagchi-phy@msubaroda.ac.in

A wide array of spectroscopic tools can presently enable detection of molecules present in extra-terrestrial systems, or environmental pollutants such as microplastics, diagnostic and clinical practices, energy and geophysical research. This entails the development of faster detectors with high quantum efficiency to improve sensitivity of molecular detection with spectroscopic techniques. The very next step of detection is spectral analysis, and algorithms helping molecular spectral modeling are imperative for identification of molecular species. To this end, machine learning algorithms have enabled efficient classification tools. Using different classification tools, we have tried to identify the major components of agricultural wastes for easing bioenergy production from these systems. In case of agricultural waste, the random forest classification algorithm yields the best results for our samples [1]. Moreover, modeling the agricultural waste spectral data with neural network algorithms shows reasonably good accuracy between the predicted and the experimental values. In the case of simple molecules, machine learning helps in characterizing the presence of isotopes such as deuterium in spectra of protostars and exoplanets to give an idea of the possible reactions happening in the conditions prevailing there. We also explore some pattern recognition algorithms to detect simple molecules, and extend their use to microplastic detection in environmental samples. Lastly, we show how some of these algorithms can help in analysis of nutraceutical molecules useful for health sciences and improve their productivity [2].

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OP-22

QUANTIFYING THE MORPHOMETRIC AND SURFACE RUNOFF CHARACTERISTICS TO PRIORITIZE THE WATERSHED FOR FLOOD SCENARIO

Dhara Kakwani[1]*, Padmaja Sudhakar[1]

[1]Department of Environmental Studies, The M.S. University of Baroda

dharakakwani@gmail.com

Morphometric analysis includes the quantification of the watershed characteristics to recognize the 3-dimensional structure of the watershed. This study involves the integration of morphometric, hypsometric ,and surface runoff analysis to extract the flood scenario for Heran Watershed, a data-scarce watershed. It forms part of the Lower Narmada Basin and is an agrarian watershed. For better understanding, the watershed was divided into 17 sub-watersheds. Linear, Relief and Areal aspects of the sub-watersheds were extracted along with the hypsometric curve and hypsometric integral. Soil Conservation Service- Curve Number (SCS-CN) approach was used to quantify the runoff characteristics for the watershed. It was observed that sub-watershed 7, 12, 15, 4, 11, and 5 were categorised into high priority, sub-watersheds 3, 1, 8, 10, 6, and 14 into moderate priority and remaining sub-watersheds were categorised as low priority. It was concluded that the western portion of the watershed having the quaternary sediments is more prone to flooding as compared to the eastern portion formed by Deccan Traps. Moreover, it was also identified that more than 70% of the rainfall is lost as surface runoff leading to accelerated chances of flooding. Therefore, by understanding the morphometric characteristics with the surface runoff patterns, appropriate flood management of the watershed can be performed.

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POSTER PRESENTATION

PP-01

FINGERPRINT PROFILING OF HERBAL FORMULATION

Rohit Agrahari[1], G S Chakraborthy[2], Rakhi Mishra[3]

[1]Research Scholar, Faculty of Pharmacy, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat 391760.

[2]Principal and Professor, Faculty of Pharmacy, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat 391760.

[3]Research Scholar, Faculty of Pharmacy, Parul Institute of Pharmacy and Research, Parul University, Vadodara, Gujarat 391760.

rohitagrahari710101@gmail.com, *g.chakraborthy19159@paruluniversity.ac.in*, *rakhimishra1278@gmail.com*

High-Performance Thin-Layer Chromatography (HPTLC) is a widely used analytical method for the qualitative and quantitative measurement of the phytochemical herbal drugs. It is used at the higher level of the separation during this process and controlled with the software CAT. The principle of HPTLC is based on the separation. In which all the solvents used in the preparation of the standard and test solution should be HPLC grade; otherwise, the result is not accurate. In which study to establish the HPTLC fingerprint profile of the *Psoralea corylifolia* and *Nigella sativa*, both herbal drugs used in traditional medicine. The phytochemical analysis in which the hydroalcoholic extract of the *Psoralea corylifolia* and *N. sativa* as a standard drug involved psoralen and isopsoralen in the bakuchi and thymoquinone in the *N. sativa*. The HPTLC analysis was performed on the coated silica gel plates using the mobile phase (hexane: ethyl acetate) (8.5:1.5 v/v), which is used in the separation of the various phytochemicals that are present in the drug, and after running the mobile phase, the plate was dried and then put in the UV chamber for the visualization of the compound at 254 nm and 366 nm. After the visualization of the compound, put it on the HPTLC machine for the absorbance in 254 nm and identification of how much compound is present in the test drug and compare it with the standard drug; it is called quantification of the drug. Herbal formulations play a crucial role in traditional medicine because their efficacy is high, and they have lower side effects. *Psoralea Corylifolia* and *Nigella Sativa* are two important medicinal plants and herbs. They have pharmacological properties such as anti-inflammatory, antioxidant, antimicrobial, and repigmentation properties.

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ABSTRACTS

PP-02

MICROBIAL ANALYSIS OF CULTIVABLE *BACILLUS* ISOLATES OF SEA WATER AND SALINE REGIONS OF WESTERN INDIA

Krutika Joshi, Dinesh Siju, Shivani Kagal, Pooja Gurjar, Krishna Patel, Nandita Baxi.**
Department of Microbiology and Biotechnology Centre- The Maharaja Sayajirao University of Baroda, VADODARA
krishnapatel01296@gmail.com, nanditabaxi@yahoo.com

Bacteria of terrestrial regions, coastal regions and sea water are usually halotolerant, facultative halophilic or halophilic [1]. They also thrive in nutrient-limited environments. The ones which are culturable can be studied for morphology, physiology and biotechnological potential. Several studies and reports are available of bacteria isolated from such regions. However vast stretches of such area are available and specific locations can be studied and differ as per the organic matter and pollutants in the region. Sea water, soil sample and rhizosphere soil was collected from two regions of Kacchh and Bhavnagar regions of Gujarat and from Mumbai. The Kacchh region is desert type, whereas Bhavnagar region near Nari is of creek type and Mumbai region is coastal area. Few of the isolates were found to be cocci, and many were found to be rod shaped bacilli. Identification by MALDI TOF was done (**Table 1).** The predominant genus was found to be *Bacillus* type. Of the *Bacillus* isolates one of the isolates was also confirmed by or 16S rRNA gene sequencing (Figure 1). Most of the bacteria obtained could grow on high sodium chloride concentration (Table 2, **Figure 2**). One of the *Bacillus* isolates was found to produce extracellular polymer and was of *Bacillus species.* It was studied further as such bacteria help to retain water in saline soil regions. The polymer formation was enhanced in presence of sucrose and the polymer contained carbohydrate as shown by TLC. These results will be further discussed with their importance. (Table 3, Figure 3). Such microbial polymers hold significant industrial value and find broad applications in the biomedical, cosmetic, and pharmaceutical sectors and food industry [2].

Table-1 Predominant cultivable *Bacillus* isolates found in sea water and saline terrestrial regions

Identification	Total different isolates
Bacillus cereus,	6
Bacillus subtilis	3
Bacillus flexus	1

Figure-2 Typical bacterial colonies of *Bacillus* isolate on high sodium chloride

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PP-03

CURRENT REGULATORY REQUIREMENTS FOR BIOEQUIVALENCE STUDIES IN PHARMA RESEARCH AND DEVELOPMENT

Vijay Masiwal[1], Dr. Navnit Prajapati, Dr. Ravishankara M.N, Mahendra Patel
PhD research scholars, faculty of pharmacy, M.S. University, Vadodara
vijaymasiwal@gmail.com

Generic pharmaceutical products need to conform to the same standards of quality, efficacy and safety as required of the originator's (innovator) product. Specifically, the Generic product should be therapeutically equivalent and interchangeable with the reference product. Testing the bioequivalence between a test product pharmaceutically equivalent or a pharmaceutical alternative and a suitable reference product in a pharmacokinetic study with a limited number of subjects is one way of demonstrating therapeutic equivalence. Generic drug applications are termed "abbreviated" because they are generally not required to include preclinical and clinical data to establish safety and effectiveness. This present study provides the information about important aspects involved in bioequivalence and Regulatory requirements for Bioequivalence study in research and development of the pharmaceutical industry. Bioequivalence studies are integral to pharmaceutical research and development, ensuring that generic drugs provide the same therapeutic benefit as their branded counterparts. Regulatory authorities worldwide have set comprehensive guidelines that shape the conduct of these studies, with slight variations across regions. As science and medicine continue to evolve, so too will the regulatory landscape, requiring ongoing updates to bioequivalence study standards.

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PP-04

REGULATORY REQUIREMENT AND RECENT EVOLUTION IN MEASUREMENT OF LIQUID PARTICULATE MATTER IN PHARMACEUTICAL DOSAGE FORM

Mahendra Patel[1], Dr. Navnit Prajapati[1], Dr. Ravishankara M.N[2] and Vijay Masiwal[1]

Faculty of pharmacy, M.S. University, Vadodara[1], Sun pharmaceutical industries limited, R&D, Vadodara[2]

mahendra.p-pharphd@msubaroda.ac.in

The presence of particulate matter in intravenous injection especially in large numbers represents a potentially life-threatening health hazard [1]. Sterile injectable products are used extensively in health care. Patients, caregivers, manufacturers, and regulators have an inherent expectation for safe and effective injectable drug products. This expectation requires injectable pharmaceuticals to be produced to standards of quality, purity, and sterility that include being essentially free of extraneous matter such as particles. Particles refer to mobile, undissolved particles other than gas bubbles that are unintentionally present in an injectable product[2]. The entire regulatory agency has their guidance for the particulate matter control. Two procedures, Method 1 (Light Obscuration Particle Count Test) and Method 2 (Microscopic Particle Count Test) are used for the determination of particulate matter [2]. Light Obscuration Particle Count Test (LO) could use either light scattering or light blocking. Either way, the sample volume of water is passed in front of a laser. The way the light is offset determines the number and size of particles. Microscopic Particle Count Test method utilizes a suitable binocular microscope, filter assembly for retaining particulate matter and membrane filter for examination. Selection of either of the methods is based on not only product behaviour but also product cost. Pharmaceutical industries cannot afford for the high volume of product to be utilized for the analysis. LO required lower sample volume as compared to microscopy method. There are many Light Obscuration (LO) models of many companies available in the competitive market. Advancement in measurement of liquid particulate matter is based on different sample volume, sample viscosity and sample matrix. Each method has inherent measurement variability and comparing particle results across different measurement technologies is not always straightforward, as different methods use different physical principles to count and size particles. Nowadays, only particle size is not important for the potentially hazardous but Protein aggregates, particle morphology and shape is also important to understand the level of hazards. Recent evaluation in this technology contains both methods i.e. A Flow imaging (FI)[3] method utilizes bright-field microscopy. The sample is drawn through a flow cell that is positioned in view of a microscopy system, which then captures consecutive bright-field images for analysis. Information, such as size, morphology, and image intensity, can then be derived from the automated analysis of the digital images captured. This analysis is beneficial in categorizing particles and provides enhanced understanding of the different particle types observed [4].

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PP-05

DEVELOPMENT AND VALIDATION OF A STABILITY INDICATING HPLC METHOD FOR THE IMPURITY PROFILING OF MILTEFOSINE: A NON-CHROMOPHORIC DRUG

Vijay Chavada[1], Jayvirsinh Thakor[1], Chintan Dholakia[1],
Kumar K Singh[1], Sanjay Kabra[1], Rajiv Pande[1],
[1] Zydus Lifesciences Ltd., Zydus API Park, Behind Bright Day CBSE School, Vasna-Bhayli Canal Road, at and Post: Bhayli-390012, Dist. Vadodara, Gujarat, India
*vijay.chavada@zyduslife.com , chintan.dholakia@zyduslife.com , chavadavijay30@gmail.com

An accurate, precise and simple reverse phase high-performance liquid chromatographic (RP-HPLC) method was developed for the quantitative determination of related substances of Miltefosine, an oral medication used for the treatment of leishmaniasis and free-living amoeba infections. Miltefosine effectively targets disease-causing parasites, hence exhibits antiviral properties against a range of viruses, such as human immunodeficiency virus, hepatitis C virus and respiratory syncytial virus. The chromatographic separation was achieved using Symmetry shield RP_{18} 5 µm (150 mm × 4.6 mm) column. The optimized buffer was 10 mM sodium acetate trihydrate at pH 3.5, which was used in combination with Acetonitrile and Methanol in the ratio of 40:35:25 (%v/v/v) as mobile phase. The mobile phase was pumped at a flow rate of 0.7 mL/min for 110 minutes. The detection for non-chromatographic Miltefosine and its impurities was made possible using Refractive Index detector. The resolution for Miltefosine and related components was found to be greater than 2.0 for any pair of impurities. The stability-indicating nature of the method was demonstrated by performing forced degradation studies. There is no significant degradation when the Miltefosine was subjected to oxidation, thermal, humidity and photodegradation; while the drug substance was stable in acid and alkali degradation. The relative standard deviation obtained for the system precision and method precision studies was less than 2 %. The method performance with respect to linearity, specificity, accuracy, precision, limit of detection, limit of quantitation, ruggedness and robustness was demonstrated by satisfactory validation as per ICH-Q2(R2) guidelines. The method may be very useful for routine product quality monitoring and for stability studies.

PP-06

SYNTHESIS OF NOVEL BIXANTHENE FOR EVALUATION OF THEIR ANTICANCER ACTIVITY AGAINST BREAST CANCER

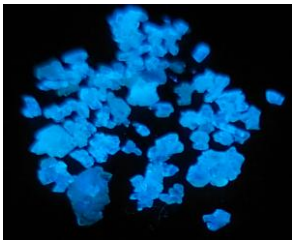
Meera Mori[a], Anjaliba Dodiya[b], C. Ratna Prabha[b], Arpita Desai[a,*]

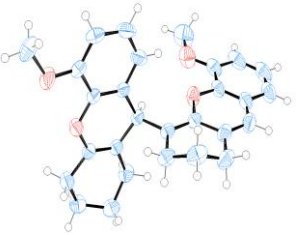
[a]Department of Chemistry, Faculty of Science, The M. S. University of Baroda, Vadodara, India

[b]Department of Biochemistry, Faculty of Science, The M. S. University of Baroda, Vadodara, India

arpitasatishdesai@gmail.com

Some of the most significant heterocyclic compounds with oxygen atoms in nature are xanthenes, which are crystalline organic compounds with two benzene rings joined to a core pyran ring.[1] In recent years, xanthene and its derivatives have drawn a lot of attention because of its numerous biological and medicinal uses.[2] Bixanthene have been synthesized by Stork enamine reaction[3] of derivatives of salicylaldehyde with cyclohexanone. The characterization of synthesized compounds was done by various techniques like IR, ^{1}H NMR, ^{13}C NMR, DEPT135, 2D NMR and SC-XRD. The purity of these novel molecules was established using HPLC analysis. The synthesized Bixanthene derivatives were tested for anticancer activity against the triple negative MDAMB-231 breast cancer cell lines. MTT assay reveals that the compound-**5** is a suitable candidate for development of an anticancer drug.





Solid Fluorescent of 2 5,5'-dimethoxy-2,2',3,3',4',9'-hexahydro-1*H*,1'*H*-4,9'-bixanthene

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PP-07

NANOSTRUCTURING OF Mn-BASED SUPERPARAMAGNETIC METAL-ORGANIC FRAMEWORKS

Saumaya Kirti[1], Nav Deepak[1], Shobha Shukla[1,2] and Sumit Saxena*[1,2]

[1]Center for Research in NanoTechnology and Science (CRNTS), IIT Bombay, Mumbai, India, 400076

[2] Nanostructures Engineering and Modeling Laboratory, Department of Metallurgical Engineering and Material Science, IIT Bombay, Mumbai, India, 400076

sumit.saxena@iitb.ac.in

Metal-organic frameworks (MOFs) are attractive candidates for meeting the needs of next-generation technologies. With a creative and meticulous design strategy, we tried to synthesize a novel Mn-based metal-organic framework with flake-like morphology which was further transformed into a beautiful marigold flower-like MOF. This grafting of MOF on a core substrate enabled us to achieve nanosized MOF with controllable thickness instead of a microsized irregularly shaped flakey MOF. Unlike typical guest encapsulation in MOF cavities, core-shell composites possess superior pore accessibility, ensuring optimal ion diffusion. They also exhibit a unique architecture that prevents the active guest from agglomerating or leaching, while promoting a tight connection between the core and shell, resulting in synergistic effects. This study utilized a sequential growth strategy to synthesize a core-shell hybrid of Fe_3O_4@Mn-MOF-NH_2. This hybrid combines a Mn-based MOF with a metal oxide to achieve both redox hopping and the through-layer mechanism of charge transport in a single system. The synthesized nanohybrid was used as an electrode material for supercapacitors, and its electrochemical properties were investigated. Additionally, these superparamagnetic MOFs can be separated almost instantaneously by applying an external magnetic field. Thus, they can be used easily in many applications like water, wastewater treatment, catalysis, etc. This hybrid MOF composite with multiple functionalities (optical, magnetic, etc.) offers huge potential for a variety of applications and enriches the MOF library. The flowered MOF hybrid design shed light on the micro or nanosized structural design changes or meticulous morphology adjustment of porous MOF composites for property optimization. This study provides an insight for the controllable preparation of MOF hybrid architectures which would further broaden the application opportunities of metal-organic framework materials.

PP-08

A BRIEF REVIEW ON RECENT TRENDS IN SUPERCAPACITOR NANOCOMPOSITES

Sumit Lad[1,2*], Atul kamble[2], Vilas kalantre[3]

[1*]Department of Chemistry, Shivaji University, Kolhapur 416 004, MS, India

[1,2]Department of Chemistry, Shri Yashwantrao Patil Science College, Solankur, Kolhapur, India

[3]Balasaheb Desai College, Patan, affiliated to Shivaji University Kolhapur, Vidyanagar, Kolhapur, 416004, Maharashtra, India

indiachemistry26@gmail.com

The escalating demand for efficient and sustainable energy storage solutions necessitates the development of high-performance supercapacitors. Recent trends in supercapacitor research focus on enhancing electrochemical performance, cycling stability, and energy density through innovative material combinations, synthesis techniques, and device architectures. This review highlights the latest advancements in supercapacitor technology, including the uses of graphene, metal oxides, conductive polymers, and their hybrids to improve electrochemical performance. Various synthesis techniques, such as hydrothermal, sol-gel, and electrospinning, are discussed to tailor material properties and optimize performance. Integrating carbon-based materials, transition metal oxides, and hydrogels is explored to enhance cycling stability and energy density. Furthermore, the review examines the importance of optimizing material combinations, electrode architectures, and electrolyte systems to achieve high-performance supercapacitors. The potential applications of advanced supercapacitors in wearable electronics, electric vehicles, and renewable energy systems are also discussed. This comprehensive review provides insights into the current state-of-the-art and future directions for supercapacitor research, paving the way for developing next-generation energy storage solutions. [1,2]

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PP-09

ZnO/DTPA AND ZnO/TMA NANOCOMPOSITES: SYNTHESIS, CHARACTERISATION AND THEIR ACTIVITY FOR PEROXIDE DEGRADATION OF DYES AND DYE MIXTURES

Hetvi Dave[1], Padmaja Pamidimukkala[1,2*]

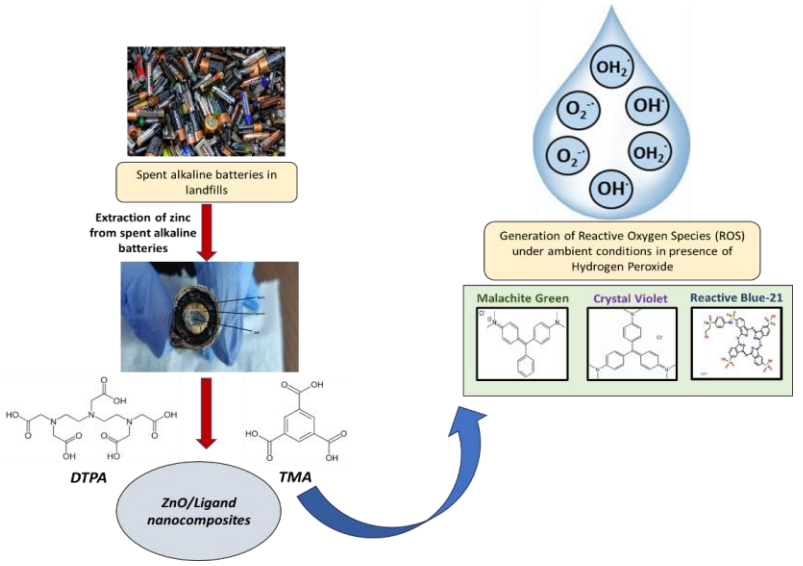
[1]Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda

[2*]Department of Environmental Studies, Faculty of Science, The Maharaja Sayajirao University of Baroda

hetvidave1006@gmail.com, padmaja.sudhakar-chem@msubaroda.ac.in

With the rapid development of textile industries, an enormous amount of industrial dye effluent is produced that leads to serious threats to aquatic environment by preventing the penetration of light through water and hindering the photosynthetic process in aquatic bodies. It also proves to be harmful to human beings as it is toxic, mutagenic and carcinogenic. E-Waste is another major source of pollution and is a cause of growing health concern. Furthermore, India has no framework for regulating e-waste such as batteries which can pose serious environmental and health risks. Efficient and economically viable techniques based on Advanced Oxidation Process (AOP) are emerging choices for degradation of dyes. On the other hand, e-waste recycling is important for environmental management to reduce pollution, conserve resources, and prevent climate change.

ZnO because of its wide band gap of 3.6 eV and large exciton binding energy of 60 meV is a widely used photocatalyst for mineralising the dyes to non-toxic products such as carbon dioxide and water. Surface modification of metal oxides using polycarboxylic acid and biopolymers is one of the major areas of interest in nanotechnology to prevent their aggregation thus increasing surface area and providing a controlled particle size. Diethylene Triamine Penta acetic Acid (DTPA) is an amino polycarboxylic acid comprising of diethylenetriamine backbone with five carboxyl groups that facilitate coordination with metal ions [1]. Trimesic acid is a rigid planar molecule with 3 carboxylic acid groups arranged symmetrically around the benzene ring [2]. As compared to AOPs based on photocatalysis with ZnO, AOP under ambient conditions without irradiation of light is rare. The objective of this work was to utilize spent alkaline battery waste as a source of ZnO for synthesis of ZnO/DTPA composites and ZnO/TMA composites by microwave assisted hydrothermal synthesis. The synthesised materials were characterized using absorption spectroscopy, Fourier Transform Infrared and X-Ray Diffraction Spectroscopy, Scanning Electron and High-Resolution Transmission Electron Microscopic techniques. The potential of ZnO/DTPA and ZnO/TMA for peroxide degradation of dyes and removal of chemical oxygen demand under ambient conditions was studied. ZnO/DTPA was more efficient as compared to ZnO/TMA for the degradation of dyes (Malachite Green, Crystal Violet, and Reactive Blue-21) and their mixtures. Additionally scavenging studies were conducted to know the involvement of Reactive Oxygen Species in the degradation process.



Schematic representation for peroxide degradation of dyes using ZnO/DTPA and ZnO/TMA nanocomposites

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PP-10

ASSESSING RO BRINE WATER FOR AGRICULTURAL SUSTAINABILITY: EFFECTS ON CROP AND SOIL

Shreya Patel[1], Punita Parikh[2*]

[1]Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat-390002

[2*]Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat-390002

punita.parikh-botany@msubaroda.ac.in

Water scarcity remains a major challenge for global food security and sustainable agriculture. As conventional water sources face increasing stress due to climate change, population growth, and competing demands, it is crucial to explore alternative irrigation solutions. Reverse osmosis (RO) brine water, a byproduct of desalination, presents a potential resource for agricultural use. However, its impact on crop growth and soil health must be thoroughly assessed before implementation. This study investigates the feasibility of using RO brine water for irrigation by examining its effects on *Raphanus sativus* L. (Radish) [1]. Phenological parameters, including root length, number of leaves, fresh weight, and dry weight, were measured to evaluate plant growth and biomass accumulation under RO brine water irrigation [2]. Additionally, soil samples collected before and after treatment were analyzed for pH and nutrient levels to determine changes in soil health. Statistical analyses (t-test or test of independence) were conducted to compare treated and control groups. This research provides valuable insights into the potential use of RO brine water in agriculture, offering a sustainable approach to water management while addressing environmental concerns associated with desalination byproducts.

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PP-11

REDUCING BIURET, ENHANCING SUSTAINABILITY: ECO-CONSCIOUS APPROACHES TO UREA PRODUCTION

Rekha Patel

Faculty, Department of Petrochemicals, Polytechnic, The M.S. University of Baroda

The formation of biuret during urea manufacturing is a significant challenge due to its detrimental effects on fertilizer quality and the environment. Biuret, a by-product of the urea synthesis process, is toxic to plants, inhibiting nitrogen absorption and stunting growth, which can reduce crop yields. Consequently, the presence of biuret in urea fertilizers not only diminishes fertilizer efficacy but also leads to higher fertilizer application rates, contributing to environmental pollution and soil degradation. As such, reducing biuret formation in urea production is critical to improving fertilizer quality and minimizing its harmful environmental effects. This abstract discusses strategies to minimize biuret formation during urea synthesis, focusing on process optimization, catalytic innovations, and post-production treatments. Urea is typically synthesized under high-pressure and high-temperature conditions, which favor the formation of biuret as a side reaction. Excessive heat and pressure cause urea molecules to decompose and recombine in undesirable ways, producing biuret. One of the primary strategies for reducing biuret content is to optimize these reaction conditions. By controlling temperature, pressure, and reaction time, side reactions that lead to biuret formation can be minimized. Reducing synthesis temperature and pressure not only limits biuret formation but also enhances the overall efficiency of urea production by favouring the desired urea-forming reaction. These adjustments can significantly lower biuret levels, improving the quality of the urea produced and reducing the environmental impact. Alongside optimizing synthesis conditions, the use of catalysts and inhibitors is another important strategy for reducing biuret formation. Catalysts can be employed to selectively promote the urea-forming reaction while suppressing side reactions that lead to biuret production. By modifying catalyst compositions or introducing new catalytic materials, the urea synthesis process can be made more efficient and cleaner, with lower biuret content. In addition, inhibitors can be introduced to prevent the chemical pathways that lead to biuret formation, further reducing biuret levels in the final product. The integration of these catalytic and inhibitory solutions into urea production processes can significantly enhance sustainability while minimizing waste. Post-production treatments also offer a viable method for reducing biuret content in urea. Techniques such as washing, crystallization, and other purification processes can help remove residual biuret from the final product. Although these methods are effective in lowering biuret content, they often incur additional operational costs and environmental challenges if not managed properly. Therefore, a balance between cost-effectiveness, efficiency, and environmental impact must be considered when implementing these methods on an industrial scale. The environmental benefits of reducing biuret in urea fertilizers are substantial. By minimizing biuret content, urea fertilizers become less toxic to plants, improving nitrogen uptake and enhancing crop growth.

This leads to more efficient fertilizer use, reducing the need for excessive fertilizer application and decreasing the risk of soil and water contamination. Furthermore, reducing biuret toxicity results in healthier soils, fostering long-term agricultural productivity and supporting sustainable farming practices. In conclusion, reducing biuret formation in urea manufacturing is crucial for improving fertilizer quality and reducing the environmental impact of urea-based fertilizers. Strategies such as optimizing reaction conditions, developing catalytic solutions, and employing post-production treatments offer promising avenues for achieving cleaner, more efficient urea production. These innovations contribute to the development of more sustainable agricultural practices, benefiting both the agricultural industry and the environment.

ABSTRACTS

PP-12

THE USE OF ZIRCONIUM AMINO TRIS(METHYLENEPHOSPHONIC ACID) (Zr-ATMP) IN THE REMOVAL OF WATER SOLUBLE DYE BY ADSORPTION PROCESS

Krishna G Panchal, Vasudev Vekariya, Pushti Vyas, Brijesh Shah *
Department of Chemistry, School of Sciences, Navrachana University, Vadodara, Gujarat, India
*brijeshshah27@gmail.com

Removal of toxic dye from wastewater is a key environmental concern, amongst the various cationic dyes, the malachite green (MG) standing out as a major contaminant due to its persistence and negative consequences [1]. Amongst the various types of materials metal phsophonates exhibits good selectivity and affinity for these type of dyes [2,3]. Zirconium amino tris(methylenephosphonic acid) (Zr-ATMP), a novel hybrid ion-exchange material from the class of tetravalent metal acid (TMA) salts, exhibits good ion-exchange characteristics and good selectivity of Cu^{2+} among the transition metal ions, Pb^{2+} among the heavy metal ions have been reported [4]. No systematic study have been reported for the removal of hazardous dye using this material. In the present study, we synthesized the Zr-ATMP using reported conditions [4] and explored it's application for the removal of MG dye from the solution. Various parameters such as dye concentration, adsorbent dose, temperature, contact time, and pH were studied in order to optimize the adsorption efficiency. The equilibrium behaviour was described using various adsorption isotherm models, such as Langmuir, Freundlich, Temkin, and Halsey models. In order to comprehend the adsorption mechanism, kinetic experiments were also conducted using pseudo-first-order and pseudo-second-order reaction model. The findings validated Zr-ATMP's applicability as an effective adsorbent for MG removal and showed ideal adsorption conditions. This study offers insightful information about Zr-ATMP's possible use in environmental remediation and wastewater treatment.

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PP-13

REVIEW ON SMALL SCALE BIODIESEL PRODUCTION FOR SELF-SUSTAINABILITY

Deepakkumar S. Jani[1], Nikul K. Patel[2]

[1]PhD Research Scholar, Department of Mechanical Engineering, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, India – 390002;

[2]Assistant Professor, Department of Mechanical Engineering, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, India – 390002;

janideepak5457@gmail.com, *n.k.patel-med@msubaroda.ac.in*

Overall, the article discusses the need for alternative fuels due to environmental degradation and climate change, as well as the benefits of biodiesel compared to conventional diesel. It mentions that biodiesel can be produced from various sources, including non-edible seed oils, and transesterification is the most widely used process for small-scale and industrial-scale production. The article also discusses the challenges in large-scale biodiesel production, such as availability of seeds and policy instability. The advantages of biodiesel include higher cetane number, reduction in exhaust emission, lack of sulphur content, biodegradability, and compatibility with conventional diesel engines. The article also emphasizes the positive impact of biodiesel on the environment, such as reducing emissions and controlling particulate matter, unburnt hydrocarbon, carbon monoxide, and sulphate. Finally, the article suggests factors that should be considered when selecting feedstock and reactor design for small biodiesel production. Overall, the article provides a good overview of small-scale biodiesel production for self-sustainability

PP-14

STABILITY STUDIES ON *Opuntia elatior* Mill FRUIT JUICE: EFFECT OF NATURAL PRESERVATIVES ON BETANIN CONTENT AND MICROBIAL GROWTH

Dhruvi Patel, Denni Mammen

School of Science, Navrachana University, Vasna-Bhayli Road, Vadodara, India.

Fruit juice of *Opuntia elatior* Mill is used as haemoglobin booster by local people of the Saurashtra region of Gujarat. The juice is bright red due to the presence of pigment. The fruits are not available throughout the year and this poses a problem. Manufacturers of commercially available juice use pasteurization for preservation, which causes degradation of the heat-sensitive pigment. Sodium benzoate is the synthetic preservative used by many local manufacturers. This study explores the use of natural preservatives as an alternative to synthetic additives for improving the stability of *Opuntia elatior* juice. Freshly extracted juice was treated with different concentrations of natural preservatives and stored under controlled conditions viz, room temperature and refrigeration temperature for 28 days. The impact of these preservatives on microbial growth was assessed using spread plate method and betanin concentration analysed through spectrometric measurements in intervals of 7 days. Under refrigerated conditions, ascorbic acid and tartaric acid maintained good betanin concentration. With increase in concentration, the preservatives significantly inhibited microbial growth, and therefore extended shelf life of the juice. For microbial growth and colour stability, refrigeration conditions proved better than storage at room temperature. The use of natural preservatives at refrigeration temperature effectively enhances the stability of *Opuntia elatior* juice by inhibiting microbial growth and preserving its colour. Results were found to be better than the commercially used synthetic preservative sodium benzoate. These findings highlight the potential of natural preservatives as safe and effective alternatives to synthetic additives in fruit juice preservation.

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PP-15

BIODEGRADABLE POLYMERS FOR SUSTAINABLE AGRICULTURAL APPLICATIONS

Sakshi Nangia[1], Vimal Katiyar[2]

[1*,2] Centre for Sustainable Polymers, Technology Complex, Indian Institute of Technology Guwahati, Guwahati - 781039

sakshinangia24@rnd.iitg.ac.in; sakshi.verma1986@gmail.com

The increasing environmental concerns associated with conventional polymers/ plastics in agriculture have accelerated the development and adoption of biodegradable polymers as sustainable alternatives. These polymers, derived from renewable sources such as starch, chitosan, polylactic acid (PLA), polyhydroxyalkanoates (PHA), and cellulose derivatives, offer promising solutions for agricultural applications while minimizing ecological footprints. Biodegradable polymers are employed in various forms, including mulching films, seed coatings, controlled-release fertilizers, plant support systems, and compostable packaging. They decompose under natural environmental conditions, transforming into non-toxic byproducts like carbon dioxide, water, and biomass. This eco-friendly degradation reduces plastic accumulation in soil, improves soil health, and enhances crop productivity. Moreover, biodegradable polymers can be tailored to exhibit desirable mechanical properties, degradation rates, and functional additives, aligning with specific agricultural needs. Despite the promising potential, challenges remain regarding production costs, standardization, and scalability for widespread agricultural adoption. This review highlights the current advancements, environmental benefits, challenges, and future prospects of biodegradable polymers in sustainable agriculture, emphasizing their pivotal role in fostering environmentally responsible agricultural practices.

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PP-16

SORPTION BEHAVIOUR OF Ti BASED HYBRID TETRA VALENT METAL ACID SALTS TOWARDS RARE EARTH METAL IONS

Kalpana Maheria*, Damin Patel, Vivek Paswan, Henil Lankapati, Dhara Patel, Meet Patel

Department of Chemistry, Sardar Vallabhbhai National Institute of Technology, Ichchhanath, Surat - 395 007, Gujarat, India

kcm@chem.svnit.ac.in

In the present work, a hybrid ion exchanger of the class of tetravalent metal acid salts has been synthesized by a sol-gel route, by treating titanium tetrachloride with hydroxyethylidine diphosphonic acid (HEDP) and amino-tris-methylene phosphonic acid (ATMP) to give titanium-HEDP (Ti-HEDP) and titanium - ATMP (Ti-ATMP), respectively. These materials have been characterized for elemental, spectral and thermal analysis. The ion exchange capacity of both the sorbents has been determined by the column method [1]. The sorption behaviour of Ti-HEDP and Ti-ATMP sorbents towards rare earth metal ions, particularly, Nd (III) and Sm (III), has been studied. Moreover, the effects of *p*H, metal ion concentration and contact time on metal ion sorption efficiency of both the sorbent materials have been investigated. Further, kinetic and thermodynamic studies have been performed and various kinetic parameters such as overall rate constant (K), equilibrium constant (K_c), first order forward (k_1) and reverse rate (k_2) constants and thermodynamic parameters [(ΔG°), (ΔH°), and (ΔS°)] have been evaluated. The study reveal higher metal ion removal efficiency of Ti-ATMP as compared to Ti-HEDP under optimum experimental conditions, which is ascribed to the presence of higher exchangeable sites in Ti- ATMP, a hybrid sorbent material.

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PP-17

ADVANCING BIODEGRADABLE PLASTICS FROM *SOLANUM TUBEROSUM* L. THROUGH METHOD OPTIMIZATION: A SUSTAINABLE SOLUTION TO MITIGATE PLASTIC POLLUTION

Pinaki Parmar[1], Punita Parikh[2*]

[1]Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara-390002

[2*] Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara-390002

punita.parikh-botany@msubaroda.ac.in

Plastic pollution has become a global crisis, severely impacting the environment by contaminating soil and water, disrupting ecosystems, and contributing to climate instability. Conventional plastics, due to their non-biodegradable nature, persist in the environment for centuries, making sustainable alternatives a necessity. Biodegradable plastics derived from renewable natural polymers, such as potato starch, offer a promising solution. However, inconsistencies in fabrication methods and the lack of standardization have hindered their large-scale production, material performance, and commercial feasibility.This study focuses on addressing these challenges by systematically evaluating and optimizing different methods for producing biodegradable plastic sheets. Ten distinct methods were selected and analysed, all using a similar chemical composition but varying in processing conditions such as the sequence of chemical additions and the inclusion or exclusion of plasticizers and acids. Potato starch served as the primary polymer to ensure uniformity across all experiments. The plastic sheets obtained through these methods underwent extensive analytical characterization, including film thickness measurement, moisture content analysis[1], water absorption testing, solubility evaluation, swelling tests[2], tensile strength assessment, and Fourier-transform infrared spectroscopy (FTIR) analysis[3].The results revealed that the sequence of chemical additions and the presence of plasticizers played a crucial role in determining the physical and mechanical properties of the biodegradable sheets. Plasticizer-enhanced formulations significantly improved flexibility and tensile strength, making them more suitable for practical applications. Meanwhile, optimized chemical sequences helped enhance transparency, reduce surface defects such as cracks, and minimize trapped air bubbles, thereby improving the structural integrity of the films. Moisture absorption and solubility tests confirmed the biodegradability of the sheets, demonstrating their potential as an environmentally friendly alternative to traditional plastics. Additionally, FTIR analysis validated the chemical integrity of the biodegradable polymers, ensuring that the key structural components essential for degradation were retained. By integrating principles of green chemistry and analytical standardization, this research establishes a reproducible and optimized method for creating biodegradable plastics with consistent quality and performance. The findings not only contribute to the development of scalable eco-friendly alternatives but also align with global sustainability initiatives aimed at reducing plastic waste and mitigating environmental pollution. This study underscores the significance of material standardization in advancing biodegradable plastics as a viable solution for a cleaner and more sustainable future.

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PP-18

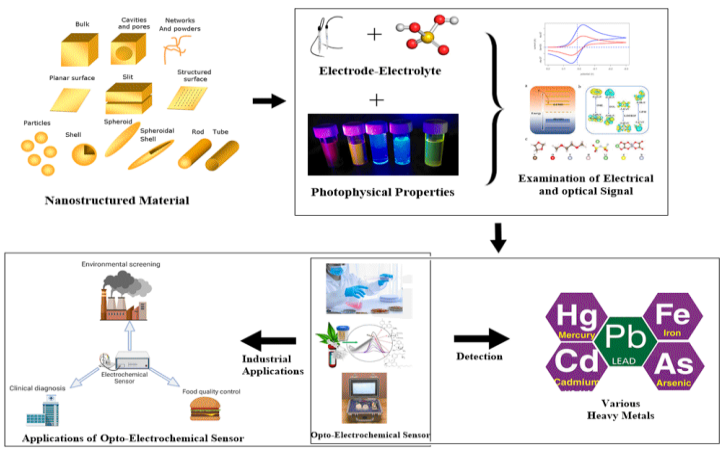
RECENT DEVELOPMENT IN THE FABRICATION OF NANOSTRUCTURED MATERIAL-BASED OPTO-ELECTROCHEMICAL SENSORS TO DETECT HEAVY METALS

Jyoti Sharma and Suban K Sahoo

Department of Applied Chemistry, Sardar Vallabhbhai Patel Institute of Technology, Surat 395007, Gujarat, India.

sks@chem.svnit.ac.in

Heavy metal pollution has been increasing significantly and has been detected in the air, food, and beverages. In contemporary society, the prevalence of contaminants in food products, including fruits and vegetables, are rising, posing risks to human health. Heavy metals are detected in the human body from common sources such as food, vegetables, fruits, beverages, medicines, sunscreen lotions, and air. Researchers have analysed various nanomaterial-based sensors for the pre-emptive detection of heavy metals. These sensors can differentiate between toxicities and prevent product counterfeiting. This sensor can rapidly detect hazardous materials in various food products and beverages at low ppm and ppb levels. This review primarily focuses on the fabrication of opto-electrochemical sensors utilizing various nanostructured materials to detect heavy metals in food and beverage products, sunscreen lotions, air, and medicines to improve human health. It also describes the advantages of using opto-electrochemical sensors over other types of sensors (electrical, electrochemical, chemosensory, and biosensor). This paper presents signal amplification and enhancement of the sensor with the aid of various enzyme receptors, nanocomposites, fibres, and polymers. Techno-analysis reports indicate that detection tests are considerably more expensive in the market for the examination of batch production. Therefore, this sensor can assist in the detection of hazardous/poisonous materials by interacting with electron donors and acceptors and utilizing the FRET mechanism with optical and electrical properties. This study also examines various real-time case studies of heavy metal detection, along with an analysis of the qualitative and quantitative aspects of heavy-metal detection industrial applications.



PP-19

ADVANCING MSWI FLY-ASH MANAGEMENT: CHARACTERIZATION AND CHLORIDE REMOVAL STUDIES

Yuti Desai[1], Vinay K. Singh[1,2], Rajiv Ranjan Srivastava[3,4]

[1]Faculty of Science, Department of Environmental Studies, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat-390002, India.

[2]Faculty of Science, Department of Chemistry, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat-390002, India.

[3]Center for Advanced Chemistry, Institute of Research and Development, Duy Tan University, Da Nang-550000, Vietnam.

[4]Resource Management, Faculty of Natural Sciences, Duy Tan University, Da Nang-550000, Vietnam.

yuti.desai-envphd@msubaroda.ac.in, *vinay.singh-chem@msubaroda.ac.in*, *r2.srivastava@gmail.com*

Incineration is a widely accepted method for managing municipal solid waste (MSW) in an effective manner. However, this process generates large quantities of incinerated fly-ash (IFA), which presents significant disposal issues. The hazardous nature of MSW-IFA, coupled with its high chloride content, intensifies environmental concerns and blocks its utilization in construction materials due to the corrosion effect. Therefore, understanding the characterization of MSW-IFA is crucial for assessing its composition, environmental impact, and potential for resource recovery. Identifying its physical, chemical, and mineralogical properties aids in developing efficient treatment strategies. Moreover, the chloride removal is crucial to reduce leaching risks, enhance material reutilization, and minimize environmental contamination, making it a key step in sustainable waste management. This study analyses MSW-IFA samples from different stockpiles, identifying CaO, K_2O, SiO_2, S, and Cl as major components, along with heavy metals such as iron, chromium, zinc, and lead, which pose environmental risks if landfilled. The research further investigates chloride removal under varying conditions, including temperature, solid-liquid ratio, extracting solution, and leaching time, to determine optimal treatment parameters. Experimental results showed a maximum chloride removal efficiency of 89% at 80 °C with a 60-minute leaching time, highlighting an effective approach for facilitating the recycling and reuse of MSW-IFA.

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PP-20

SUSTAINABLE DYE DEGRADATION USING NANOCOMPOSITED CELLULOSE HYDROGEL DERIVED FROM *Typha angustifolia L.*

Nayan Nimavat[1], Punita Parikh[2*]

[1] Department of Botany Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat-390002.

[2*] Department of Botany Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat-390002.

punita.parikh-botany@msubaroda.ac.in

The increasing environmental pollution caused by industrial dye effluents necessitates the development of sustainable and efficient remediation strategies[1]. In this study, cellulose was successfully isolated from the invasive aquatic plant *Typha angustifolia* and utilized for the synthesis of cellulose-based nanocomposite hydrogels. The isolated cellulose and synthesized cellulose hydrogel were characterized using X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR) to confirm structural integrity and successful hydrogel formation[2]. To enhance the dye degradation potential, silver nanoparticles (AgNPs) were synthesized via a green synthesis approach using *Typha angustifolia L.* plant extract and incorporated into the cellulose hydrogel matrix. The efficiency of the synthesized nanocomposited cellulose hydrogel was evaluated through the degradation kinetics of both cationic (Rhodamine B) and anionic (Fast Sulphon Black) dyes. The hydrogel demonstrated significant degradation efficiency for both dye types, making it a promising candidate for wastewater treatment applications. The degradation kinetics followed a pseudo-first-order reaction, indicating effective interaction between the hydrogel and dye molecules. The enhanced catalytic activity of the AgNPs within the hydrogel matrix further improved the degradation efficiency under visible light conditions. The study highlights the potential of cellulose-based nanocomposite hydrogels as a sustainable and eco-friendly alternative for industrial effluent treatment. The use of *Typha angustifolia L.*-derived cellulose and green-synthesized AgNPs ensures the sustainability of the material while addressing the critical issue of water pollution. Future research will focus on optimizing hydrogel composition, exploring additional nanomaterials for enhanced photocatalytic activity, and scaling up the process for real-world applications.

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PP-21

ENHANCED ADSORPTION EFFICIENCY OF CARBON NANOTUBE THROUGH HYDROGEN AND CHLORINE PASSIVATION FOR WATER PURIFICATION: A DFT AND MOLECULAR DYNAMICS PERSPECTIVE

Riddhi D. Sainda*, and Prafulla K. Jha.

Department of Physics, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India-390002.

riddhiahir2211@gmail.com

The rapid urbanization, industrialization, and the widespread use of chemical products, such as pesticides in agriculture and other human activities, have led to a significant rise in synthetic organic and inorganic pollutants inside water bodies[1]. These contaminants pose serious health risks to living organisms. In this study, we present a systematic study on the adsorption of toxic pesticides—Atrazine, Carbetamide, and Glyphosate from water using hydrogen and chlorine-passivated carbon nanotubes (CNTs)[1,2]. We also performed classical molecular dynamics (MD) simulations for up to 50 ns to examine the interaction mechanisms between the pesticides and CNTs. Our results indicate that the presence of hydrogen and chlorine functional groups enhances the adsorption efficiency of CNTs. To further understand the adsorption mechanisms and stability, we analyze the root mean square displacement (RMSD), radial distribution function (RDF), and diffusion coefficient of pesticides (via mean squared displacement, MSD)[3]. Additionally, we computed the binding energy, revealing preferential adsorption of Atrazine and Carbetamide compared to Glyphosate. Overall, our study provides valuable insights into the interaction mechanisms of pesticides with hydrogen- and chlorine-passivated CNTs in a water environment. These findings highlight the potential application of passivated CNTs for effective pollutant separation from water.

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PP-22

HIGH PRECISION AUTOMATED HELIUM GAS PYCNOMETER: A GREEN METHOD FOR THE MEASUREMENT OF TRUE DENSITY OF SOLID PROPELLANT

Soyamol Thomas, Ramya P R , Sreedevi M S, Syam V S, Jeesha G S, B Rani Mathammal, Cherian Thomas

Process and Quality Control Division, Aero Space Ordnance Entity,
Vikram Sarabhai Space Centre, Thiruvananthapuram-695022

soyamarry@gmail.com

Density is a critical parameter in solid propellant as it affects performance and characteristics of the propellant. Density determines the specific impulse and burning rate. Its variation affects the stability, consistency and influences the thermal and mechanical properties of the propellant. Density is one of the characteristic properties of any material and its accurate measurement is an important quality control tool. Density can be measured by various methods. Depending upon the parameter like volume or packing that is considered for the measurement, density is reported in various terms like skeletal density, bulk density, apparent density etc. The density is considered as a critical parameter in qualification of raw material and final finished product in any industry. Therefore, it is highly essential to measure the density of a sample with high precision and accuracy. Generally, density is measured by using Archimedes principle for solids. In a solid block, volume can be determined much more accurately compared to powders and foam like materials.

Density of solid propellant is measured from each batch as a quality check and it depends on the composition, particle size and distribution and process parameters like mixing time, cure temperature etc. It is measured from sample coupons by using an Electronic densimeter based on Archimedes principles. In this method, the solvent employed and temperature of measurement has an important role in the results. The solvent is chosen such that it doesn't have any affinity to any of the ingredients in the system for which density is being measured. Further while measuring density of a sample, it is essential to maintain the temperature of the medium constant and density of the solvent at the same temperature is also to be determined separately. Most commonly, toluene is used as the medium for the measurement. Though the results obtained by using toluene as solvent are accurate, handling and exposure to hazardous solvents for longer duration are not desirable.

In addition to the hazardous nature, these test methods are destructive methods and analysis cannot be repeated in case of any ambiguity in obtained results. Moreover, solid propellant being a composite material, the probability of absorption of solvent to the solid propellant sample is always debated.

With the aim of continual quality control improvement, a High precision automated Helium Gas Pycnometer is installed to ensure consistent density measurements. In this method, the volume of the material is accurately determined by gas displacement. Helium is the preferred medium due its peculiar nature. A number of analyses were carried out with different types of solid propellant formulation. The test method is optimised and validated with the current practice of liquid displacement method.

This paper describes the challenges encountered during the validation of High precision automated Helium Gas pycnometer for the measurement of density of solid propellant. Optimisation of the test method, effect of various parameters for the optimisation, correlation with the current practice, statistical analysis of data for validation etc. are also described. The major advantage in this method is, it is non-destructive in nature and hence tests can be repeated. In addition, data verification & analysis is possible at any point of time after the test also. In addition to that it is a green method as there is no exposure to chemicals or chemical environment. The paper deals with the successful validation and implementation of the High precision automated Helium Gas Pycnometer as a green advanced technique for the measurement of density of solid propellant.

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PP-23

COMPARATIVE STUDY OF VARIOUS POLY(D,L-LACTIC ACID) BY USING SIZE EXCLUSION CHROMATOGRAPHY WITH MULTIPLE DETECTION

Chandan Kumar Karan,* Ravindra Singh, Dheer Singh, A V Karthikeyani, Alex C Pullikotil

Research & Development Centre, Indian Oil Corporation Limited, Sector-13, Faridabad-121007

karanck@indianoil.in

Gel Permeation Chromatography (GPC) enables the determination of molecular weight distribution, average molecular weights (such as number-average Mn, weight-average Mw, and Z-average Mz), and the polydispersity index (PDI) of polymer samples. These parameters are related to the size and shape of the polymer molecules in solution and can provide insights into the polymer's conformational properties. Poly(D,L-lactic acid) (PDLLA) is a type of biodegradable and bioresorbable polymer made from lactic acid, which can be derived from renewable resources such as corn starch or sugarcane. PDLLA represents a significant advancement in the field of biodegradable polymers. Different range of molecular weight averages, intrinsic viscosities, and other characteristics for various samples of PDLLA (Poly(D,L-lactic acid)) were studied. Here we have studied six different PDLLA polymers for study regarding different parameters by GPC with differential refractive index (RI), multiangle light scattering (MALS) (GPC with multi-angle light scattering detector to determine the hydrodynamic radius) and intrinsic viscosity (IV) (gel permeation chromatography with a viscometer detector to determine the intrinsic viscosity) detector. This study allowed detecting differences between apparently similar polymer samples. The study helps to correlate the structure-property relationship and also realize the mechanical strength, solubility and processing behaviour of the polymers.

PP-24

A NOVEL STRATEGY FOR MERCURY SENSING USING NITROGEN AND SULPHUR-DOPED CARBON DOTS WITH AN ON-OFF MECHANISM

Rahul Chauhan, A K Prajapati*, Sonal Thakore*
Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara 390 002, India
akprajapati@yahoo.co.uk, *sonal.thakorechem@msubaroda.ac.in*

Mercury contamination in water poses severe threats to human health and the environment due to its toxicity and bioaccumulation. This study presents nitrogen-sulphur-doped carbon dots (N-S-CDots) as a highly efficient fluorometric probe for mercury detection. The N-S-CDots were characterized using FT-IR, SEM, TEM, and XPS. The sensing experiments demonstrated high photoluminescence quantum yield, with a detection limit of 90 nm. A fluorescence-based "on-off" mechanism, where Hg^{2+} quenches fluorescence via electron transfer, offers a cost-effective, rapid alternative to traditional methods, positioning N-S-CDots as a sustainable solution for mercury monitoring in water systems.

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PP-25

DEVELOPMENT AND VALIDATION OF RAPID AND FACILE ANALYTICAL METHOD FOR DETERMINATION OF RELATED SUBSTANCES AND ASSAY OF GUANIDINE BY RP-HPLC

Dr. Shardul Bhatt, Mr. Hitesh Shah, Dr. Chintan Dholakia, Dr. Kumar K. Singh
Zydus API Park, Zydus Lifesciences Ltd., Vasna-Bhayli Canal Road, Vadodara, 390012
Shardul.B.Bhatt@Zyduslife.com

Development of Reversed Phase High Performance Liquid Chromatography (RP-HPLC) method for highly polar non-volatile molecules is a challenging and tedious task due to its non-retained property in reversed phase C8, C18 and modified chemistry HPLC columns. One such example is Guanidine and its salt.

Guanidine is an amidino carboxamide molecule. It has a central carbon atom bonded with three nitrogen atoms which makes it structurally similar to Urea. It is associated with several biological activities in human body like antitumor (anticancer), antimicrobial (antibacterial, antifungal), antiviral, antiprotozoal, anti-inflammatory, central nervous system (CNS) activity, inhibition of Na+/H+ exchanger, nitric oxide synthase (NOS) inhibition, antithrombotic effects, and potential as a chemotherapeutic agent. [1,2,3]

Currently used methods to determine guanidine by RP-HPLC require pre or post column derivatization for its detection [4, 5]. Derivatization approach is often specific to the analyte hence not suitable for the determination of related substances analysis.

In spite of being such a fascinating small nitrogen-rich organic compound the rapid and facile analytical method for related substances and assay analysis of Guanidine without its derivatization by RP-HPLC is not available.

In present study we have developed and validate analytical method for related substances and assay of Guanidine carbonate without its derivatization by HPLC equipped with Diode Array Detector (DAD) using Dionex Ionpac CS12A cation exchange column (4 x 250 mm) at 0.5% specification level for any unspecified impurity with respect to analyte concentration. The limit of quantitation (LOQ) and limit of detection (LOD) was achieved up to 20% and 10% of the specification level respectively with signal to noise ratio more than 20 at LOQ level. The range and linearity, accuracy was established in line with ICH Q2 (R2) guideline.

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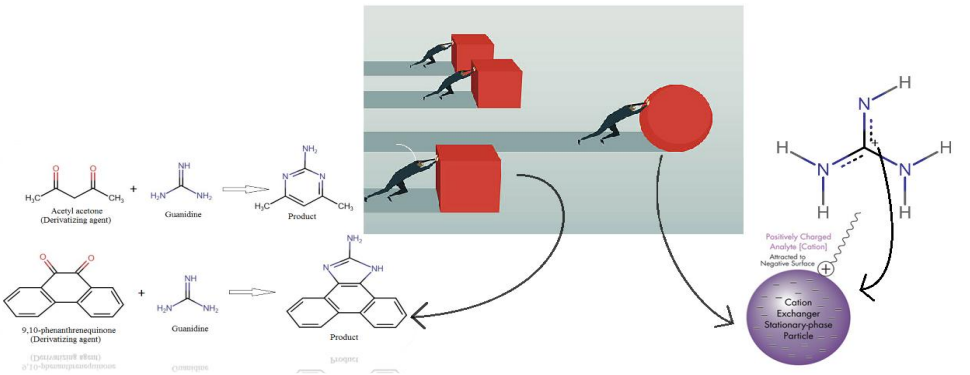
ABSTRACTS



Derivatization approach **Ionic interaction approach**

PP-26

GREEN APPROACH FOR ANALYTICAL METHOD DEVELOPMENT AND VALIDATION FOR QUANTIFICATION OF ENZYME BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Dhruv Gaikwad*, Krunalsinh Jadeja, Bhavin Chhatrala, Chintan Dholakia, Sandip Bhuva, Kumar K Singh

Zydus Lifesciences Limited, Zydus API Park,
Vasna Bhayli Canal Rd, next to Kishan Classic, behind Bright Day CBSE School, Tandalja, Vadodara, Gujarat-
India-390012.
sandip.bhuva@zyduslife.com

Due to growing importance of synthesizing Raw material, Intermediates and APIs using Enzymes as a catalyst to get high yields and exquisite selectivity, providing cost benefits compared to traditional organic synthesis and reducing waste production [1-3]. Enzyme quantification is essential in biochemical and pharmaceutical research. Traditional derivatization methods [4-5] by UV-Vis spectroscopy are often hindered by matrix interference, compromising accuracy. Alternative techniques, including colorimetric and fluorometric assays [6-8], face similar challenges in sensitivity and specificity. This study compares various methods for enzyme determination, highlighting the superior performance of High-Performance Liquid Chromatography (HPLC). With its exceptional resolution, selectivity, and precision, HPLC effectively separates enzymes from interfering matrix components, ensuring reliable and reproducible results. Our findings establish HPLC as the preferred technique for enzyme quantification in complex samples, offering a solution to the limitations of conventional methods and advancing analytical accuracy in enzymology.

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PP-27

SPECTROPHOTOMETRIC STUDY OF SILVER(II) COMPLEX WITH THIOSEMICARBAZONE DERIVATIVE IN SOLUTION STATE

Jyoti Ajudiya[a] and Mayur Shah*
Faculty of Science, Gujarat Vidyapeeth, Ahmedabad
mayur@gujaratvidyapith.org

Thiosemicarbazones are known to coordinate with various metal ions to form coordination compounds in different modes. Spectrophotometric reagent Furan-2-carbaldehyde-4-phenyl-3-thiosemicarbazone (FCTSC) is synthesized from 4-phenyl-3-thiosemicarbazide and Furan-2-carbaldehyde by condensation method [1,2]. The reagent forms Light green color with Silver (II) at pH 4. Ag (II)-FCTSC gives maximum absorbance at 379 nm. The Ag-FCTSC complex has formed a 1:2 M:L ratio with FCTSC. Beer's law obeys in the range of 0.27- 8.63 µg/mL. Molar absorptivity and Sandell's sensitivity for Ag (II) is 15.38 $\times 10^4$ L $mol^{-1}cm^{-1}$ and 0.01 µg/cm^2 respectively. Stability constant for Ag (II) is found to be 7.4×10^6. This spectrophotometric method will be applied for the determination of Silver in various samples.

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PP-28

A CHEMODOSIMETER APPROACH: DESIGN AND DEVELOPMENT OF "TURN-OFF" ANTHRACENE BASED FLUORESCENT MOLECULAR PROBE FOR THE DETECTION OF Fe^{3+} AND OH^- IONS IN AQUEOUS MEDIUM

Jyotsna Bhawar[1], Anupa Kumbhar[1*]

[a] Department of Chemistry, Savitribai Phule Pune University, Pune-411007, Maharashtra, India.

*bhawarjyotsna29@gmail.com, kumbharanupa@gmail.com**

Iron is one of the most essential trace elements in biological systems and performs a major function in the growth and development of living systems as well as in various cellular biochemical processes like oxygen-transport and regulation of metalloenzymes. Both iron deficiency and overload are harmful to human health. For example, Fe^{3+} deficiency leads to anaemia and excess iron in the body causes liver and kidney damage. It is also involved in progression of Parkinson's, Alzheimer's, and Huntington's diseases. Long-term exposure to hydroxyl ions can induce biochemical and physiological problems in humans, including irritation and respiratory paralysis. Therefore, it is crucial to monitor their levels in the physiological system.

In our efforts to address this issue an anthracene-based fluorescent probe, AOX was developed in our lab. It was characterized by different physicochemical techniques including single crystal X-ray structure. AOX shows selective fluorescence turn-off response towards Fe^{3+} and OH^- ions in presences of 18 interfering cations and anions. The detailed investigation of these systems reveal that AOX act as fluorescent turn-off chemo-dosimeter wherein a new non-fluorescent molecule is formed at the end of titration with Fe^{3+} and OH^- ions. The mechanism of sensing is established by HRMS and ^1H NMR titration. A change in fluorescence from blue to colourless under the UV allows naked-eye detection of Fe^{3+} in real time. The lowest detection limit in solution for Fe^{3+} and OH^- was found to be 0.0156 µM and 0.293 µM respectively.

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PP-29

PHOSPHOLIPIDS, POLYPHENOLS AND FIXED OIL COMPOSITION OF *PENNISETUM GLAUCUM* (L.) R. BR. (PEARL MILLET)

Pankaj Sharma*, Denni Mammen
School of Science, Navrachana University, Vasna-Bhayli Road, Vadodara, India.
pankaj.sharma@nuv.ac.in

The present study describes the phytochemical analysis of *Pennisetum glaucum* (L.) R. Br., also known as pearl millet, which is referred to as the poor men's staple food in India and Africa. The fixed oil extracted from the seeds contained linoleic acid (45.55%), oleic acid (28.54%), palmitic acid (20.6%) and linolenic acid (2%), when assessed using GC-MS analysis. Flavonoid content was calculated to be 0.9%, with tricin, 7-methoxy luteolin and acacetin to be the major flavonoids present. Phospholipid content was found to be 0.75%, containing both lecithins and cephalins, which were detected qualitatively. The phenolic acids identified in the seeds were vanillic, syringic, ferulic, p-hydroxy benzoic acid and p-coumaric acid. The phenolic content was quantified spectrophotometrically to be 4.08 µg/g. Both flavonoids and phenolic acids are known to be highly active antioxidants. The role of antioxidants in human diet is being increasingly felt these days. Since it is understood that all the chronic diseases like diabetes, cancer, stroke, atherosclerosis etc are caused either by the reduced levels of antioxidants in the body or the increased levels of free radicals. The total antioxidant activity of the grain is found to be IC50 1.33+ 0.03 mg/mL, as assessed using DPPH radical scavenging assay. The identification of a good amount of phenolics, flavonoids, phospholipids and linoleic acid in Bajra elevates the potential of this crop and makes it one of the best food grains in the world.

PP-30

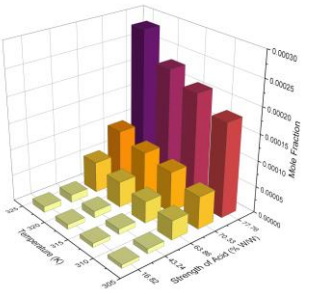
SOLUBILITY BEHAVIOR OF 1-NITRONAPHTHALENE IN H_2SO_4: EFFECTS OF ACID CONCENTRATION AND TEMPERATURE

Jay H. Tailor[1], N. V. Bhate[1*]

[1]Chemical Engineering Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, Gujarat, India.

n.v.bhate-chemengg@msubaroda.ac.in

Nitro derivatives of naphthalene are key intermediates in various industrial products. Naphthalene nitration in mixed acid systems has been extensively investigated to improve yield and selectivity [1-4]. The process produces 1-nitronaphthalene (NN) initially, followed by dinitronaphthalene isomers. While essential for process optimization, solubility data of naphthalene nitroderivatives in sulfuric acid remains unreported. This study examines 1-nitronaphthalene solubility across different sulfuric acid concentrations and temperatures to enhance liquid-phase nitration. Solubility experiments were conducted in an SLE cell by mixing excess nitro derivative with sulfuric acid of specified strength at temperatures ranging from 308.15 to 323.15 K. Saturated samples (1 ml) were analyzed using a Shimadzu UV-1800 spectrophotometer after appropriate dilution with acetonitrile. Calibration was performed using synthetic samples prepared in acetonitrile. The study covered sulfuric acid concentrations from 10% to 75%, with the upper limit chosen due to exponential solubility increases beyond this strength. Three-dimensional bar plots (Figure 1) demonstrate the relationships between acid strength, temperature, and solubility. The data reveals a sharp solubility increase above 70% acid strength, with temperature effects showing linear trends at lower acid concentrations and steeper increases at higher concentrations. Experimental data was modeled using Van't Hoff, Modified Apelblat, and NRTL equations. Thermodynamic mixing properties ($\Delta_{mix}H$, $\Delta_{mix}G$, and $\Delta_{mix}S$) were calculated using excess mixing properties derived from the NRTL model. The Modified Apelblat model provided the best fit with an average %AAD of 1.218, while Van't Hoff and NRTL models showed comparable performance. NRTL-based thermodynamic calculations indicate a spontaneous, endothermic, and entropy-driven dissolution process across all studied acid concentrations.



Solubility of nitronaphthalene in different strengths of sulfuric acid at different temperatures.

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PP-31

EFFECT OF DIAMINE AND POST CURING ON PROPERTIES OF POLYIMIDES SYNTHESIZED VIA ONE-STEP ROUTE

Roopa Dimple, Suchithra C, Deepa Devapal
Analytical and Spectroscopy Division,
Analytical Spectroscopy and Ceramics Group,
Propellants, Polymers, Chemicals and Materials Entity,
Vikram Sarabhai Space Centre,
Thiruvananthapuram- 695 022, Kerala, India
roopa_dimple@vssc.gov.in, c_suchithra@vssc.gov.in,
deepa_devapal_rajdeep@vssc.gov.in

Polyimides represent the class of high-performance polymers which contains two acyl groups as part of their backbone structure. Among aromatic and aliphatic polyimides, the aromatic polyimides need special mention with regard to their electrically insulating capability, higher purity of the synthesized compound, flame retardancy and better thermo oxidative stability compared to most other high performance polymers. They find wide applications in space technology as insulators in batteries, polyimide pipelines for cryo insulation, multi-layer film insulation for the satellites, inflatable antenna and thermally stable materials for high temperature uses. The thermal stability, flame retardancy and self-extinguishing properties of polyimides are attributed to the structural aspect of aromatic and heterocyclic moieties. However, characterization of polyimides is often very difficult owing to the poor solubility in most of the common solvents. The present work deals with the studies on polyimides synthesized using a one-step route at elevated temperature in a high boiling solvent. Monomers used were mixtures of dianhydrides and diamines in different mole ratios. The monomers were selected in such a way as to impart high temperature properties, oxidative resistance, atomic oxygen resistance and flexibility. The synthesized polyimides were post-cured in a controlled atmosphere at different temperatures. Evaluation of the polyimide structure, physical parameters and the effect of post-curing upon the synthesized and heat treated polyimides were achieved using different analytical techniques.Formation of polyimides was confirmed from the FTIR analysis and the corresponding imide conversion was calculated from the ratio of absorbances of C-N and aromatic moieties. Polyimide synthesized from binaphthyl diamine gave better imide conversion in the range of 5-7 whereas those from diaminodiphenyl methane and bis-4 amino phenyl sulfone gave imide conversions in the range of 1-2. Even Though the bis 4-amino phenyl sulfone systems gave a higher glass transition temperature of the range of 362-365°C, compared to the range of 320-350°C obtained from diaminodiphenyl systems, the char residue was only in the range of 40-50%. The binaphthyl diamine systems were found to have better char residue of 60-65% suitable for high temperature applications. Incorporation of binaphthyl diamine in the polymer composition was found to aid the formation of colourless polyimides contrary to the conventional intense yellow-orange coloured polyimides by way of disruption in the planarity of the aromatic rings and thus reducing the charge transfer. Increased aromatic content of the binaphthyl diamine was further improving the char residue making the polyimide suitable for applications requiring both colorlessness and higher char residue.

ABSTRACTS

PP-32

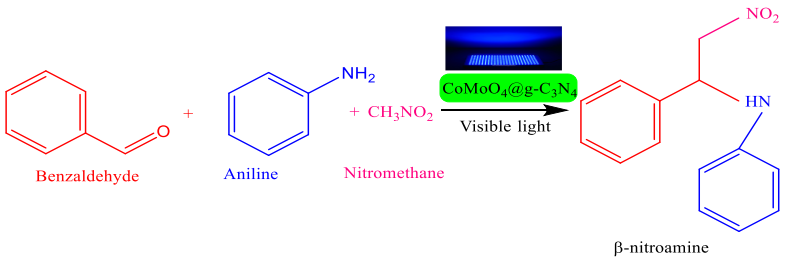
VISIBLE LIGHT DRIVEN NITRO-MANNICH REACTION USING CoMoO4@g-C3N4 PHOTOCATALYSTS

Shivani Agrawal, Chetan K. Modi*

Department of Applied Chemistry, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, Gujarat, India

chetanmodi-appchem@msubaroda.ac.in

Photocatalysis research emphasizes on developing ecologically beneficial and sustainable methods for reduction of generated chemical contaminants [1]. For this, we synthesized visible-light-active photocatalysts by doping cobalt molybdate (CoMoO4) with varying % of loading, i.e., 3%, 5%, and 10% onto g-C3N4 matrix, which were synthesized using urea and barbituric acid as starting precursors. The resulting CoMoO4@g-C3N4 composites exhibited superior photocatalytic efficiency in the Nitro-Mannich reaction under illumination with a 50 W blue LED light, outperforming pristine g-C3N4. Comprehensive characterization of these photocatalysts was conducted using assorted techniques including FTIR, XPS, XRD, HR-TEM, EDX, Mott-Schottky analysis, EIS, and UV−Visible DRS analysis. Among all these prepared catalysts, CoMoO4@g-C3N4 (3%) catalyst demonstrated exceptional performance, achieving 98% benzaldehyde conversion with 79.22% product selectivity. Additionally, it displayed excellent stability, with negligible activity loss after five successive recycling runs.



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PP-33

SYNTHESIS, CHARACTERIZATION AND MESOMORPHIC BEHAVIOUR OF FURAN BASED CHALCONE COMPOUNDS

Kashyap Patel, Dr. Kiran Nakum*

Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara-390002.

patel.kashyap14696@gmail.com

A series of twelve new (E)-1-(4-(((E)-4-(alkoxy)-2-hydroxybenzylidene)amino)phenyl)-3-(furan-2-yl)prop-2-en-1-one **FS-(2-18)**. Furan based chalcone - liquid crystals have been prepared and investigated for their mesomorphic properties. Each compound differs from each other by the alkoxy chain length varies between carbon n=2 to n=18. Proposed molecular structures of the prepared compounds were confirmed via elemental analysis, FT-IR, and ^{1}H NMR & ^{13}C NMR, and Mass, spectroscopy. The mesomorphic behaviour, optical properties and thermal stability of all new compounds have been investigated by polarized optical microscopy (POM), differential scanning calorimetry (DSC) analysis. Characteristic textures of smectic C and Nematic phase were observed for all new mesogenic compounds. The compounds from butyloxy to hexyloxy derivatives are non-mesogenic while heptyloxy to octadecyloxy derivatives are mesogenic. The compounds from heptyloxy to dodecyloxy derivatives exhibited monotropic nematic phase while compounds from tetradecyloxy to octadecyloxy derivative showed monotropic Smectic C phase.

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PP-34

BIOPOLYMER STABILIZED ZERO-VALENT IRON NANOPARTICLES AS MAGNETIC CATALYST FOR RAPID REDUCTION OF NITROAROMATICS

Miraj Patel[a], Sonal Thakore[a]*
Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara 390 002, India
chemistry2797@yahoo.com , *sonal.thakore-chem@msubaroda.ac.in*

The reduction of nitroaromatics such as p-nitrophenol (p-NP), 2,4-dinitrophenol (2,4-DNP), and 2,4,6-trinitrophenol (2,4,6-TNP) is of synthetic importance. Traditional catalysts often prove to be expensive and require harsh conditions. This research introduces an economical catalyst utilizing zerovalent iron (ZVI). The use of UV-Vis spectrophotometry for reaction monitoring provides a practical and accessible alternative to more complex techniques such as NMR, GC, or HPLC, making this approach suitable for widespread application. The findings underscore nZVI as a cost-effective, magnetically recoverable, recyclable, and eco-friendly for the reduction of nitroaromatic substances.

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PP-35

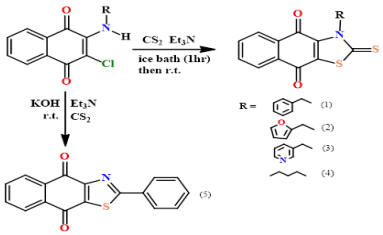
FORMATION OF Δ4-THIAZOLINE-2-THIONES BY INTRAMOLECULAR CYCLISATION OF DITHIOCARBAMATE VIA MICHAEL SUBSTITUTION AND THIAZOLE BY BASE CATALYSED UNUSUAL SUBSTITUTION REACTION

Aniket A. Deshmukh,[a] Sanjay K Verma,[a] and Vinay K. Singh.[a*]

[a] Department of Chemistry, Faculty of Science, The M. S. University of Baroda, Vadodara- 390002, India.

vinay.singh-chem@msubaroda.ac.in

A novel one-pot synthesis of cyclic organosulfur compounds (**1-4**) was investigated in the presence of carbon disulfide (CS_2) and triethylamine (Et_3N). This study successfully yielded a series of thermodynamically stable cyclic dithiocarbamates, expanding the scope of sulfur-containing heterocycles. Remarkably, in the presence of potassium hydroxide (KOH), the reaction exclusively produced compound **5**, whereas its absence resulted in the selective formation of compound **1**. Plausible mechanisms for both transformations have been proposed. All the compounds have been characterized by microanalysis and standard spectroscopic methods such as ^1H and ^{13}C NMR, IR, and UV-visible absorption spectroscopy. The molecular structures for all compounds (**1-5**) were elucidated by single crystal X-ray diffraction (SCXRD) and the structures of the cyclized products were confirmed. Compounds **1**, **3**, and **5** crystallized in a monoclinic crystal system, while compounds **2** and **3** exhibited a triclinic crystal system.[1,2]



Scheme 1. Development of decorative cyclic organosulfur compounds.

The photophysical properties of all compounds were investigated using UV-visible absorption spectroscopy, fluorescence emission studies, and thermogravimetric analysis. The synthesized compounds were evaluated for their antibacterial activity using the Broth dilution method against two Gram-positive bacteria (*S. aureus and B. subtilis*) and two Gram-negative bacteria (*E. coli and P. aeruginosa*). Additionally, their antifungal activity was assessed against C. *albicans and A. niger*, with compound concentrations ranging from 10 µg to 600 µg. This work provides a straightforward approach for the efficient synthesis of previously unreported cyclic dithiocarbamate and thiazole derivatives, offering valuable insights into their potential applications in organic and medicinal chemistry. [3,4]

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PP-36

EXPERIMENTAL OPTIMISATION OF BIODIESEL YIELD FROM NON EDIBLE OIL USING RESPONSE SURFACE METHODOLOGY

Kunal P. Argade[1], Jharna Gupta[1]*, Nitin Bhate[1] and Nikul K. Patel[2]

[1] Department of Chemical Engineering, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, India – 390002

[2] Department of Mechanical Engineering, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, India – 390002

jharnagupta-chemengg@msubaroda.ac.in

In the present study, we investigated the low-cost biodiesel production by transesterification of Mahua seed oil by using a homogeneous catalyst [1]. Comparative studies of different homogeneous catalysts (KOH, NaOH and CH_3ONa) at lab scale regarding catalytic activity and highest biodiesel yield were performed as shown in figure 1. The results revealed that NaOH was more effective than KOH and CH_3ONa, producing a yield of 93%. The optimized conditions for the NaOH-catalyzed transesterification reaction were 0.4 gm NaOH, 1:6 oil to methanol molar ratio, 60°C reaction temperature, and 60 minutes reaction time. The Response Surface Methodology (RSM) based Central Composite Design (CCD) was used in Design of Experiments (DOE) software to optimize the various transesterification process variables such as reaction temperature, amount of catalyst, and oil to molar ratio to evaluate their effect on biodiesel yield as shown in figure 2 [2]. A quadratic model was created for the prediction of Biodiesel yield [3]. The model's R^2 score was 0.96, showing a satisfactory level of accuracy. A reaction temperature of 55 °C, a methanol-to-oil molar ratio of 6:1, a NaOH catalyst concentration of 0.4 gm, and a reaction duration of 50 minutes were found to be the optimised parameters. The estimated and actual biodiesel yields under these circumstances were 93.49% and 95.0%, respectively. After this a small-scale reactor (5 litre capacity) was fabricated for biodiesel production as shown in figure 3 and experiments were performed under these optimal conditions and the obtained yield was 96% which is more than the lab scale yield. The quality of produced biodiesel was evaluated according to the ASTM D6751 standard which was found within the acceptable limits [4]. Further GC-purity analysis of biodiesel was also done for biodiesel characterisation [5]. These values and characterization experimentally satisfied the accuracy of the model.

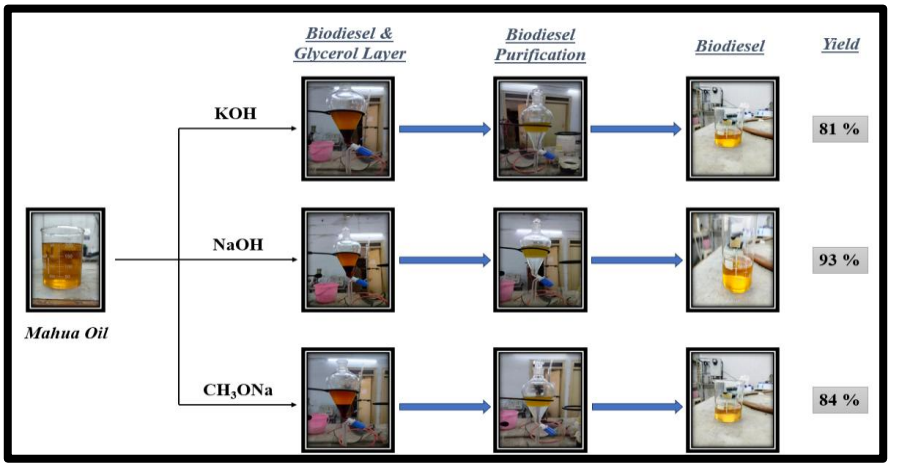
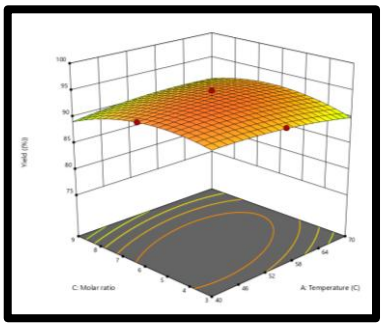
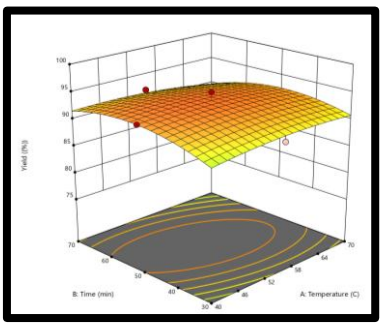


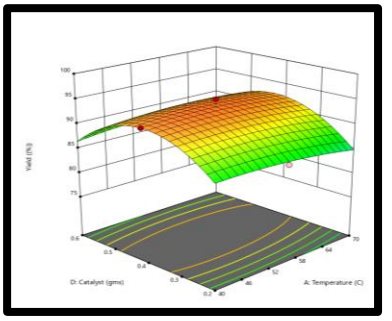
Figure 1: Biodiesel Production using Homogeneous Catalyst



(a)



(b)



(c)

Figure 2. Effect of reaction parameters on biodiesel yield (a): 3D plot for the temperature and time impact on biodiesel yield (b): 3D plot for the interaction impacts of the reaction temperature and the molar ratio on the yield of biodiesel.(c): 3D plot for the influence of catalyst concentration as well as temperature on biodiesel yield.

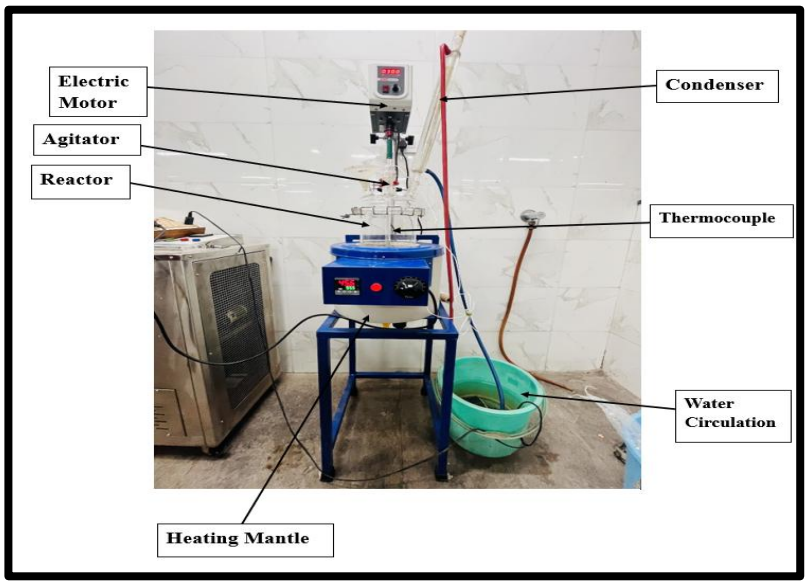


Figure 3 Biodiesel Production on Small Scale reactor setup

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PP-37

RATIONALLY DESIGNED POLYMER-SUPPORTED PD(II) CATALYST FOR SELECTIVE ORTHO-C(SP^2)–H HALOGENATION OF ACETANILIDE AND ANILINE DERIVATIVES: SYNERGISTIC EXPERIMENTAL AND DFT INVESTIGATIONS

Akash V. Gujarati, Dr. Divyesh K. Patel*

Department of Chemistry, Faculty of Science,

The Maharaja Sayajirao University of Baroda, Vadodara-390002.

gujratiakash004@gmail.com

In this work, 4-((4-methylbenzyl)oxy)benzaldehyde resin supported $Pd^{(II)}$-Schiff base PS@$Pd(OAc)_2$ has been synthesized. FT-IR, XPS, TGA, ICP-MS, and Powder XRD established the structure of PS@$Pd(OAc)_2$. The morphology and distribution of elements on PS@$Pd(OAc)_2$ were determined by SEM, TEM, and Elemental Mapping analysis. The heterogenized PS@$Pd(OAc)_2$ catalyst was found to promote selective *ortho*-halogenation of acetanilide and Aniline derivatives. In this reaction, this catalyst exhibits a distinct synergistic effect. The significant mass-transfer limitation results from a nonsignificant distribution of active sites amalgamated with the crumpling of catalysts, which facilitates the smooth, easy movement of the reactants and products toward the well spaced active catalytic sites on the catalyst's surface. These characteristics increase the catalytic activity of PS@$Pd(OAc)_2$. Moreover, the catalyst was found to be quite robust for this reaction with very less metal leaching and thus it can be efficiently recycled. Hence, multiple uses were established and its reusability proved in this important reaction.

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PP-38

SPIN-SYMMETRY DRIVEN ANISOTROPIES IN ALTERMAGNETIC MATERIAL MnF_2: A DENSITY FUNCTIONAL THEORY STUDY

Apeksha Gauswami*, and Prafulla K. Jha.
Department of Physics, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India-390002.
apeksha.g-phyphd@msubaroda.ac.in

Altermagnets are a class of compensated magnets characterized by spin symmetry groups that permit alternating spin polarizations in both the real-space crystal lattice and the momentum-space electronic structure [1]. In these materials, the anisotropic local crystal environment of different sublattices lowers the system's symmetry, ensuring that opposite-spin sublattices are connected solely through rotational symmetries. This structural configuration gives rise to an unconventional spin-polarized band structure in momentum space. The reduced symmetry of the crystal structure is expected to manifest in the anisotropy of the anomalous Hall effect (AHE) [2]. The AHE arises in solids with broken time-reversal symmetry as a direct consequence of spin-orbit coupling (SOC). Both experimental and theoretical studies have significantly advanced our understanding of this phenomenon, replacing earlier controversies with a more comprehensive framework. The interaction between experimental and theoretical approaches has played a key role in elucidating the underlying mechanisms governing AHE. In this study, we investigate the structural, electronic, and spin-transport properties of MnF_2, a candidate altermagnetic material [3], using first-principles density functional theory (DFT) calculations. Initially, we examine the influence of SOC on spin-splitting in the band structure of MnF_2. Our calculations reveal that the three anomalous Hall conductivity (AHC) components exhibit a vanishing sign in σ_{yz}, while non-zero values are observed for σ_{xz} and σ_{xy}, highlighting the anisotropic nature of the AHE in this material. Additionally, we compute the spin-resolved density of states (DOS) to analyze the contributions of spin-up and spin-down states. Furthermore, the dynamical stability of the studied material, a critical factor for their practical applications, is evaluated through phonon dispersion analysis. Our results indicate that MnF_2 exhibits real phonon frequencies throughout the entire Brillouin zone, confirming its dynamical stability [4]. Our findings underscore the key contributions to AHC from band crossings and symmetry-driven anisotropies in the electronic structure. The distinct nature of anomalous Hall transport in altermagnets, as demonstrated in this study, highlights their potential for spintronics and low-dissipation electronic applications. These results pave the way for further exploration of altermagnetic materials in next-generation electronic devices.

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PP-39

SYNTHESIS, CHARACTERIZATION AND APPLICATION OF POLYETHYLENE TEREPHTHALATE BASED POLYESTER RESIN WITH JUTE FIBER REINFORCED COMPOSITE

Pragnesh Rathva[1], Meet Patel[2] , Lata Raj[3]

[1,3] Shri C.N.P.F. Arts & D.N. Science College, Dabhoi, Vadodara, Gujarat, India.

[2]Institute of Science & Technology for Advanced Studies & Research (ISTAR), The CVM University Vallabh Vidyanagar-388120, Gujarat, India.

pragneshrathva5213@gmail.com

Polymer is the most important material for our life, but with the increase in the use of polymer materials, the wastage of this material is also increasing and it is the most effective issue of society. In this research study, an attempt has been made to use polymer waste in value added production through chemical recycling methods. Polyethylene terephthalate was recycled using the glycolysis method. The use of glycolysis product was used in synthesis of unsaturated polyester resins in presence of anhydride and dibasic acid by condensation polymerization method. As well as epoxy resin was synthesized using phenol, formaldehyde and epichlorohydrin. The characteristics of glycolysis product, unsaturated polyester resin and epoxy resin were determined by spectral, thermal and physical methods. Synthesized both resins were used in matrix materials and jute fiber was used as reinforcing material in composite formation. All the composites were studied for chemical, thermal and mechanical properties.

PP-40

DESIGN AND SYNTHESIS OF COUMARIN HYBRIDS BASED DONOR-Π-ACCEPTOR COMPOUNDS FOR OPTOELECTRONIC APPLICATIONS

Jay Patel, Rina Soni, and Divyesh Patel*

Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara 390 002, India

*Divyesh.patel-chem@msubaroda.ac.in**

A series of donor-π-acceptor compounds featuring 6 and 7 amino coumarin derivatives linked to active methylene moieties was synthesized. Coumarin served as the electron donor and π-conjugated system, while barbituric acid functioned as the electron acceptor, enhancing the optoelectronic properties of the compounds. Optical characterization through UV-Visible absorption and fluorescence spectroscopy revealed notable features, while a CIE chromaticity diagram visualized their emission properties. Gaussian DFT studies provided insights into electronic structures, molecular orbitals, and charge transfer characteristics. The calculated hyperpolarizability values suggest potential applications in nonlinear optics, making these compounds promising candidates for optoelectronic and photonic devices.

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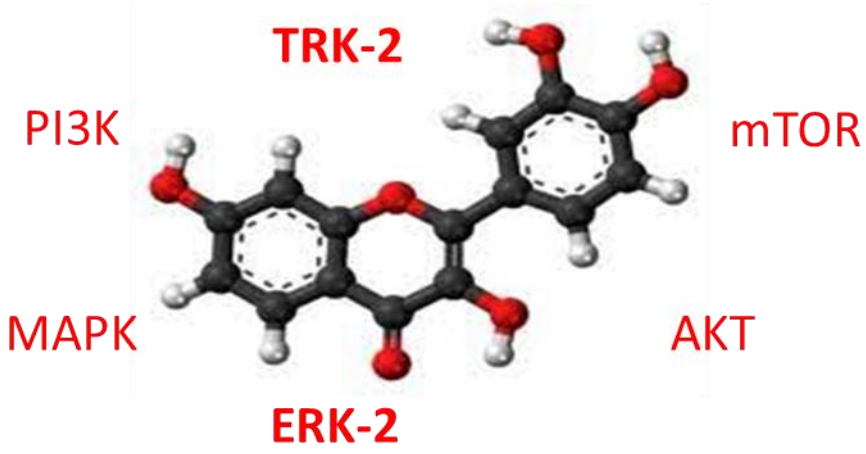
PP-41

SYNTHESIS OF FISETIN DERIVATIVE AS A TRK INHIBITOR

Tejas R. Parsaniya* and Divyesh Patel
Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara-390002
trparsaniyatr@outlook.com

Natural products are the source of inspiration for the development of new products for chemistry, pharmacy, and medicine. Fisetin is one of those natural molecules. As an aspect of our ongoing research in search of new anticancer drugs, a series of fisetin-based derivatives were synthesised and characterised. To implement our solution, we have started with a molecular docking study to identify the fisetin derivative with the highest affinity for a specific target, i.e., the Trk receptor; following this, we have used in vitro analysis through cell line (Sh-Sy-Sy neuroblastoma cell line) to understand anticancer properties.



Fisetin

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ABSTRACTS

PP-42

CURCUMINOID BASED SUPRAMOLECULAR VESICLES FOR pH TRIGGERED SUSTAINED RELEASE OF CAPECITABINE

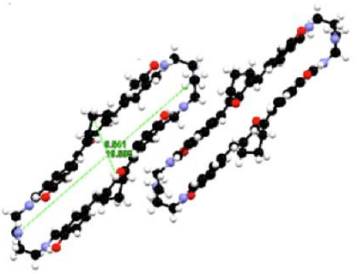
Priyanka Mathur [a], Meera Mori [a], Foram Patel [a], Darshee Baxi [a], Arpita Desai [a]*

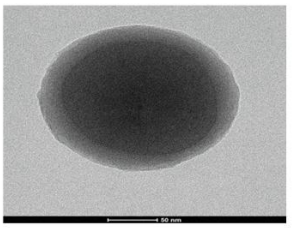
[a]Department of Chemistry, Faculty of Science, The Maharaja Sayajirao University of Baroda, Sayajigunj, Vadodara, Gujarat 390002, India

[b]Department of Biomedical and Life Sciences, School of Science, Navrachana University, Bhayli, Vadodara, Gujarat 391410, India

arpitasatishdesai@gmail.com

The second most prevalent type of cancer worldwide is breast cancer. The various treatments for breast cancer include chemotherapeutic medications, radiation therapy, and surgical resection. They change a number of normal gene activity and generally imparts local toxicity to patients suffering from breast cancer.[1] Because of their low toxicity, ability to interact with a variety of cancer-related targets, and effectiveness in eradicating cancer stem cells, natural products have gathered a lot of interest.[2] One such natural product, curcumin, has the capacity to influence the invasion and proliferation of breast cancer cells by inhibiting the genes that trigger NF-κB. We have created a macrocycle by condensation of 2, 6-bis((E)-4-hydroxy-3-formylbenzylidene) cyclohexan-1-one with N 1-(2-aminoethyl) ethane-1, 2-diamine. A new suparmolecular vesicle is created by selectively reducing and PEGylating the macrocyclic corand. Because PEG-diacid is flexible, the vesicle can create a water compartment and encapsulate the anticancer medication capecitabine in different ratios. The created systems showed a prolonged release of capecitabine under pH stimulus[3].





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PP-43

MUSHROOM BIOSORBENTS: A SUSTAINABLE SOLUTION FOR HEAVY METAL REMOVAL FROM WATER

Yashashwinee Badiger, Rizwan Chavda, K. Santhosh Kumar*, Naznin Shaikh*
Department of Chemical Sciences, School of Science, GSFC university, Vadodara. 391750.
naznin.pathan@gsfcuniversity.ac.in

Heavy metal contamination in water poses a severe environmental and health hazard, necessitating efficient and sustainable removal methods. Atomic Absorption Spectroscopy (AAS) is a widely used analytical technique for detecting and quantifying heavy metals in aqueous systems.

In this study, the potential of mushroom-based biosorbents for heavy metal removal from water was investigated. Mushrooms, rich in biopolymers such as chitin, proteins, and polysaccharides, exhibit excellent metal-binding capabilities through adsorption mechanisms involving ion exchange, complexation, and surface precipitation.

The efficiency of mushroom biomass in removing heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), and mercury (Hg) was assessed using AAS. Experimental results demonstrated significant metal uptake, highlighting the effectiveness of mushrooms as a low- cost, eco-friendly alternative to conventional adsorbents. This study emphasizes the applicability of mushroom-based biosorbents for water purification, contributing to the development of sustainable wastewater treatment technologies.

PP-44

SYNTHESIS AND CHARACTERIZATION OF BIO- PRECURSOR BASED SOLID PROPELLANT CATALYSTS

Rakesh Ranjan, Vijendra Kumar, Parvathy C, Abhilash KS, Deepa Devapal, Nallaperumal M

Analytical, Spectroscopy and Ceramics Group
Vikram Sarabhai Space Centre, Indian Space Research Organization,
Thiruvananthapuram, Kerala, India-695022
r_rakesh@vssc.gov.in

A cost-effective green synthesis method was adopted to synthesize the transition metal oxide micro-nanoparticles of iron/cobalt in different weight ratios using garlic cloves paste. The bio- precursor acts as reducing and stabilizing agent for the solid propellant catalysts. These catalysts are intended for thermal decomposition of ammonium perchlorate (AP) which is an oxidizer in the composite solid propellant. The thermo-catalytic activity of green synthesized catalysts towards decomposition of AP was comprehensively demonstrated by DSC-TGA techniques. The addition of phytochemically assisted mixed metal oxide catalysts exhibited a significant drop in decomposition temperature of AP, indicating excellent thermo-catalytic behavior of mixed metal oxides of cobalt/Iron. It can be observed that maximum drop in AP decomposition temperature was achieved for the iron/cobalt oxide catalyst in the ratio of 1:9. Propellant burn rate studies were carried out for Co/Fe oxide at 40 ksc using 0.25% catalyst. A burn rate of 8.07±0.05 mm/sec was obtained for Co/Fe (9:1) catalyst which is comparable to those commercial catalysts currently being used.

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