

22ND
EDITION OF

GLOBAL CONFERENCE ON
**CATALYSIS & REACTION
ENGINEERING**



*Advancing **Catalysis & Chemical Engineering**: From
Principles to Practice*

October 05-07, 2026 | Tokyo, Japan



IN-PERSON:

Hilton Tokyo Narita Airport
456 Kosuge Narita City Chiba 286-0127
Tokyo, Japan

VIRTUAL:

Central European Summer Time (CEST)

22ND EDITION OF

Global Conference on

CATALYSIS & REACTION ENGINEERING

HYBRID EVENT

05-07

OCTOBER 2026

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ABSTRACTS



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Keynote Speakers



Dai Yeun Jeong

Asia Climate Change Education Center,
South Korea



Enrico Paris

Council for Agricultural Research and
Economics (CREA), Italy



Guo-Wei He

TEDA International Cardiovascular Hospital,
China



Hanna Kierzkowska-Pawlak

Lodz University of Technology, Poland



Ram Sambhar Shukla

Central Salt and Marine Chemicals
Research Institute (CSIR), India



Sergey Suchkov

N.D. Zelinskii Institute for Organic Chemistry,
Russia



Stanislaw Dzwigaj

Sorbonne University, France



Thomas J Webster

Brown University, United States



Tokeer Ahmad

Jamia Millia Islamia, India

Keynote Speakers



Vladimer Tsitsishvili

Tbilisi State University, Georgia



Yarub Al-Douri

European Academy of Sciences, Belgium



Welcome Message

Dai Yeun Jeong

Asia Climate Change Education Center and
Jeju National University, South Korea

Dear CAT 2026 Visitors

We are delighted to invite you to the upcoming the 22nd Edition of Global Conference on Catalysis, Chemical Engineering & Technologies (CAT 2026) to be held in Tokyo, Japan during October 5-7, 2026.

The goal of CAT 2026 is to explore transformative developments in catalysis and chemical engineering through fundamental and applied aspects of this field. This goal is linked to strive to create inclusive and intellectually stimulating environments where professionals from diverse sectors can connect, share insights, and inspire progress.

The research on the theme of CAT 2026 goes beyond the simple technical realm of catalysis and chemical engineering and provides a foundation for restructuring the socioeconomic system through its contribution to the industrial sector. In this sense, it is no doubt that CAT 2026 is a vibrant platform to refresh your knowledge, spark new collaborations, and offer valuable networking opportunities with some of the most influential minds in the field.

We are actively looking forward to welcoming you to the CAT 2026 and collectively exploring the frontiers for expediting the future endeavors in catalysis and chemical engineering.



Welcome Message

Hanna Kierzkowska-Pawlak

Lodz University of Technology, Poland

Dear colleagues,

It is a great pleasure and honor to welcome you to this scientific forum devoted to catalysis and reaction engineering.

Catalysis plays a central role in addressing global challenges related to energy transition, CO₂ conversion and sustainable chemical processes. In this context, two issues are especially important: the development of nanocatalysts that are highly active, selective, and durable, and the ability to integrate them into forms compatible with modern reactor designs, including heterogeneous structured reactors. Our research has shown that cold plasma deposition offers a promising route to address both of these needs. It makes it possible to create nanocomposite coatings directly on 3D packings, transforming them into functional catalytic systems. At the same time, this method allows precise control over the molecular and nanostructure of the films, which is crucial for catalytic performance.

I hope that the ideas presented here will stimulate fruitful discussions and inspire new collaborations. Wishing you a successful and inspiring conference.

Welcome Message



Sergey Suchkov

N.D. Zelinskii Institute for Organic Chemistry, Russia

Dear Colleagues, Scientists, Bioengineers and Friends,

On behalf of the Organizing Committee, it is my pleasure to invite you from all over the world to Welcome to the 22nd Edition of Global Conference on Catalysis, Chemical Engineering & Technologies (CAT 2026), set to unfold in the historic city of Tokyo, October 5-7, 2026.

This event is contributing to the further improvement of global biocatalysis and chemical engineering in its very broad scope of fields, trends and applications, including medicinal chemistry, biochemistry and associated drug discovery, polymer biochemistry, surface and interface chemistry and even quantum chemistry. This highlights the multi- and interdisciplinary nature and very broad scope of biocatalysis and chemical engineering to provide all participants a catalytic opportunity to exchange ideas, learn from each other and initiate collaborations.

Keynote speeches will be given by distinguished scholars and experts from academic institutions and industry, and oral presentation by delegates and poster presentations by young junior participants.

This conference will provide excellent opportunity to establish highly productive relations and collaborations for future research and projects. Your participation and contributions are fundamental to the success of this conference. Together, we aspire not only to deepen our collective understanding but also to propel innovation within catalysis and design-driven chemical engineering.

We hope to see you all in grand Tokyo, to enjoy the event along with the exceptional beauty of the ancient and unique historical city. We extend a heartfelt welcome on this occasion and will have an appealing, exciting and unforgettable experience and thank you!

Welcome Message



Stanislaw Dzwigaj

Sorbonne University-CNRS, France

Dear congress visitors,

It is my honor and great pleasure to write a few welcome notes to you. Through centuries people were fascinated with the possibilities of synthesis of new materials with extraordinary properties. New materials are practically needed in all domains of life. Design and synthesis of new materials is one of the most important and interesting part of material sciences. Particularly a synthesis of new active and selective catalysts is a very important challenge. Our main aim concentrates on the new methods of the synthesis of single-site hierarchical porous zeolite catalysts with acid-base and redox properties. Such zeolite catalysts with active sites formed by incorporation of heteroelements in their framework are perspective as catalysts of protection of environment and biofeedstock conversion into valuable chemicals.



Welcome Message

Thomas J. Webster

Brown University, USA

Dear Colleagues and Friends,

Welcome to the 22nd Edition of the Global Conference on Catalysis, Chemical Engineering & Technology (CAT 2026)!

Without a doubt, recent advances in catalyst, chemistry, and chemical engineering have revolutionized numerous fields. But, how did this occur? Was your research part of these advancements? Have we innovated and commercialized such research enough? Are companies paying attention to this wonderful research? Are Universities helping you? What about your federal funding agencies? And, most importantly, are you in the right environment to innovate and commercialize your research? In my own experience, above all else, it takes a supportive environment. Find the right community. Find this conference.

I left the very negative, ultra-competitive, stifling Northeastern University in Boston over 5 years ago. I have never seen such negative, cut-throat, and miserable people in my 30-year career! Only after I moved did I find a truly supportive environment that allowed me to form over a dozen companies and yes, I found truly supportive people who value me and my contributions. Because I left Northeastern University, I have since commercialized my chemical engineering research into medical devices now in over 45,000 patients with no failures, only success!

So, I encourage everyone to find that right environment. Make that move. And attend the right conferences: CAT 2026 is such a conference where you will meet the right people! And be inspired, not discouraged like I was at Northeastern University for far too long! I, and the patients I have helped, wish we could get those years back!

It will change your life once you make the commitment to surround yourself with positive people. I know, because I lived it.

I look forward to seeing everyone to further share my story and give you that positive boost!



Welcome Message

Yarub Al-Douri

European Academy of Sciences, Belgium

The CAT 2026 is one of the specialized and reputed institutes nationwide. It is giving the task of improving the scientific achievements in catalysis and engineering, and working hardly on several areas related to science and engineering. CAT 2026 is to improve networking and presenting a platform for scientific discussions. It is organized to donate the scientists, engineers, academicians, researchers, students and companies an opportunity for presenting their latest research finding, discoveries, ideas and products to focus on its wide applications. With renowned speakers, qualified participants and industrial experts, CAT 2026 offers a valuable chance to all delegates to share, learn and exchange views, opinions and thoughts for the future of their respective research areas. It may generate to create links and network amongst established scientist and students from all over the world for the betterment of science and engineering to solve common problems and improve the future.



Welcome Message

Tsitsishvili Vladimer

Petre Melikishvili Institute of Physical and Organic Chemistry, Georgia

Dear Congress participants, it is a great honor for me to address you with greetings, which I do with joy and pleasure. Research into the catalytic properties of natural and synthetic zeolites has been ongoing for many years and remains relevant, and the use of Gas Chromatography - Mass Spectrometry methods for analyzing the resulting products, as well as the use of ultrasound to accelerate transformations, have become routine techniques. The oxidation of organic compounds is so well studied that it seems possible to predict any transformation, the entire spectrum of target and byproducts. However, classical ideas are not always justified, as we will attempt to demonstrate in our report on the oxidation of 4-methoxytoluene.

Welcome Message



Guo Wei He

TEDA International Cardiovascular Hospital, China

It is a great honor and privilege to welcome you all to the 22nd Edition of the Global Conference on Catalysis, Chemical Engineering & Technology (CAT 2026). Under the theme Advancing Catalysis & Chemical Engineering: From Principles to Practice, our goal is to bridge fundamental research with industrial application. The field is advancing at an unprecedented pace, and now is the perfect moment to foster collaboration across disciplines. We trust that our rich program of keynote presentations, oral sessions, and interactive workshops will offer you valuable opportunities to share insights and build lasting networks. I extend my deepest gratitude to the Organizing Committee, sponsors, speakers, and each of you for making this gathering possible. I look forward to the inspiring discussions ahead as we work together to shape the future of catalysis and sustainable chemical technologies.

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About Magnus Group About

Magnus Group, a distinguished scientific event organizer, has been at the forefront of fostering knowledge exchange and collaboration since its inception in 2015. With a steadfast commitment to the ethos of Share, receive, grow, Magnus Group has successfully organized over 200 conferences spanning diverse fields, including Healthcare, Medical, Pharmaceuticals, Chemistry, Nursing, Agriculture, and Plant Sciences.

The core philosophy of Magnus Group revolves around creating dynamic platforms that facilitate the exchange of cutting-edge research, insights, and innovations within the global scientific community. By bringing together experts, scholars, and professionals from various disciplines, Magnus Group cultivates an environment conducive to intellectual discourse, networking, and interdisciplinary collaboration.

Magnus Group's unwavering dedication to organizing impactful scientific events has positioned it as a key player in the global scientific community. By adhering to the motto of Share, receive, grow, Magnus Group continues to contribute significantly to the advancement of knowledge and the development of innovative solutions in various scientific domains.

About CAT 2026

About

The **22nd Global Conference on Catalysis & Reaction Engineering (CAT 2026)** will take place from **October 5-7, 2026**, at **Tokyo, Japan**, with an option for virtual participation. The conference will bring together catalysis researchers, chemical engineers, scientists, academics, industry professionals, and technology experts from around the world.

Under the central theme **Advances and Innovations in Catalysis & Reaction Engineering**, CAT 2026 provides a global platform for sharing knowledge, presenting innovative research, and exploring emerging technologies shaping the future of catalysis and chemical engineering.

The hybrid conference will feature **keynote lectures, technical presentations, scientific discussions, industry insights, and networking opportunities**, covering topics including heterogeneous and homogeneous catalysis, photocatalysis, biocatalysis, electrocatalysis, nanocatalysts, catalyst design, reaction engineering, reactor design, green chemistry, sustainable catalysis, computational catalysis, artificial intelligence, energy conversion, hydrogen production, carbon capture and utilization, biomass conversion, and environmental catalysis.

CAT 2026 encourages collaboration between academia and industry, highlighting technological advancements, practical solutions, sustainable processes, energy-efficient technologies, and innovative catalytic approaches addressing global challenges in chemical and energy-related industries.

About CPD Accreditation About

CAT 2026 is officially accredited for Continuing Professional Development (CPD) by The CPD Group (UK), a globally recognized provider of continuing education certification. CPD accreditation ensures that professionals continue to enhance their knowledge, skills, and competencies through structured learning activities.

At CAT 2026, participants can earn 1 CPD credit for every hour of attendance in conference sessions. These credits formally recognize the time spent in professional learning and support ongoing professional development across scientific, academic, research, and industrial fields.

Earning CPD credits demonstrates a commitment to maintaining high professional standards and staying updated with the latest developments in catalysis and reaction engineering. CPD participation can also support career advancement, professional certification requirements, and academic or professional portfolios, depending on the policies of individual institutions or regulatory bodies.

In addition to educational value, the conference provides opportunities to engage with experts, researchers, and peers from around the world, encouraging knowledge exchange and professional networking.

Attending CAT 2026 not only offers a high-quality scientific learning experience but also provides internationally recognized CPD credits that reflect participants' dedication to continuous professional growth.

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KEYNOTE PRESENTATIONS





Dai-Yeun Jeong^{1,2}

¹Asia Climate Change Education Center, South Korea

²Jeju National University, South Korea

Biography: Dai-Yeun Jeong is presently the Director of Asia Climate Change Education Center and an emeritus professor of environmental sociology at Jeju National University in South Korea. Jeong received BA and MA degrees in sociology from Korea University, South Korea, and a PhD in environmental sociology from the University of Queensland, Australia. Jeong was a professor of environmental sociology at Jeju National University, South Korea from 1981 to 2012. Past major professional activities include a teaching professor at the University of Sheffield in the United Kingdom, the president of

the Asia-Pacific Sociological Association, a delegate of the South Korean Government to the United Nations Framework Convention on Climate Change (UNFCCC) and the Organisation for Economic Co-operation and Development (OECD) environmental meeting, and a member of the Presidential Commission on Sustainable Development, Republic of Korea. Jeong has published 60 environment-related research papers in domestic and international academic journals and 13 books including *Environmental Sociology*, and has conducted 100 unpublished environment-related research projects funded by domestic and international organizations.

The concept and implications of low-carbon green growth

Contemporary era is defined as a risky society in terms of environmental problems. As we know, the United Nations has adopted two important agendas towards the present and future socioeconomic development at a global level in relation to environmental problems since 1992 when Rio Summit was held. One is the ideology of sustainable development, and the other one is that climate change is placed at the top among various environmental problems in terms of its impact on nature and human society. The former is green growth toward the co-existence between nature and humans, while the latter is toward reducing carbon emission which is the human-induced contributor to climate change.

The former and the latter may be collectively represented as Low-Carbon Green Growth which is the current and future ideology and practice of socioeconomic development. In this context, this paper aims at defining the concept of low-carbon green growth, and examining its implications. The presentation will be composed of five parts as below.

Part 1: The mechanism of nature being polluted or destroyed will be explained. This is an explanation regarding the background of why the ideology and practice of low-carbon green growth emerged.

Part 2: The concept of low-carbon will be explained. The explanation will be done comparing similar concepts such as carbon-neutral, carbon-zero, and climate neutrality. In addition, how to approach low-carbon, carbon-neutral and carbon-zero will be explained.

Part 3: The concept of green growth will be explained. The explanation will be based on the concept defined by the Organisation for Economic Co-operation and Development (OECD), United Nations, and academia, and then the concepts will be synthesized.

Part 4: The implications of low-carbon green growth will be examined in terms of conceptual and practical aspect. The conceptual implications will be examined in relation to the concept of impact of climate change, because as explained above, sustainable development and climate change are the sources from which the ideology of low-carbon green growth was promoted. Meanwhile, the practical implications will be examined in relation to the strategies being launched for achieving low-carbon green growth.

Part 5: A wide range of strategies are required for achieving low-carbon green growth. As the concluding remark, what capacity should be built will be discussed in relation to the strategies to be launched.



Enrico Paris^{1*}, Monica Carnevale¹, Francesco Gallucci¹, Carmine Cava², Domenico Borello²

¹Council for Agricultural Research and Economics (CREA),
Center of Engineering and Agro-Food Processing, Italy

²La Sapienza University of Rome, Italy

Biography: Enrico Paris holds an MSc in Analytical Chemistry in 2017 and a PhD cum laude in Energy and Environmental Engineering in 2022 from Sapienza University of Rome, Italy, and has been serving as a Technologist at the LASER-B Laboratory, the Laboratory for Experimental Activities on Renewable Energy from Biomass, since 2022. Paris has also been a member of the Italian Association of Chemists and Physicists since 2020, and since 2024 has held the National Scientific Qualification as Associate Professor in the Italian higher education system, for the disciplinary field 07/C1, Agricultural,

Forest and Biosystems Engineering. Paris has collaborated on several national and European projects focused on the use of biomass in thermochemical conversion systems, is an active reviewer and editor for several international scientific journals and has contributed to the scientific committees of multiple international conferences. Paris is the author of 65 Scopus-indexed publications and holds an H-index of 12.

Influence of various catalysts on H₂ enhancement and CO₂ capture during syngas upgrading

Biomass gasification represents a promising thermochemical route for the valorization of agro-forestry residues, offering a sustainable alternative to conventional waste-management practices while enabling the production of a versatile fuel: syngas. This gas mixture, typically composed of H₂, CO, CO₂ and CH₄ in variable proportions, can be used for heat and power generation or as a precursor for the synthesis of value-added chemicals. However, the raw syngas derived from biomass gasification often contains undesired species and exhibits suboptimal H₂ concentrations, limiting both its energetic performance and its suitability for downstream applications. Catalyst-assisted syngas upgrading has therefore become an area of increasing scientific interest, as it provides a pathway to selectively enhance hydrogen content while reducing CO₂ and other unwanted components. Different classes of catalytic and adsorbent materials can promote reactions such as CO₂ capture, reforming of light hydrocarbons, and water-gas shift, ultimately leading to a cleaner and more hydrogen-rich syngas.

In this study, a controlled synthetic gas mixture with known concentrations of H₂, CO, CO₂, CH₄ and N₂ was employed to systematically investigate the behavior of several candidate materials, specifically CaO, MgO, CuO and Li₂ZrO₃. Experiments were carried out in a laboratory-scale reactor designed to evaluate the influence of material properties and operating conditions on syngas composition. The focus of the analysis was twofold: (i) to identify the extent to which

each material can enhance hydrogen concentration through catalytic or sorptive effects, and (ii) to examine the advantages, limitations and potential synergies associated with their use under conditions representative of biomass gasification environments. Beyond highlighting the materials' individual performance, the study contributes to a broader understanding of how solid catalysts and sorbents can support the development of more efficient, flexible and sustainable gasification-based energy systems.



Guo-Wei He^{1,2}

¹TEDA International Cardiovascular Hospital, Tianjin University, China

²The National Academy of Medicine, France

Biography: Guo-Wei He, MD, PhD, DSc, is Distinguished Professor of Tianjin University, China and Academician (Foreign Correspondence Member) at The National Academy of Medicine, France since 2019. Professor He is Vice President and Senior Cardiac Surgeon at TEDA International Cardiovascular Hospital, Tianjin University and Director of the Institute for Cardiovascular Diseases, Tianjin University and Chinese Academy of Medical Sciences. Professor He also holds Clinical Professor of Surgery at Oregon Health and Science University, Portland, United States since 2003. In addition, Professor

He is Director of the Branch Center for the National Clinical Research Center for Cardiovascular Disease and Director of the Tianjin Key Laboratory for Molecular Regulation and Translational Medicine of Cardiovascular Diseases. Professor He obtained a Doctor of Science in 2003 and a PhD in 1989 from Monash University, Melbourne, Australia. Professor He was Chair Professor of Cardiothoracic Surgery, University of Hong Kong from 1995 to 2000, Research Chair Professor, Chinese University of Hong Kong from 2000 to 2009, and Director of Cardiovasc Res Lab, St Vincent Hospital, Portland, United States from 1994 to 2012. Professor He is an active cardiac surgeon and has performed more than 7,000 open heart operations, ranks in the top 0.05% of all scholars worldwide (ScholarGPS), is listed among the World's Top 2% Scientists from 2019 to 2024 by Stanford University, and holds an H-index of 57, in the world top 1%. Professor He ranks in the world's top 1% in Medicine, Chemistry, Genetics and Molecular Biology, and is a Highly-Cited Chinese Scholar in Clinical Medicine (Elsevier 2024).

Post-translational modifications of proteins in cardiovascular diseases

Protein post-translational modifications, particularly reversible lysine acylation, have emerged as critical arbiters of cardiac homeostasis and disease. Our group has systematically employed quantitative Post-Translational Modification (PTM) proteomics to elucidate the roles of propionylation, crotonylation, and 2-hydroxyisobutyrylation in human atrial fibrillation, coronary artery bypass grafts, and cardiac hypertrophy. These studies uncover precise molecular mechanisms through which site-specific acyl modifications dictate cardiac energetics, redox balance, and electrophysiology, offering novel therapeutic targets.

In patients developing new-onset postoperative atrial fibrillation following coronary bypass surgery, we constructed the first lysine propionylome of human right atrium. We discovered that propionylation of ALDH6A1 at Lys113 is elevated 2.25-fold, which enhances its binding to NAD⁺, elevates NADH levels, and drives Reactive Oxygen Species (ROS) accumulation. This

ALDH6A1-NADH-ROS axis creates a pro-arrhythmic oxidative environment that promotes the initiation of postoperative atrial fibrillation.

To address the differential long-term patency of arterial versus venous coronary grafts, we performed paired crotonylome analysis of internal thoracic artery and saphenous vein segments from 150 patients. Vein grafts demonstrated significantly higher crotonylation levels on the anti-oxidative enzymes thioredoxin (K3), glyoxalase 1 (K157), and GAPDH (K61), which depressed their enzymatic activities, leading to methylglyoxal accumulation and severe oxidative stress. Strikingly, pharmacological inhibition of the crotonyltransferase CBP or overexpression of the decrotonylases HDAC1/3 restored enzyme function and mitigated oxidative damage. These findings demonstrate that epigenetic modulation of crotonylation may possibly arterialize vein grafts to improve long-term patency.

In chronic atrial fibrillation, we mapped the 2-hydroxyisobutyrylome of human atrial tissue and identified decreased 2-hydroxyisobutyrylation of hexokinase-1 at K418. This modification impairs glucose binding and glycolytic flux, reducing ATP production. The resultant energy deficit upregulates the KATP channel subunit Kir6.2, enhances KATP current, and shortens atrial action potential duration, thereby directly coupling a single PTM site to the electrical remodeling that sustains the arrhythmia.

Using Sirt1 cardiac-specific knockout mice, we demonstrated that loss of this deacylase causes hypercrotonylation of SERCA2a at Lys120. The modification weakens ATP binding, depresses sarcoplasmic reticulum calcium re-uptake, and precipitates cardiac hypertrophy, systolic dysfunction, and arrhythmias. This mechanism illustrates how a defect in PTM eraser activity can translate into profound structural and functional heart disease.

Collectively, these investigations establish that site-specific lysine acylations function as molecular switches on key metabolic, anti-oxidative, and ion-handling proteins, directly governing cardiac pathophysiology. The regulatory enzymes—sirtuins, CBP/p300, and HDACs—emerge as tractable therapeutic targets. Our comprehensive review further details how the crosstalk among diverse acylations (acetylation, crotonylation, propionylation, lactylation, malonylation, succinylation, and lipidation) drives cardiac hypertrophy through chromatin remodeling and metabolic reprogramming, highlighting the promise of isoform-specific enzyme modulators. These insights pave the way for PTM-directed precision medicine strategies, including small-molecule agents and gene-editing approaches that precisely target individual acylation sites, to combat atrial fibrillation, vein graft disease, and heart failure.



Hanna Kierzkowska-Pawlak

Lodz University of Technology, Poland

Biography: Hanna Kierzkowska-Pawlak is a full professor of chemical engineering at the Faculty of Process and Environmental Engineering Lodz University of Technology. In 2016–2017, Kierzkowska-Pawlak was a visiting researcher at Shizuoka University, Japan. Research focuses on catalytic CO₂ conversion to value-added chemicals and advancing absorption technologies for CO₂ capture. Kierzkowska-Pawlak is an expert in cold plasma methods for the fabrication of new thin-film nanocatalysts for environmental applications and applies plasma techniques to material surface engineering, has served as

an evaluator for the European Commission in FP7-ENERGY, Horizon 2020 and Horizon Europe calls, and since 2019 has been Chair of the Chemical Engineering Discipline Council at Lodz University of Technology.

Plasma-deposited nanocomposite thin films as integrated catalytic systems on structured packings: Concepts and applications

Cold-plasma deposition has emerged as a powerful tool for engineering thin-film nanocomposite catalysts with precisely controlled nano-, molecular, and electronic structures, enabling their use as fully integrated catalytic systems on structured packings. This strategy aligns with the catalyst-by-design concept by combining rational materials design with practical engineering aspects: the catalyst can be fabricated as a thin film deposited directly onto a variety of materials and complex-shaped supports, without altering its original geometry. The proposed approach provides a straightforward route to advanced gas-phase and gas-liquid reactors, where the structured packing retains its hydrodynamic and mechanical properties while acquiring tailored catalytic functionality.

Here, recent developments in plasma-deposited nanocomposite thin films fabricated using Plasma-Enhanced Chemical Vapor Deposition (PECVD) are presented, including CoO_x, CuO_x, NiO_x, and FeO_x-based materials, as well as nanohybrids such as CoO–WO₃ and CoO–FeO_x. These materials were deposited as uniform thin films (<1 μm) on calcined Kanthal meshes and plates, creating scalable catalytic packings suitable for different applications such as CO₂ hydrogenation, hydrocarbon combustion, CO₂ hydration, and wastewater ozonation.

Among the tested catalysts, cobalt-based nanomaterials have been studied most extensively due to the multiple oxidation states and nanostructures of CoO_x, which provide catalytic versatility across different processes. CoO_x-based nanocomposites have shown high activity in hydrocarbon combustion and CO₂ methanation. When applied to structured

packings, they outperform conventional catalytic materials and enable stable operation in laboratory-scale reactors. The nanohybrid systems such as CoO-WO_3 and $\text{CoO}_x\text{-FeO}$, tested in CO_2 hydrogenation, reveal that their catalytic behavior is not additive but governed by nanoscale heterojunctions formed between the two different metal oxides, leading to a drastic change in CO and CH_4 selectivity compared with the corresponding single-metal-oxide nanocomposite.

Together, these results demonstrate that cold-plasma deposition provides a versatile route for designing catalytic thin films on structured packings. By precise control of their structure, plasma-engineered nanocomposites enable high-performance catalytic systems for advanced reactor design in applications such as CO_2 and hydrocarbon conversion and wastewater treatment.



Ram Sambhar Shukla

Central Salt and Marine Chemicals Research Institute, Council of Scientific and Industrial Research (CSIR), Bhavnagar, India

Biography: Ram Sambhar Shukla received BSc in 1975, MSc in 1977 and PhD in 1981 degrees and PDF of CSIR from 1981 to 1983 from University of Allahabad, India and joined the Inorganic Materials and Catalysis Division of CSIR-Central Salt and Marine Chemicals Research Institute, Bhavnagar, India as research scientist in 1983. Specializations include catalyst materials, green organic transformations of O_2 , CO_2 , CO , H_2 and CH_4 , and high temperature-pressure material and catalysis. Shukla is a Life Member of the National Academy of Sciences India, Allahabad and the Catalysis

Society of India, Madras, was a Member of Indian Reference Materials, Delhi and was Chairman (Alternate) of the Inorganic Materials Sectional Committee of the Bureau of Indian Standards, Delhi. As a Bilateral Exchange of Scientists awardee Shukla visited France (CNRS, 1993) and Korea (KOSEF, 2002) for collaborative research on C-H and CO_2 respectively, was awarded brain pool scientist in 2011 and researched in Korea on utilization of CO_2 as soft oxidant. Shukla has performed as faculty Professor for the PhD course of the Academy of Scientific and Innovative Research (AcSIR) and of Bhavnagar University, is a reviewer for reputed journals for materials and catalysis and a PhD examiner for Indian universities, and is credited with 100 papers, 5 patents, 2 reviews, 4 books and chapters, 54 invited lectures, 23 international and 73 national conferences, 17 students guidance and 20 research projects.

Advances in heterogeneous catalysis for green conversion of propene to aldehydes and alcohols

Conversion of propene to aldehydes and alcohols are industrially important reactions and are carried out by hydroformylation of propene using syn gas, a mixture of carbon monoxide and hydrogen gases. Propene hydroformylation to n-butanal had a great commercial importance, because from the total hydroformylation production capacity (8.8 million tons/year), ~86% is based on propene hydroformylation. The industrial application of n-butanal is to use it as a vital chemical intermediate to produce plastics, resins, solvents and rubber accelerators. Propene hydroformylation is industrially practiced under homogeneous conditions using cobalt and rhodium metal based catalysts. Homogeneous catalysis has limitations of the separation of the cost effective metal based catalysts and products. Heterogeneous catalysis has the potential benefit of easy separation and recycling of the catalyst as well as easy purification of the products.

About 60% of world consumption of n-butanal, obtained from propene hydroformylation, is converted to 2-ethylhexanol. 2-ethylhexanol is a valuable intermediate for the chemical industry in the production of dioctyl phthalate, other plasticizers, coatings, adhesives,

lubricants, fine and specialty chemicals. In the existing commercial process, the synthesis of 2-ethylhexanol from propene is carried out in three steps, with three different catalysts: hydroformylation (Rh/Co), aldol condensation (NaOH/KOH) and hydrogenation (Ni/Cu), which has drawbacks: (i) three steps process is uneconomical from industrial and energy perspectives, (ii) use of hazardous reagents liquid KOH/NaOH in large amount for the aldol condensation step, and problem of their effluent in disposal, and (iii) handling of liquid base and post synthesis work-up in separation of spent KOH/NaOH from reactants and products increases the capital as well production cost of 2-ethylhexanol. In this existing commercial homogeneous catalytic process the spent liquid base generated after the reaction is in the range of 1.0 to 1.5 ton, for every 10 tons of product. This causes a huge cost of 30%, spending for cleaning and recycling the liquid base.

To overcome these drawbacks, a novel multi-functional catalyst, [HF/HT], synthesized by impregnation of inorganic metal complex, $\text{HRh}(\text{CO})(\text{PPh}_3)_3$ [HF] on a solid soft base hydrotalcite, $(\text{Mg}_{1-x}\text{Al}_x(\text{OH}_2)_{x+}(\text{CO}_3^{2-})_{x/n}) \cdot m \text{H}_2\text{O}$ [HT], is developed by us, and this had effectively performed the effective heterogeneous catalysis of hydroformylation, aldol condensation and hydrogenation in a single pot. In the heterogeneous catalyst [HF/HT], the soft solid base hydrotalcite [HT] effectively afforded to play dual role as support as well as base, thereby potentially avoiding the use of strong liquid base NaOH/KOH, during the synthesis of 2-ethylhexanol from propene. The heterogeneous catalyst [HF/HT] had potentially made the synthesis of aldehydes and alcohols from propene, green, economic and environment friendly. Present key talk will account the detailed investigations performed for the said multifunctional catalyst system involving the synthesis, characterization of the catalyst, catalysis, kinetic and future aspects of the reactions of propene with synthesis gas.

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Biography: Sergey Suchkov was born in the City of Astrakhan, Russia, in a family of dynasty medical doctors. In 1980 Suchkov graduated from Astrakhan State Medical University and was awarded MD, in 1985 maintained a PhD as a PhD student of Sechenov University and the Institute of Medical Enzymology, and in 2001 maintained a Doctor Degree at the National Institute of Immunology, Russia. From 1989 to 1995 Suchkov was Head of the Lab of Clinical Immunology, Helmholtz Eye Research Institute in Moscow, and from 1995 to 2004 Chair of the Dept for Clinical Immunology, Moscow Clinical Research Institute

(MONIKI). At present Sergey Suchkov, MD, PhD, is Professor in Medicine and Immunology and Director of the Center for Biodesign of N.D. Zelinskii Institute for Organic Chemistry, Russian Academy of Sciences, Moscow, Russia; R&D Director, InMedStar, Russia-UAE; Senior Scientific Advisor of China Hong Kong Innovation International Business Association, Hong Kong; and Secretary General, United Cultural Convention, Cambridge, United Kingdom. Suchkov is a member of the New York Academy of Sciences, USA; EPMA, Brussels; ISPM, Japan; PMC, Washington DC, USA; AMEE, Dundee, Scotland; ACS, Washington DC, USA; AHA, Dallas, TX, USA; ARVO, Rockville, MD, USA; and ISER, Anchorage, AK, USA.

Personalized and Precision Medicine (PPM) as a unique healthcare model *via* biodesign, bio- and chemical engineering, translational applications, and upgraded business modeling to secure the human healthcare and biosafety

Traditionally a disease has been defined by its clinical presentation and observable characteristics, not by the underlying molecular mechanisms, pathways and systems biology-related processes specific to a particular patient, ignoring persons-at-risk. A new systems approach to subclinical and diseased states and wellness resulted in a new trend in the healthcare services, namely, Personalized and Precision Medicine (PPM).

Translational researchers, bio-designers and bioengineers, bio-manufacturers and bio-market experts are beginning to realize the promise of PPM, translating to direct benefit to patients or persons-at-risk. And across worldwide basic, translational, clinical and applied research, and throughout the bio-industries, scientific breakthroughs have been the launching point for principal bioproduct developments in the translational trajectory. For instance, companion diagnostics tools, theranosticums and targeted therapies and biomarkers represent important stakes for the pharma, in terms of market access, of return on investment and of image among the prescribers. At the same time, they probably represent only the generation of products resulting translational research and applications. So,

developing medicines and predictive diagnostic tools requires changes to traditional clinical trial designs, as well as the use of innovative and adaptive testing procedures that result in new types of data.

Nanobio applications are as diverse as sustainable energy, regenerative medicine, biomedical imaging, drug and vaccine delivery, and personalised medicine. The impact of these new technologies will be felt across a wide range of endeavours, from therapeutic and tissue regeneration products, to bioderived consumer products and environmental applications. Of particular interest is nanotechnology research at the biointerface, including nanoparticles developed to detect pre-early cancer biomarkers, smart surfaces mimicking conditions in the body and encouraging high rates of stem cell production, and the engineering of cells to produce the building blocks for plastics.

Making the best use of those innovations and being ready to demonstrate results for regulatory bodies requires specialized knowledge that many clinical development teams don't have. The areas where companies are most likely to encounter challenges, are data analysis and workforce expertise, biomarker and diagnostic test development, and cultural awareness. Navigating those complexities and ever-evolving technologies will pass regulatory muster and provide sufficient data for a successful launch of PPM, is a huge task. So, partnering and forming strategic alliances between researchers, bio-designers, clinicians, business, regulatory bodies and government can help ensure an optimal development program that leverages the academia and industry experience and the FDA's new and evolving toolkit to speed our way to getting new tools into the innovative markets.

The global biotechnology market integrating biodesign, bioengineering and biomanufacturing, is driven by government initiatives owing to the growth of the design-based biotechnology sector. Government initiatives are oriented towards modernizing the drug regulatory pathway, standardizing clinical studies, improving reimbursement policies, and speeding up the product approval process, thereby offering lucrative growth opportunities to the market.

In this sense, the new-age business ventures are more idea-centric and not just product-based. The key to success in business is not just inheritance; it is creation of more wealth and the constant innovation, from the prevailing to the next best practices. An entrepreneur, typically, is inspired to start a business because the entrepreneur perceives a consumer need that is not being adequately filled. Bio-entrepreneurship can be described as a process of action an entrepreneur undertakes to establish a biodesign- and bio-industry-related enterprise being based on a set of the transdisciplinary principles to have the final bioproduct developed and succeeded. The bioentrepreneur is often a scientist or researcher-turned-entrepreneur who wishes to see their research successes put into practice through commercialization.

Even the most innovative healthcare, including nanobio, technologies being translated in the right direction, would provide patient benefits only when adopted by clinicians or patients in actual practice. So, co-development between innovation-related builders and customers is a key agile principle. And in the coming wave of innovation in the broad-scope applications, learning rapidly what new bioproduct features work well for clinicians and patients will become even more crucial.



Stanislaw Dzwigaj

Sorbonne Université, France

Biography: Stanislaw Dzwigaj received a PhD degree in 1982 at the Jerzy Haber Institute of Catalysis and Surface Chemistry, Krakow, Poland. After two years of postdoctoral stay at the Laboratoire de Réactivité de Surface, Université P. et M. Curie, Paris, Dzwigaj obtained in 1990 a position of contracted researcher in the same laboratory devoted to surface reactivity in relation to catalysis phenomena, and in 2008 obtained a permanent position in CNRS as a researcher. On February 19, 2014, for outstanding scientific achievements, Dzwigaj received the title of professor. Published work includes more than 170

papers published in reputable international journals.

Application of vanadium, tantalum and chromium single-site zeolite catalysts in catalysis

The metal ions well dispersed at zeolite framework are considered to be active sites of catalytic processes. Therefore, the incorporation of these metals into zeolites as isolated tetrahedral sites appears to be the important task. We have earlier shown that the incorporation of transition metal ions into vacant T-atom sites of framework zeolite is strongly favored when, in the first step, zeolite is dealuminated by treatment with nitric acid solution and then, in the second step, the incorporation of transition metal ions results in the reaction between the cationic metal species of the precursor solution and the SiO-H groups of vacant T-atom sites created by dealumination of zeolite. During this keynote talk the design of single-site zeolite catalysts with transition metal will be described and characterized by different physical techniques both at the macroscopic (XRD, BET, TPR, TEM) and molecular level (FT-IR, NMR, DR UV-Vis, XPS, EPR, XAFS).

The application of metal single-site zeolite catalysts in environmental catalysis will be discussed. This two-step postsynthesis method applied in this work allowed obtaining vanadium and tantalum single-site zeolite catalysts active in different catalytic processes such as oxidative dehydrogenation of propane into propene, selective catalytic reduction of NO_x to N_2 , and production of 1,3-butadiene from renewable sources, including ethanol obtained from biomass. Their catalytic activity strongly depended on the speciation and amount of vanadium or tantalum incorporated into zeolite structure as well as their acidity.



Thomas J. Webster^{1,2,3}

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Biography: Thomas J. Webster's degrees are in chemical engineering from the University of Pittsburgh, BS in 1995, USA, and in biomedical engineering from RPI, PhD in 2000, USA. Webster has served as a professor at Purdue from 2000 to 2005, Brown from 2005 to 2012, and Northeastern from 2012 to 2021, serving as Chemical Engineering Department Chair from 2012 to 2019, and has formed over a dozen companies who have numerous FDA approved medical products currently improving human health in over 30,000 patients. Webster is currently helping those companies

and serves as a professor at Brown University, Saveetha University, Hebei University of Technology, UFPI, and others. Webster has numerous awards including 2020 World Top 2% Scientist by Citations (PLOS), 2020 SCOPUS Highly Cited Research in the top 1% Materials Science and Mixed Fields, 2021 Clarivate Top 0.1% Most Influential Researchers in Pharmacology and Toxicology, and 2022 Best Materials Science Scientist by Citations (Research.com), and is a fellow of over 8 societies. Webster has an H-index of 136 on Google Scholar.

Nanomaterials to fight cancer, cysts, infection, and numerous other health ailments: Human data

This presentation will provide an over 30 year journey to develop materials that improve disease prevention, detection, and treatment. Due to the extremely high surface area to volume ratios of nanomaterials as well as their tailored surface energy, this presentation will provide human clinical data of nanoparticles used for treating cancer, cyst, infection, and other ailments. Importantly, nanomaterials of different chemistry but of similar dimension have been shown to possess the surface energy necessary to endogenously adsorb select proteins from bodily fluids immediately after implantation to target and kill cancer cells, cyst cells, and bacteria. Currently such materials are in over 45,000 patients showing no signs of failure but only clinical success. In this manner, this invited talk will demonstrate how nanomaterials have served as the true catalyst to fight numerous diseases that have plagued human health for centuries.



Tokeer Ahmad

Jamia Millia Islamia, New Delhi, India

Biography: Tokeer Ahmad, a full Professor of Chemistry at Jamia Millia Islamia, Delhi, graduated from IIT Roorkee and IIT Delhi, and is extensively working on multifunctional heterostructures for HER, CRR and NRR applications to meet energy and sustainability goals. Ahmad has supervised 16 PhDs and 88 postgraduates, completed 10 projects, published 235 research papers with cumulative impact factor 875, one patent and three books with research citation of 10,720, an h-index of 61 and an i10-index of 196. Ahmad is an active reviewer

of 215 journals, has delivered 233 invited talks, evaluated 72 external doctoral theses and presented 140 conference papers, and is the recipient of the CRSI Bronze Medal, MRSI Medal, SMC Bronze Medal, ISCAS Medal, Inspired Teacher's President of India Award, Springer Nature Editor of Distinction Award, DST-DFG award, IIT Delhi Alumni Faculty Award, Distinguished Scientist Award, Dr. S. S. Deshpande National Award, Maulana Abul Kalam Azad Excellence Award of Education and Teacher's Excellence Award. Ahmad is an Elected Member of the National Academy of Sciences India and a Fellow of the Royal Society of Chemistry, United Kingdom, and has been figured in the World Top 2% Scientists for six consecutive years since 2020 in both lists including career long by Stanford University, USA.

Advanced nanostructures for carbon neutrality and sustainable H₂ energy

Advanced materials based heterogeneous catalysis involving photochemical and photoelectrochemical water splitting is an ultimate source of hydrogen generation as renewable green energy for tackling the ongoing fuel crisis. Carbon based materials are ideal for overall water splitting as a result of the excellent alignment of its band edges with water redox potentials. However, a single catalyst with a limited number of active sites does not exhibit significant photo and electrocatalytic activity for hydrogen production. Therefore, we have developed the semiconductor heterostructures of carbon materials with oxides, sulphides, selenides, other TMCs/TMDs NPs and QDs as the highly efficient nanocatalysts for enhanced hydrogen evolution reactions. The monophasic heterostructures have been designed in different weight ratios with fairly uniform distribution of nearly spherical particles and high specific surface area which creates an interfacial charge transfer between two semiconductors. As prepared heterostructures showed significant hydrogen evolution which is evident by observing high apparent quantum yield, low onset potential, lower overpotential and high electrochemical active surface area that will be presented in detail.



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Biography: Vladimer Tsitsishvili, born 1947, graduated from the Physics Department of Tbilisi State University in experimental physics in 1970, and holds Candidate of Physical and Mathematical Sciences in Physics of Magnetic Phenomena, 1975, and Doctor of Chemical Sciences in Physical Chemistry, 1988. Tsitsishvili is a Corresponding Member since 2001 and Full Member since 2019 of the National Academy of Sciences of Georgia, worked at the Institutes of Cybernetics from 1970 to 1978, Pharmacochemistry from 1978 to 1990 and Physical and Organic Chemistry from 1990 to 2006

of the Georgian Academy of Sciences, and served as Director from 2006 to 2018 and Chairman of the Scientific Council since 2018 of the Petre Melikishvili Institute of Physical and Organic Chemistry at Tbilisi State University.

Oxidation of 4-methoxytoluene over copper-containing BEA-type zeolite catalyst

The solvent-free oxidation of 4-methoxytoluene (4-MT or 1-methoxy-4-methylbenzene) in the liquid phase was studied using air as an oxygen source and a partially dealuminated Cu-HBEA catalyst and under the influence of Ultrasound (US, 300 W, 25 kHz, 1.5 hours). The HBEA zeolite used to prepare the catalyst was obtained from commercial NH_4BEA with a Si/Al_2 molar ratio of 38 (Zeolyst International, USA); the copper form was obtained by ion exchange between copper acetate solution and HBEA zeolite with a Si/Al molar ratio of 27.6; the Cu-HBEA zeolite contained 0.96% copper. Ultrasound-assisted reactions were carried out in a hybrid reactor (UMR-300B, Shinka, Japan), providing ultrasonic irradiation of the reaction mixture directly through the sonotrode.

According to the results of the reaction product analysis carried out using a Gas Chromatograph-Mass Spectrometer (GC/MS, Agilent Technologies, 5890B/5977A, USA), several reactions occur during the thermal catalytic oxidation of 4-MT using air oxygen on a Cu-HBEA catalyst at relatively low temperatures (323–362 K), including alkylation, oxidation, isomerization, and cyclization. The main product of these reactions is trans-anethole (1-methoxy-4-[(1E)-prop-1-en-1-yl]benzene, $\text{C}_{10}\text{H}_{12}\text{O}$); β -linalool ((3R)-3,7-dimethylocta-1,6-dien-3-ol, $\text{C}_{10}\text{H}_{18}\text{O}$), estragole (4-allylanisole, $\text{C}_{10}\text{H}_{12}\text{O}$), para-anisaldehyde (4-methoxybenzaldehyde, $\text{C}_8\text{H}_8\text{O}_2$), formic acid 2-isopropyl ester ($\text{C}_{10}\text{H}_{12}\text{O}_2$), 1-(4-methoxyphenyl)-2-propanone ($\text{C}_{12}\text{H}_{12}\text{O}_2$) and 1-(3-methyl-2-butenyloxy-4-(1-propenyl)

benzene ($C_{14}H_{18}O$) are also formed, and in small quantities d-Limonene ((4R)-1-methyl-4-prop-1-en-2-ylcyclohexene, $C_{10}H_{16}$), 2,4-dimethylanisole (1-methoxy-2,4-dimethylbenzene, $C_9H_{12}O$), trans- α -bergamotene ((1S,5S,6R)-2,6-dimethyl-6-(4-methylpent-3-enyl)bicyclo[3.1.1]hept-2-ene, $C_{15}H_{24}$) and 1-(4-methoxyphenyl)propane-1,2-diol ($C_{10}H_{14}O_3$). The formation of precipitation products on the catalyst, its blackening and coating with resinous products, was observed.

The formation of *trans*-anethole is unusual both during thermal catalytic oxidation and during the action of ultrasound. The yield of *trans*-anethole in thermal catalytic oxidation is high, 72%, at 362 K. In the oxidation of 4-methoxytoluene ($C_8H_{10}O$) in the presence of a Cu-HBEA catalyst, the formation of *trans*-anethole ($C_{10}H_{12}O$) and other C9-C12 molecules with an elongated side carbon chain in comparison with the methyl group of 4-MT does not agree with the classical ideas of anethole formation from 4-MT. For this, radical halogenation and condensation are used.

In the ultrasound-assisted catalytic oxidation of 4-MT, the selectivity for the formation of the target product, 4-MBA, is approximately six times higher than in thermal catalytic oxidation, and amounts to 41.7% upon complete conversion of 4-MT.



Yarub Al-Douri

European Academy of Sciences, Belgium

Biography: Yarub Al-Douri is a Fellow of the European Academy of Sciences, Fellow of the Islamic World Academy of Sciences, Fellow of the Arab Thought Forum and IETI Distinguished Fellow, winner of the NCPD International Prize 2025 and winner of the Khalifa International Award for Date Palm and Agricultural Innovation 2024, with 87 awards in total. Al-Douri is Associate Editor of Nano-Micro Letters (Springer) and Editor-in-Chief of Experimental and Theoretical Nanotechnology.

Morphological studies of quinary alloys

The $\text{Cu}_2\text{Zn}_{1-x}\text{Cd}_x\text{SnS}_4$ quinary alloy nanofibres with different Cd concentrations were grown on glass substrate using the electrospinning technique. The structural properties of $\text{Cu}_2\text{Zn}_{1-x}\text{Cd}_x\text{SnS}_4$ quinary alloy nanofibres were investigated by X-Ray Diffraction (XRD), Field Emission-Scanning Electron Microscopy (FE-SEM) and Atomic Force Microscopy (AFM). Optical properties were analysed through UV-Visible Spectrophotometry (UV-Vis) and Photoluminescence Spectroscopy (PL), which revealed that there is a decrease in band gap from 1.75 eV to 1.61 eV, with the increasing Cd concentration from $x=0$ to $x=1$. The current–voltage measurements exhibited a power conversion efficiency of 3% under the solar illumination with intensity of 100 mW/cm^2 . Electrical properties supported that the $\text{Cu}_2\text{Zn}_{1-x}\text{Cd}_x\text{SnS}_4$ quinary alloy can be used as an absorber in solar cells. The bulk modulus, refractive index and dielectric constant were also investigated.

Morphological studies of quinary alloys play a crucial role in understanding the relationship between microstructure and material performance in advanced engineering and technological applications. Quinary alloys, composed of five principal elements, exhibit complex phase formations, unique grain structures, and enhanced mechanical, thermal, electrical, and corrosion-resistant properties compared with conventional binary or ternary alloys. Morphological characterization focuses on examining surface features, grain boundaries, crystallite size, porosity, phase distribution, and particle agglomeration using analytical techniques such as Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), and X-Ray Diffraction (XRD). These studies provide valuable insight into how synthesis methods,

heat treatment, cooling rates, and compositional variations influence the alloy structure. Uniform morphology and fine grain distribution often contribute to improved hardness, tensile strength, conductivity, and catalytic efficiency. In nanostructured quinary alloys, morphology strongly affects electron transport, optical behavior, and magnetic properties, making them highly attractive for applications in energy storage, solar cells, sensors, coatings, and biomedical devices. Furthermore, morphological investigations help identify defects, secondary phases, and structural instabilities that may reduce performance or durability. Understanding these microstructural characteristics enables researchers to optimize alloy fabrication processes and design high-performance multifunctional materials for industrial, environmental, and technological advancements.

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OCTOBER 2026

ORAL PRESENTATIONS





Abhishek Bansal

New Era Consultancy Services, India

Protein and enzyme conformational dynamics as catalytic state transitions: A B-Bio/B-Chem framework demonstrated using BVidAL Clinical Software Suite

Protein and enzyme function depends not only on molecular composition, but also on conformational organization, dynamic structural transitions, active-site geometry, and regulated interaction with substrates, cofactors, inhibitors, and surrounding biochemical environments. This presentation proposes a B-Bio/B-Chem framework for interpreting protein and enzyme conformational dynamics as catalytic state transitions, where folding, binding, activation, inhibition, reaction progression, and product release are treated as connected geometric and biochemical state changes.

The proposed framework links protein folding, conformational flexibility, active-site alignment, substrate recognition, transition-state stabilization, and reaction-pathway control within a unified interpretive model. In this view, enzymatic catalysis is not treated only as a static chemical reaction, but as a dynamic sequence of biologically constrained structural and energetic transformations. Enzyme activity may therefore be represented through changes in conformation, catalytic orientation, reaction-state accessibility, molecular coupling, and regulatory control. The same framework can also support interpretation of enzyme inhibition, including active-site obstruction, allosteric modulation, conformational restriction, and loss of catalytic efficiency.

BVidAL Clinical Software Suite, Software as a Medical Device (SaMD), is used as a research-oriented software environment to organize biochemical, structural, and biomedical evidence into an interpretable workflow. The presentation includes protein-structure examples, enzyme reaction pathways, catalytic-state diagrams, inhibitor interaction models, and B-Chem/B-Bio explanatory outputs. The aim is to demonstrate how protein conformational dynamics and

enzyme catalysis can be represented as structured state transitions suitable for academic study, computational modeling, medicinal chemistry, pharmacology, and biomedical research.

Biography

Abhishek Bansal is an independent consultant, researcher, and amateur scholar whose recent work reflects over 20 years of fully self-funded, self-directed research. Bansal has proposed novel B-Equations and related engineering frameworks for impedance analysis, transformers, inverters, generators, pumps, solar systems, machinery, turbines, batteries, SMPS, and short-circuit analysis. In biomedical science, Bansal has formally claimed Novel Bansal-NonLinear Theory and Novel Bansal-Biology Theory with nine frameworks, including B-Phy, B-Chem, B-Disease, B-Pharma, B-AI, and B-Prosthetics, and has developed the free BVidAL Clinical Software Suite in beta version and BVidAL RTOS (Real Time Operating System) for biomedical analysis, simulation, imaging, signals, and medical-device research.



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A model fitting approach for the investigation of thermo-kinetic parameters of rice straw: A viable renewable energy resource in Bangladesh

The depletion of fossil-fuel resources coupled with the growing environmental issues related to the burning of agricultural wastes have pushed the quest to find alternative sources of energy that is more sustainable. The agricultural wastes especially rice straw have a good potential as renewable and sustainable feedstock in generation of energy. Rice straw burning is a major contributor of air pollutants and greenhouse gases, and thus leads to environmental degradation in many rice-producing countries, particularly those in the Asia and African regions. Pyrolysis is a thermochemical conversion type of transforming rice straw into value products of biochar, bio-oil, and syngas. The research is aimed at analytically investigating the pyrolysis behavior of rice straw by applying thermogravimetric analysis and model-based kinetic interpretation to determine the practicability of the material as an alternative energy source. A heating rate of 5°C min⁻¹ in an inert nitrogen atmosphere was used to define the thermogravimetric study from ambient temperature to 900 °C and kinetic parameters were derived through the Coats-Redfern method.

The findings showed that there are three characteristic steps of biomass thermal degradation and they were: (i) moisture evaporation at temperatures between 30°C and 150°C, (ii) major devolatilization at temperatures 200°C to 400°C involved in the degradation of hemicellulose and cellulose, and (iii) progressive lignin degradation at high temperatures of 600°C and higher and the formation of char. The decomposition range of 230°C to 400°C was found to be the ideal pyrolysis temperature range, which can be explained by the maximum level of

devolatilization. The results showed that the F1.5 chemical reaction order model has the highest regression coefficient of 0.9709 compared to other models, indicating its better reliability, while the *diffusion model D3* also demonstrated strong reliability. The *activation energy* value varied between 16.86 kJ/mol and 78.12 kJ/mol, indicating that the reactivity of the biomass is relatively high with favourable conversion characteristics compared to other lignocellulosic biomass materials. The thermodynamic analysis indicated positive values of *enthalpy change* ranging from 12 to 74 kJ/mol, which confirmed the endothermic process of rice straw pyrolysis and the requirement of heat supply to the process. The positive values of *Gibbs free energy change* ranging from 70 to 170 kJ/mol indicated *non-spontaneity* of the reaction process, while the *negative values of entropy change* indicated increased order of the product formed through the process of pyrolysis.

The analysis of the results obtained through the process of pyrolysis with the existing literature indicated that the values of activation energy were consistent with the values obtained through other lignocellulosic biomass-based studies. The results obtained through the process of pyrolysis have confirmed that the process of rice straw pyrolysis is technically viable and environmentally sound for the production of valuable biofuels such as biochar, bio-oils, and syngas from agricultural waste. The study contributes to sustainable energy transition efforts by supporting agro-residue-based decentralized energy systems and enhancing resource recovery pathways in developing regions.

Keywords: Rice Straw Pyrolysis, Thermogravimetric Analysis, Coats–Redfern Kinetics, Activation Energy, Thermodynamic Analysis, Bioenergy, Agricultural Waste Valorization, Circular Economy.

Biography

Abu Md. Mehdi Hassan is a dedicated academician and researcher with a passion for advancing the field of physics and contributing to sustainable energy solutions. Hassan completed a Master of Science in Physics from the University of Chittagong, Bangladesh, and holds a distinguished position as a Professor of Physics at a government college in Bangladesh. Hassan has pursued a PhD in Energy and Sustainability Engineering from Lincoln University College, Malaysia, with research aiming to explore efficient, sustainable methods of harnessing energy from waste materials, contributing to both waste management solutions and the global pursuit of cleaner energy alternatives.



Bashir Ahmad Dar

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Reusable clay–Cu catalysts: Green routes to key organic transformations

The pursuit of environmentally sustainable chemical processes has placed green chemistry at the forefront of modern research. Within this framework, heterogeneous catalysis has emerged as a cornerstone for achieving efficiency, selectivity, and reusability in organic transformations. Among the diverse classes of heterogeneous catalysts, those derived from natural resources such as clays and zeolites have attracted considerable attention due to their abundance, low cost, and environmentally benign nature.

Clays are layered aluminosilicates with inherent acidic properties, enabling them to function as both Brønsted and Lewis acids. Their structural versatility allows modification through ion exchange or incorporation of transition metals, thereby enhancing catalytic activity. In our research, copper-supported clay (Cu–clay) catalysts have demonstrated remarkable potential as reusable systems for a wide range of organic reactions. The synergy between the clay matrix and copper ions provides a robust platform that combines high surface area, tunable acidity, and strong metal-support interactions.

Our studies reveal that Cu–clay catalysts exhibit excellent reactivity and selectivity in key organic transformations, including C–C coupling, oxidation, and reduction reactions. The catalysts are not only efficient but also recyclable, retaining activity over multiple cycles without significant loss of performance. This reusability addresses one of the central challenges in green chemistry, minimizing waste and reducing reliance on non-renewable resources. Furthermore, the ease of preparation and scalability of these catalysts make them attractive for both laboratory-scale synthesis and industrial applications.

Mechanistic investigations provide insights into the role of copper species in facilitating electron transfer processes, while the clay support stabilizes active sites and prevents leaching. Characterization techniques such as XRD, FTIR, SEM, and BET surface analysis confirm the structural integrity and surface properties of the catalysts, reinforcing their suitability for sustainable applications.

By integrating natural clay matrices with copper, our work highlights a pathway toward greener chemical processes that balance efficiency with sustainability. Attendees will gain actionable knowledge applicable to academic research, teaching, and industrial practice, reinforcing the role of natural resource-based catalysts in advancing the goals of green chemistry.

Biography

Bashir Ahmad Dar is a distinguished chemist and academician currently serving as an Assistant Professor of Chemistry at the Government Degree College Uri. With a strong foundation in chemistry, Dar holds a PhD from the University of Jammu, where the research focused on the preparation and characterization of clay-supported catalysts for organic transformations. Dar has an extensive teaching portfolio, having served at reputed institutions such as the Government Degree College Sopore, Baramulla, and the University of Kashmir. Research interests include catalysis, nanomaterials, adsorption studies, and green chemistry, with an emphasis on environmental remediation and sustainable chemical processes. Dar has earned several honours, including the CSIR Junior and Senior Research Fellowships, the GATE qualification, and the Best Paper Award in 2019 from the Nature Science Foundation, and as an active editorial board member of multiple international journals continues to promote excellence in chemical research and peer review.



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Development of specialty amines derived from acrylonitrile: A case study of *N,N*-dimethyl-1,3-propanediamine

Acrylonitrile serves as a key intermediate in the petrochemical industry and provides an essential feedstock for numerous downstream products including synthetic fibers, plastics, rubbers, and fine chemicals. Rapid expansion of global acrylonitrile capacity in recent years has created a supply surplus that has reduced market prices and compressed industrial profit margins. Development of high-value downstream products therefore represents an important pathway for improving the economic competitiveness of the acrylonitrile industry. Specialty amines derived from acrylonitrile have attracted increasing attention because they exhibit broad applications in personal care products, pharmaceuticals, surfactants, and functional materials.

This study investigates the catalytic synthesis of *N,N*-dimethyl-1,3-propanediamine, an important intermediate widely used in the production of surfactants and cosmetic ingredients. Industrial production technologies for this compound remain dominated by foreign continuous processes, while domestic production primarily relies on batch operations with limited efficiency and scalability. Development of efficient catalytic systems and scalable reaction processes therefore represents a critical objective for improving domestic production capacity.

A supported Ni-based catalytic system was designed for the amination and hydrogenation reactions involved in the synthesis route. Systematic screening of active metals and catalyst supports was conducted to improve catalytic activity, selectivity, and stability. Commercial Al_2O_3 exhibited favorable surface properties and strong metal dispersion ability and therefore served as an effective catalyst support. Catalyst deactivation behavior was investigated through XRD,

XPS, TEM, and thermogravimetric analysis. The results demonstrate that catalyst deactivation primarily originates from metal oxidation, carbon deposition, and particle sintering during the reaction process. Catalyst modification strategies were subsequently developed to enhance stability. Introduction of Cu effectively suppressed metal sintering, while incorporation of CeO₂ reduced carbon deposition and allowed a lower Ni loading without sacrificing catalytic performance.

The optimized catalytic system achieved complete conversion of acrylonitrile and produced the intermediate *N,N*-dimethylaminopropionitrile with a yield of 99.7%. Subsequent hydrogenation afforded *N,N*-dimethyl-1,3-propanediamine with yields exceeding 90% under optimized reaction conditions. The developed catalytic process was successfully scaled from laboratory reactors to a 20 L pilot reactor. Comprehensive safety evaluation including risk assessment and HAZOP analysis confirmed the operational safety and technical feasibility of the process.

This work further explores catalytic synthesis routes for additional acrylonitrile-derived specialty amines including propionitrile and *N,N*-bis(3-aminopropyl)methylamine. The results demonstrate that catalytic amination and hydrogenation strategies provide an efficient pathway for the scalable synthesis of high-value specialty amines from acrylonitrile. The study therefore offers a practical catalytic and process development framework for upgrading acrylonitrile downstream products and supports the industrial production of high-value functional amines.

Biography

Chen Wu received a PhD from Northwestern Polytechnical University in 2022 and is currently a specially appointed Associate Research Fellow at the Institute of Zhejiang University-Quzhou. Research focuses on catalysts for the green synthesis of fine chemicals, including catalyst design, catalytic performance, and industrial applications. Wu has published over 20 papers in leading journals such as *Applied Catalysis B: Environmental*, *ACS Catalysis*, *AIChE Journal*, and *Industrial & Engineering Chemistry Research*, and has participated in several national and provincial research projects.



Collin G. Joseph

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From bauxite waste to value: Technologies for red mud reuse

Red Mud (RM), the highly alkaline, iron and alumina rich residue generated during the Bayer refining of bauxite, presents a persistent environmental challenge due to its large volumes, caustic pH and potential for metal mobilization. This review synthesizes recent advances in converting RM from an industrial liability into a versatile secondary resource. It summarizes how targeted physico-chemical treatments, including acidification, neutralization and carbonation, thermal activation and composite formation with biochars, clays or polymers, alter RM surface chemistry, porosity and stability to create materials suitable for adsorption, coagulation, catalysis and incorporation into construction products. Acid treatments and surface functionalization increase available binding sites and enhance uptake of anionic species such as phosphate and fluoride and certain heavy metals; neutralization and carbonation reduce alkalinity and soluble alkali leaching, improving environmental safety for land applications; thermal activation and sintering increase surface area and catalytic activity for organic pollutant degradation; and composite approaches combine RM's metal oxide functionality with complementary matrices to broaden contaminant selectivity and mechanical performance.

Reported laboratory and pilot studies demonstrate promising removal efficiencies for dyes, phosphates, heavy metals and emerging contaminants, effective catalytic degradation of organics, and successful partial replacement of cement or aggregate in bricks, tiles and glass ceramics with acceptable mechanical properties when leachability is controlled. Nevertheless, significant barriers remain to widescale adoption. Key gaps include limited long term field data on leaching and ecotoxicity under variable climatic conditions, inconsistent pre-treatment and modification protocols that hinder comparability, energy and cost penalties associated with thermal routes, and a lack of standardized testing and regulatory pathways for RM derived construction materials.

To realize RM's circular economy potential, future work should prioritize low cost, low energy modification strategies, rigorous life cycle and techno-economic assessments, harmonized leaching and performance standards, and demonstration projects that integrate RM reuse with existing industrial processes, e.g., coupling thermal activation to waste heat streams. Policy incentives and cross sector partnerships will be essential to scale safe applications while protecting human and ecosystem health. In summary, modified red mud offers a suite of environmentally beneficial uses that can substantially reduce disposal impacts, but responsible deployment requires coordinated research on long term stability, standardized processing methods and clear regulatory frameworks to ensure both performance and safety.

Keywords: Red Mud, Disposal, Utilization, Water Treatment.

This research was supported by the Research Management Centre, Universiti Putra Malaysia in collaboration with the Centre for Research & Innovation of Universiti Malaysia Sabah (Grant No. RACE0008-ST-2013) and is gratefully acknowledged.

Biography

Collin G. Joseph is a Chartered Chemist and Professor in the Industrial Chemistry Programme at Universiti Malaysia Sabah (UMS), where the academic career began in 2003, and earned a PhD in Chemical Engineering from the University of Nottingham, United Kingdom, in 2011. Joseph has received numerous Excellence and Service Awards, along with Gold Medals for research and innovation at MTE, ITEX, and PEREKA competitions, with expertise spanning Adsorbent Technology, Sonophotochemistry, and Ozone Chemistry. In 2014 Joseph founded the Sonophotochemistry Research Group and continues to lead it, and from 2020 to 2023 served as Head of the Industrial Chemistry Programme within the UMS Faculty of Science and Technology. Joseph has been invited to review over 250 manuscripts for Tier 1 journals published by Elsevier, Springer, and Taylor & Francis since 2007, is a frequent keynote speaker and session chair at international conferences, sits on the Editorial Board of the Malaysian Journal of Chemistry, serves as Review Editor for Photocatalysis in Frontiers in Chemistry, and was a Guest Editor for Catalysts and is a Guest Editor for Processes. Joseph was awarded Fellowship status of the Malaysian Institute of Chemistry in 2021 and is a member of the American Chemical Society and Majlis Profesor Negara.



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Ultrastable ZnAlPO₄ catalyst for stable CF₄ hydrolysis over 3700 hours

Tetrafluoromethane (CF₄) is among the most persistent and hazardous greenhouse gases emitted from semiconductor manufacturing processes. Due to its exceptionally high global warming potential of 7,380 and an atmospheric lifetime exceeding 50,000 years, the effective abatement of CF₄ has become a critical environmental imperative. Among various mitigation strategies, catalytic hydrolysis over cost-effective γ -Al₂O₃-based materials has received widespread attention as a practical option. However, conventional γ -Al₂O₃ catalysts readily react with byproduct Hydrofluoric Acid (HF) to transformation into catalytically inert α -Al₂O₃ phases, resulting in rapid deactivation and severely hindering their industrial application.

To address this challenge, we developed a novel pellet-type ZnAlPO₄ catalyst synthesized via an extrusion method, achieving simultaneous incorporation of phosphate (P) and zinc (Zn) into the γ -Al₂O₃ framework. Phosphoric acid treatment yields thermodynamically stable phosphate-alumina interactions at the surface region. This structural anchoring effectively shields the active framework from corrosive fluorine poisoning and suppresses the HF-induced phase transition to α -Al₂O₃. Concurrently, the introduction of Zn modulates the local electronic structures of alumina, promoting electron transfer that significantly increases the density of strong coordinatively unsaturated Lewis acidic Al sites. This electronic modification facilitates charge transfer to the chemisorbed CF₄ molecules, thereby lowering the kinetic barrier for C-F bond activation. Density Functional Theory (DFT) calculations substantiate these findings by confirming that the synergistic cooperative Zn-Al environments substantially stabilize CF₄ adsorption and diminish the activation penalty for subsequent dissociation.

Catalytic performance tests were executed using industrially relevant pelletized specimens under harsh conditions featuring 5,000 ppm CF₄ and ~8% steam. The optimized Zn(20)AlPO₄ catalyst, containing 20 wt.% Zn, achieved complete CF₄ conversion at 700°C, lowering the

required reaction temperature by 50 °C compared to pristine AlPO_4 . Most notably, the Zn(20)AlPO_4 catalyst exhibited exceptional long-term durability, maintaining 100% catalytic activity and complete morphological integrity for over 3,700 hours without any detectable crystalline degradation or irreversible phase changes. In contrast, phosphate-free $\gamma\text{-Al}_2\text{O}_3$ and ZnAl_2O_4 catalysts exhibited rapid and progressive deactivation, respectively, both accompanied by a distinct phase transformation into the inactive $\alpha\text{-Al}_2\text{O}_3$ phase after the durability tests. Furthermore, a comparative cost analysis demonstrated that our Zn(20)AlPO_4 catalyst is highly cost-effective, being 700 times less expensive than conventional gallium-based formulations. These findings represent a significant breakthrough in industrial PFCs abatement and provide an extendable design framework for engineering robust, HF-resistant catalysts for treating various fluorinated greenhouse gases.

Biography

Eun-Han Lee is a PhD candidate in the Department of Chemical and Biomolecular Engineering at Yonsei University, Republic of Korea. Lee's research focuses on the development of alumina-based catalysts for the abatement of non- CO_2 greenhouse gases, including CF_4 , NF_3 , SF_6 , N_2O , and HFCs, has authored several SCI publications in catalysis and environmental engineering and is actively involved in catalyst design, catalytic reaction engineering, and greenhouse gas mitigation technologies. Current work focuses on developing highly durable catalysts for the hydrolysis of fluorinated greenhouse gases.

Dr. Ryi received his Ph.D. from Korea University in 2008 and worked at University of British Columbia (UBC) in Canada as a post-doc. fellow. He is a principal researcher in the Greenhouse Gas Research Department at Korea Institute of Energy Research (KIER). His research interests are in the development of Pd-based hydrogen selective membrane and its application, such as membrane reactors. Recently, his research has been focused on the catalysts for ammonia decomposition, natural gas steam reforming and abatement of Non- CO_2 greenhouse gas such as N_2O , HFCs, PFCs, NF_3 and SF_6 . He published ~80 international journals and ~120 patents.



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Reduction of lead, cadmium, and nickel accumulation in edible herbs grown in contaminated soil using horticultural waste residues

Background: Contamination of agricultural soils with lead (Pb), cadmium (Cd), and nickel (Ni) represents a major environmental and food-safety concern. These potentially toxic metals can be transferred from contaminated soil to edible plants, enter the human food chain, and adversely affect human health. This study evaluated the effectiveness of a mixture of woody walnut and almond shells, used as horticultural waste residues, as an inexpensive, readily available, and environmentally sustainable soil amendment for reducing Pb, Cd, and Ni accumulation in edible herbs grown in contaminated soil.

Methods: Walnut and almond shells were repeatedly washed with deionized water, dried, ground into fine particles, sieved, and thoroughly mixed in predetermined proportions. The prepared mixture was incorporated into soil contaminated with Pb, Cd, and Ni, while contaminated soil without the shell amendment served as the control. Seeds of edible herbs were planted in the prepared soils, and the aerial parts of the plants were collected over three successive harvests. Following standard sample-preparation and acid-digestion procedures, Pb, Cd, and Ni concentrations in the soil and plant tissues were determined using atomic absorption spectrometry. All experiments were conducted in triplicate. The data were analyzed using analysis of variance, followed by Duncan's multiple range test, with statistical significance established at $P \leq 0.05$.

Results: Incorporation of the walnut and almond shell mixture did not significantly reduce the total concentrations of Pb, Cd, or Ni in the contaminated soil. However, the accumulation of all three metals in the aerial parts of the edible herbs was significantly lower than that observed in the control group ($P \leq 0.05$). The reduction in metal accumulation increased across successive harvests, with the greatest effect recorded at the final harvest. At this stage, Pb and Cd concentrations in edible herbs grown in the amended soil were more than 70% lower than those measured in the control plants. Nickel accumulation was reduced by 79% compared with the control group. These findings indicate that the mixture of woody walnut and almond shells restricted the bioavailability and soil-to-plant transfer of Pb, Cd, and Ni without substantially changing their total concentrations in the soil.

Conclusion: The mixture of woody walnut and almond shells significantly reduced Pb, Cd, and Ni accumulation in edible herbs cultivated in contaminated soil. The amendment was particularly effective in limiting Ni uptake, resulting in a 79% reduction at the final harvest. Therefore, these horticultural waste residues have the potential to serve as a natural, economical, and environmentally sustainable soil amendment for restricting the transfer of potentially toxic metals to edible crops, supporting the beneficial reuse of agricultural by-products, and improving food safety.

Keywords: Walnut Shells; Almond Shells; Horticultural Waste Residues; Edible Herbs; Lead; Cadmium; Nickel; Contaminated Soil; Food Safety

Biography

Dr. Fatemehsadat Mirmohammadmakki received her PhD in Food industrial engineering and science - Food Chemistry in 2021 from Islamic Azad University, Sciences and Research Branch. She then joined the research group at the same institution. Her research focuses on agricultural products, edible oils, and extracts, with a specialization in biosorbents for reducing heavy metals in food, soil, and wastewater. Also, she is researcher of Medical Ethics and Law Research Center, Shahid Beheshti University of Medical Sciences. A lecturer and researcher, she has contributed to sustainable pollution control and has published over 10 research articles and participated in more than 50 national and international conferences.



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Spontaneous deposition of boron oxide on a rhodium nanostructure for selective conversion of syngas to ethanol

Ethanol has been regarded as a crucial platform molecule for the modern chemical industry to produce valuable chemicals with a large demand. The current ethanol production strongly depends on the fermentation of grains, which competes with human food. Developing non-grain route for ethanol production is highly desirable, and multiple routes have been developed by cellulose hydrogenolysis and ethylene hydration. Besides these techniques, a trend is to produce ethanol from syngas, which is a mixture of CO and hydrogen that can be easily obtained on a large scale from coal, biomass, and natural gas. Since the 1950s, the supported Rh nanoparticles with various promoters such as Mn, Fe, Cu, V, Ti, Mo, Zr, alkali metals and rare earth metals have been investigated in direct conversion of syngas to ethanol. However, the methane selectivity is usually higher than 50% with C₂-oxygenate selectivity lower than 40% in most cases. It is still far to meet the desirable selectivity to oxygenate products because of the uncontrollable methanation.

Generally, the formation of methane is mainly due to excessive dissociation of carbon-oxygen bonds (C-O) and subsequent hydrogenation of hydrocarbons intermediates (CH_x). Hindering CO dissociation and weakening the hydrogenation activity of the catalysts is supposed to reduce methane selectivity. Note that selectively blocking the specific sites for undesired side reactions on catalyst nanostructure is a promising way to improve the performances, especially for structurally-sensitive processes such as CO dissociation on Rh surfaces. However, it is a challenge for the control of catalyst structure at atomic scale.

Herein, we show that a boron oxide species could spontaneously and selectively react with the low-coordination sites on Rh nanoparticles, which are responsible for undesired

methanation in the conversion of syngas to ethanol. As a result, the boron oxide modified RhMn nanoparticles on a silica support ($\text{RhMnB}_{39}/\text{SiO}_2$) exhibited oxygenate selectivity as high as 63.9% by methane selectivity reduced to 31.1%, of which 90.1% of the oxygenates are C2-oxygenates. Such an oxygenate selectivity outperforms supported RhMn catalysts, which usually exhibit selectivity of higher than 50% for undesired methane. This work offers an alternative route for ethanol production from syngas.

Biography

Jiale Xiao is a doctoral student from the research group of Professor Feng-Shou Xiao at Zhejiang University, with research mainly focused on the conversion of syngas to alcohols.



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Distant binuclear vanadium V(II) cationic sites in zeolites and their reactivity

Divalent cations stabilized in the framework of silicon rich zeolites represents redox catalytic sites applied in number of redox catalytic reactions, for example N_2O and NO_x abatement and selective oxidation of methane to methanol. Nevertheless, the attention was focussed on metals with significantly preferred divalency as Cu, Co, Ni, Fe. In this paper, we present the first report on the preparation of silicon rich zeolite of ferrierite topology with Si/Al 8.5 with bare divalent vanadium cations in extra-framework cationic sites. Moreover, activity of pairs of cooperating V(II) ions in binuclear cationic sites towards small important molecules is discussed.

Biography

Jiri Dedecek is Head of the Department of Structure and Dynamics in Catalysis of the J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, Czech Republic. Dedecek's work is oriented on the application of a multi-spectroscopic approach for the characterization of zeolite catalysts on an atomic level and for rational design of zeolite catalysts.



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Oxidation of methane to methanol over pairs of transition metal ions stabilized in the zeolite matrices

Selective oxidation of methane to methanol represents one of the possibilities for gas to liquid transformation of this key energy source. Recently were developed systems based on binuclear transition metal ions sites, formed for example by Fe(II) ions, capable of splitting molecular oxygen and forming highly active paired or isolated α -oxygen species which subsequently oxidize methane to methanol. These systems work in a quasi-catalytic regime analogously as was reported for Cu-zeolites, but work under isothermal conditions and without need of water vapor for the extraction of oxidation products. In this paper, the mechanism of oxygen activation is studied, as well as the role of the nature of transition metal ions and local arrangement of the binuclear cationic site. It was found that splitting of molecular oxygen and subsequent oxidation of methane is not unique for Fe-ferrierite, but can be connected with a number of systems when fulfilled some requirements on the zeolite topology, framework Al organization and arrangement of the active site. Moreover, the oxygen speciation depends on the conditions of the reaction including subsequent treatment in an oxidative atmosphere. The rate determining step of the whole reaction chain represents desorption of methanol from the active site.

Biography

Jiri Dedecek is Head of the Department of Structure and Dynamics in Catalysis of the J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, Czech Republic. Dedecek's work is oriented on the application of a multi-spectroscopic approach for the characterization of zeolite catalysts on an atomic level and for rational design of zeolite catalysts.



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Catalytic pathways for clean energy transition: Advancing CO₂ conversion and hydrogen production toward a net-zero future

The rapid development of scalable low-carbon energy technologies is essential to meet the growing climate crisis, and heterogeneous catalysis is key to enabling the clean energy transition. In this work, we investigate the design and performance of multifunctional catalytic systems for two important processes: electrochemical reduction of CO₂ to value-added fuels and chemicals and catalytic production of green hydrogen by water splitting. We aim at the rational design of catalyst surfaces on the nanometre scale that simultaneously improve reaction selectivity, turnover frequency and long-term stability under realistic operating conditions.

The transition metal-based catalysts were supported on high surface area substrates and characterised by X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM) and X-ray Photoelectron Spectroscopy (XPS). Electrochemical performance was evaluated in a custom flow-cell reactor, and product distribution was analysed by gas chromatography. First results show enhanced CO₂-to-CO selectivity exceeding 85% at moderate overpotentials, coupled with stable hydrogen evolution activity over prolonged cycling. Density Functional Theory (DFT) calculations were used to elucidate active site geometry and reaction intermediates, providing mechanistic insights to inform rational catalyst optimisation.

These results add to the growing evidence that precision catalyst engineering can bridge the gap between lab-scale proof-of-concept and industrially relevant energy applications. The current study provides insights into the structure-activity relationships of electrocatalytic systems and offers a viable route towards carbon-neutral chemical production. Future perspectives are integration with renewable energy sources and scale-up assessment in wider power-to-x contexts.

Biography

Justine Osei-Owusu is a researcher at the University of West London specialising in energy systems and machine learning, with a focus on computational modelling and energy simulations. Her work explores the application of data-driven methods to optimise energy processes and support the transition to cleaner, more sustainable systems. Bridging the fields of artificial intelligence and energy engineering, Justine develops simulation frameworks that advance understanding of complex energy behaviour and inform real-world decision-making in the context of climate change mitigation.



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Modifying titanium dioxide photocatalysts for sustainable wastewater remediation

Wastewater remediation using Solar Light-driven Photocatalytic Degradation (SLPD) is a sustainable, green, and cost-effective method. This requires a highly stable, non-toxic semiconductor that can harness solar light to break down hazardous organic pollutants such as dyes, pesticides, and pharmaceuticals into harmless byproducts such as CO₂ and H₂O via a clean, solar-driven oxidation process. Further, for practical application, the PhotoCatalyst (PC) must be recyclable and able to be recovered from water. Titanium Dioxide (TiO₂) is an extensively studied and popular photocatalyst due to its low cost, non-toxicity, and stability, yet its efficiency is limited by its wide band gap energy of ~3.2 eV, narrowing down its absorptivity to the UV region of just ~4% of the solar spectrum and rapid electron hole recombination. To improve its sustainability and efficiency, scientists commonly use techniques such as heteroatom doping, facet engineering to enhance reactivity, and attaching TiO₂ to magnetic cores and carbon-based materials. Coupling TiO₂ with carbonaceous materials, including fullerene, graphene, carbon dots, and activated carbon, can facilitate effective charge separation through interfacial electron transfer, thereby improving electron-hole separation and conductivity and narrowing the band gap. Heterostructure formation with materials such as MoS₂ or exposure of high-energy (001) facets further enhances the reactivity and adsorption of organic pollutants. The talk will cover strategies to enhance the efficiency of TiO₂ PC for wastewater remediation and approaches towards highly recyclable and recoverable TiO₂, which can pave the way towards practical applications.

Biography

K. Y. Sandhya is currently a professor in the Department of Chemistry at the Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram, and received a PhD in Science from the National Institute of Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram. Sandhya has postdoctoral experience from Raman Research Institute, Bangalore, and the University of Medicine and Dentistry, Robert Wood Johnson Medical School, affiliated with Rutgers University, New Jersey, and was a scientist at the Sree Chitra Thirunal Institute of Medical Science and Technology (SCTIMST), Thiruvananthapuram. Sandhya has ~70 papers in international journals and 2 book chapters, has had work featured as cover pages in many reputed journals of RSC, Wiley, and ACS, and acts as a reviewer for many of those journals. Current research interests focus on sustainable materials and methods, including developing photocatalysts for the removal of pollutants from water, electrochemical sensors for biomolecules and pollutants, and electrode materials for advanced Li-ion batteries and supercapacitors.



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Magnetic $\text{Mn}_x\text{Ni}_{1-x}\text{Fe}_2\text{O}_4$ nanoparticles for environmental remediation: Dye adsorption, adsorption mechanism, and recovery of the adsorbents

Nano-structured spinel ferrites have been attractive for wastewater treatment to remove hazardous effluents. This study reports the adsorption of Methylene Blue (MB) dye by nanocrystalline spinel ferrites $\text{Mn}_x\text{Ni}_{1-x}\text{Fe}_2\text{O}_4$ ($x=0.0$ to 1.0 , step 0.2) and recovery of the same nanoparticles used in the dye adsorption experiment. The nano ferrite powders were synthesized by the citrate-gel auto-combustion technique, which carries the advantage of quick preparation of ferrite powders at a much lower temperature of 180°C to 200°C compared to the conventional ceramic method. X-Ray Diffraction (XRD) confirmed the formation of single-phased *fcc* spinel ferrites. The pore structure and pore surface area of the synthesized ferrite nanoparticles were studied by BET analysis.

The experiment was carried out for various time intervals using the ferrite samples for different concentrations, *i.e.* 5, 10, 15, and 20 mg/L of MB dye. The UV-Vis. spectra were recorded by using the MB dye solutions for all concentrations to study the absorbance. It shows fast removal of dye during the first 30 minutes and thereafter it moderates or decreases very slowly. The maximum removal efficiency was observed at equilibrium time $t=35$ minutes, which is a very effective dye removal property of prepared nano-structured Mn-Ni ferrites. Among all the tested samples, the highest adsorption efficiency was observed by the $x=1.0$ sample for 5 mg/L MB dye solution which is the excellent result of this experiment.

Equilibrium isotherms were analyzed by Langmuir, Freundlich, and Tempkin isotherm models. The adsorption mechanism was studied by fitting the experimental data with the pseudo-first-order and pseudo-second-order kinetic models. After performing the experiment, the ferrite

samples were recovered and characterized by XRD and FTIR, which are in good agreement with the used ferrite samples and the basic characteristics of nano-structured spinel ferrites. These nano ferrites can be used in environmental remediation like wastewater treatment for pollutant and toxic dyes due to their remarkable dye adsorption performance.

Biography

Laxmi J. Hathiya is a materials scientist specializing in nano ferrites, with over 10 years of research experience, and recently completed a postdoctoral fellowship at CHARUSAT University, India, working on rare-earth ion-substituted Mn-Zn ferrite-based fluids for hyperthermia applications. Hathiya earned a PhD in Physics from Saurashtra University in 2023 with doctoral work on Synthesis and characterization of nano-structured ferrites with reference to special applications and also attained the best thesis award, and was awarded a national fellowship by UGC, a statutory body of the Government of India, working as a JRF and SRF at the Department of Physics, Saurashtra University under this fellowship. Prior to this, Hathiya was a lecturer of Physics at VVP Engineering College, Rajkot, India, and received an MSc in Physics from Saurashtra University in 2014. Hathiya has presented research work at many national and international conferences and achieved best presentation awards, has published research papers in peer-reviewed journals and conference proceedings as well as book chapters and a patent, and serves as a reviewer for six SCI-indexed journals.



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Single-cell RNA sequencing reveals vascular heterogeneity and immune crosstalk in the glioma blood-tumor barrier

Background: Glioblastoma (GBM) remains the most devastating primary brain malignancy, with a dismal 5-year survival rate of only 7.2%. The Blood-Brain Barrier (BBB), a specialized neurovascular unit composed of Endothelial Cells (ECs), Pericytes (PCs), and astrocytic end-feet, undergoes pathological remodeling into a dysfunctional Blood-Tumor Barrier (BTB) during glioma progression. However, the cellular heterogeneity and dynamic molecular changes underlying this BBB-to-BTB transition remain incompletely characterized.

Methods: We performed a comprehensive secondary analysis of a public single-cell RNA sequencing dataset (GEO: GSE242044), comprising 100,939 cells from normal brain samples and 83,041 cells from glioma samples. Unsupervised clustering, cell type annotation, pseudotime trajectory analysis, and cell-cell communication network inference were conducted using Seurat, Monocle2, and CellChat pipelines.

Results: Comparative analysis revealed significant compositional shifts in the glioma microenvironment, with endothelial cell proportions increasing from 61.8% to 73.1% ($p < 0.01$) and pericytes decreasing 3.4-fold from 15.9% to 4.7% ($p < 0.001$). Astrocytes exhibited an 11.5-fold increase, 0.25% to 2.88% ($p < 0.001$), reflecting reactive astrogliosis. Cell-cell communication analysis demonstrated a dramatic rewiring of interaction networks: while normal tissues were dominated by pericytes-Smooth Muscle Cells (SMCs) crosstalk critical for BBB maintenance,

tumor tissues shifted toward astrocytes-ECs interactions driven by pro-angiogenic VEGFA-VEGFR2 signaling.

Pseudotime trajectory analysis identified novel tumor-specific subclusters across all three vascular cell types. Tumor pericytes exhibited distinct transcriptional programs enriched for ECM remodeling, with upregulated TUSC3, DAP, NTMT1, SNF8, and RAP1B. Tumor SMCs underwent a synthetic phenotype shift characterized by ribosomal protein upregulation (RPL26, RPL36, RPS23, EEF1A1, RPS2), suggesting translational hyperactivation and loss of contractile function. Notably, endothelial cells diverged into two terminal disease trajectories: a CCND1-driven proliferative pathway and an HSPH1-mediated stress-resistant pathway, with coordinated upregulation of HNRNPAB across both trajectories.

Conclusions: This study reveals previously unrecognized heterogeneity in glioma-associated vascular cells and establishes a vascular dysfunction triad model linking pericyte ECM remodeling, SMC synthetic phenotype switching, and EC dual oncogenic activation to BTB disruption. The identified tumor-specific markers TUSC3, RPL26, CCND1 and HSPH1 represent promising therapeutic targets for precision vascular targeting strategies aimed at normalizing the tumor vasculature, enhancing drug delivery, and overcoming therapeutic resistance in glioma.

Keywords: Glioma, Blood-Tumor Barrier, Vascular Heterogeneity, Single-Cell RNA Sequencing, Tumor Microenvironment, Pericytes, Endothelial Cells.

Biography

Ling Yin earned a PhD in Vegetable Genetics and Breeding from South China Agricultural University in 2016 and completed postdoctoral training at Fudan University and the University of Florida College of Medicine. From 2017 to 2024, Yin served as Postdoctoral Associate and Biological Scientist II at the University of Florida, where the research focused on AAV-based gene therapy, cancer immunology, and tumor microenvironment regulation. Yin has published extensively in high-impact journals including Drug Discovery Today, Molecular Therapy, and Frontiers in Immunology, with expertise spanning single-cell multi-omics, spatial transcriptomics, and precision medicine, currently serves on the editorial boards of multiple international journals and is actively investigating vascular heterogeneity and immune crosstalk in solid tumors.



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Enzymatic pre-treatment of red meat abattoir effluent to reduce fat, oil, and grease while enhancing biogas generation

The discharge of untreated abattoir effluent significantly endangers the environment due to its organic load and concentrations of Fats, Oils, and Grease (FOG). This study examined the impact of enzymatic pre-treatment, leveraging a commercial biological product (Eco-flush™), on the hydrolysis of FOG in red meat abattoir effluent. This procedure aims to enhance effluent quality and increase bioenergy output during Anaerobic Digestion (AD). Characterisation of the raw effluent revealed a chemical oxygen demand of 1818 mg/L, FOG at 2593 mg/L, turbidity measuring 592 FAU, ammonia concentrations of 155 mg/L, and a low concentration of dissolved oxygen of 1.78 mg/L. The enzymatic treatment of the wastewater significantly influenced the pollutant levels of the effluent by effectively hydrolysing FOG. Maximum levels of hydrolysed FOG and maximum soluble Chemical Oxygen Demand (sCOD) were established using enzyme dosages varying from 0.25% to 1.00% (v/v). Our investigation demonstrated that the optimal hydrolysis of FOG occurred at an enzyme concentration of 0.5% (v/v), resulting in the extraction of 17174 mg/L from the effluent solution as compared to the initial 1818 mg/L, which was readily extracted prior to pre-treatment. Exceeding the optimum enzyme concentrations to 0.75% and 1.00% (v/v) resulted in decreased process efficacy, presumably owing to enzyme saturation and process inhibition. The enzyme-assisted pre-treatment adversely affected ammonia and turbidity levels in the effluent, leading to an increase; however, the pre-treated effluent yielded improved biogas and biomethane production during AD, with biogas increases of up to 159% and methane purity of 70%.

Biography

Mabatho Moreroa, a Professional Engineering Technologist holds a doctoral degree in Engineering from the University of South Africa (UNISA). In her research, she specialises in finding renewable energy solutions through the valorisation of biomass for biogas production, and chemical products. She also finds interest in carbon capture using membrane technology and biofuel production using indigenous African resources. She is currently a holder of the Women in Research (WiR) grant, and the Black Academic Advancement Program (BAAP) grant awarded by the National Research Foundation (NRF). Dr Moreroa currently serves as a Senior Lecturer in the Department of Chemical and Materials Engineering at UNISA and an ambassador for women in engineering at the Engineering Council of South Africa (ECSA).



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The use of environmental catalysis for wastewater treatment: Advancement and future perspectives

Environmental catalysis refers to green catalysis applied for pollutant breakdown or production of chemicals without producing an undesirable byproduct. For example, a catalyst which is derived from waste or less expensive materials is promising for circular economy. Here we review environmental photocatalysis, biocatalysis, and electrocatalysis, with a focus on catalyst synthesis, structure, and applications. The removal of toxic chemicals from the wastewater to keep a cleaner and greener environment is a challenging area nowadays for managing liquid waste. Therefore, scientists are in search of novel technologies to treat and recycle wastewater. Rapid industrialization and urbanization put significant quantities of hazardous pollutants in the marine environment, creating serious risks to human health and ecosystem. Conventional wastewater treatment methods have limited removal of stubborn organic contaminants, heavy metals, and emerging pollutants. Environmental catalysis has arisen as a gifted approach for addressing these challenges through the expansion of well-organized technologies.

Recently, nano catalyst design has meaningfully improved the efficiency and removal of pollutants from wastewater. Nanostructured materials, including metal oxides, semiconductor nanoparticles, carbon-based nanomaterials, and hybrid nanocomposites, exhibit high surface area, improved catalytic activity, and superior selectivity compared to conventional catalysts, and catalytic reduction reactions for the treatment of industrial effluents. In current years, many researchers have been working on the treatment using photocatalysts. Environmental catalysis has emerged as a key approach for sustainable pollution control and green chemical processes, as discussed in recent studies.

This study reviews recent developments in nano catalysts useful for environmental remedies, with a specific focus on photocatalytic degradation of organic pollutants and wastewater

treatment policies. The instruments governing catalytic activity are discussed. Furthermore, opportunities for integrating nano catalytic technologies into large-scale wastewater treatment systems are highlighted.

The results show that environmental catalysis gives substantial efficient pollutant removal in water treatments. Continued research in catalyst design, optimizing, and industrial employment is expected to accelerate the adoption of environmentally friendly catalytic technologies for future wastewater treatment applications.

Keywords: Environmental and Nano Catalysis, Wastewater Treatment, Photocatalysis, Advanced Oxidation Processes, Sustainable Water Management.

Biography

Maqsood Ur Rahman is an MS Chemical Engineer specializing in environmental engineering and wastewater treatment, and completed an MSc in Advanced Chemical Engineering from the University of Engineering and Technology (UET), Peshawar, Pakistan. Rahman's research focuses on industrial wastewater treatment, pollutant removal, and sustainable environmental technologies, has published research work in the field of wastewater treatment and has presented findings at scientific forums including PLOS ONE. Current interests include environmental catalysis, advanced oxidation processes, and sustainable technologies for wastewater treatment of industries and reuse, and Rahman is currently exploring PhD opportunities at international universities.



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Catalytic potential and practical limitations of N-doped nanomaterials in plastic depolymerization

Chemical depolymerization of Polyethylene Terephthalate (PET) offers a robust pathway for sustainable plastic recycling, yet traditional glycolysis remains energy-intensive and restricted by the separation challenges of homogeneous catalysts. This study explores the catalytic potential and operational limitations of heterogeneous, nitrogen-doped transition metal nanocatalysts (Mn, Co, Zn and Fe) for PET glycolysis.

To systematically evaluate performance, the catalysts were synthesized via the pyrolysis of metal-ligand complexes using 1,10-phenanthroline across three distinct carbonaceous supports: activated carbon, carbon nanofiber, and Vulcan XC72. Furthermore, the study presents a critical comparative analysis of two thermal activation methods, conventional heating and microwave-assisted depolymerization, to assess their respective impacts on reaction kinetics and energy efficiency.

Among the tested variations, the Mn-based nanocatalyst demonstrated superior catalytic activity. The N-doping mechanism proved crucial for stabilizing the highly dispersed metal active sites. Under conventional heating, the Mn/activated carbon system achieved an 87% yield of high-purity bis(2-hydroxyethyl) terephthalate (BHET) monomer at 200°C within 2 hours. Notably, microwave-assisted glycolysis significantly accelerated the reaction rate compared to conventional methods, highlighting a promising pathway to reduce overall energy consumption. These findings demonstrate that the selection of catalyst supports for microwave-assisted PET chemolysis cannot be directly extrapolated from conventional thermal catalysis. Instead, optimal supports depend on the interplay between its dielectric properties, metal-support interactions, and the reaction mechanism governing bond cleavage.

This evaluation provides essential insights into optimizing support architecture and heating modalities, structuring a clear framework for the development of highly efficient, scalable, and reusable catalytic systems to advance the circular plastic economy.

Biography

Maria Konnova is a Research Associate at Hamad Bin Khalifa University (QEERI), Qatar. Konnova's research focuses on heterogeneous catalysis, sustainable chemical recycling of plastic waste, hydrogen storage technologies, and circular economy solutions, has authored 17 peer-reviewed publications with an h-index of 11 and is actively developing catalytic systems for PET, polycarbonate, and mixed-plastic depolymerization, as well as sustainable liquid organic hydrogen carriers. Current work integrates catalyst design, microwave-assisted chemical recycling, process intensification, and life cycle assessment to develop scalable and sustainable technologies for resource recovery and clean energy applications.



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HF-free hydrothermal synthesis of 2D-on-2D MBene@g-C₃N₄/g-C₃N₅ photo (electro) catalysts for furfural upgrading to sustainable aviation fuel

The electrochemical and photo-electrochemical upgrading of bio-oil derivatives represents a critical pathway toward sustainable aviation fuels and value-added chemicals. Herein, we present the synthesis of hydrofluoric acid-free two-dimensional MBene (MB = WB, MoB,) decorated graphitic carbon nitride heterojunctions (g-C₃N₄/g-C₃N₅) for the efficient conversion of furfural to fuel precursors. MBenes were synthesized via a hydrothermal approach using acidic and alkaline media, eliminating the environmental and safety hazards associated with conventional HF-based etching methods. Systematic compositional optimization revealed that the M10G67 catalyst, comprising 10 wt% tungsten boride and a g-C₃N₄/g-C₃N₅ heterojunction with 67 mol% C₃N₅, exhibited the lowest optical bandgap (1.58 eV) and highest electrochemically active surface area. Under photo-electrochemical conditions, M10G67 demonstrated a ca. 38% enhancement in reduction current density compared to dark conditions, achieving an electrical energy saving efficiency of ca. 11%. The pH-dependent product distribution analysis revealed that basic conditions (pH 8.5) predominantly yielded deoxygenated ring-opened products (57% of total products), representing drop-in sustainable aviation fuels and optimal precursors for sustainable aviation fuel synthesis. Density functional theory calculations elucidated the synergistic role of MBene active sites and the carbon nitride heterojunction in facilitating ring-opening and hydrodeoxygenation pathways, with Co-doped MoB/C₃N₄-C₃N₅ (representing M-(Mo/W)Bx@g-C₃N₄/g-C₃N₅) demonstrating exceptionally favourable thermodynamics for selective 1,3-pentadiene formation. This work establishes a sustainable synthetic route to high-performance 2D-on-2D photo(electro)catalysts for biomass valorisation, offering significant implications for renewable fuel production.

HF-free synthesis. WB and MoB were obtained from WAIB and MoAIB MAB phases via hydrothermal etching in HCl (1–12 M, 393–433 K, 16–24 h) followed by NH_4OH sonication. ICP analysis confirmed near-complete de-aluminization of WAIB (Al reduced from ca. 67 to ca. 2 wt%) with boron retention (B increased from ca. 19 to ca. 60 wt%), whereas the alkaline route stripped boron (down to ca. 1 wt%) and is therefore unsuitable. The acidic route was thus selected. MBene was then co-pyrolsed in situ with urea/melamine/guanidine-carbonate/3-amino-1,2,4-triazole mixtures to yield MYGX composites (Y = MBene wt%; X = mol% g- C_3N_5 in the heterojunction). XRD confirmed the tetragonal WB phase (JCPDS 35-0738) and graphitic (002) reflections at $2\theta \approx 27.5^\circ$, while FTIR revealed broadening of C=N/C–N modes (1150–1700 cm^{-1}) and attenuation of the 810 cm^{-1} s-triazine breathing mode, indicating strong WB–CN interfacial coupling.

Optical and (photo)electrochemical optimization. The composite design pairs metallic, conductive WB with a g- C_3N_4 /g- C_3N_5 heterojunction in which the g- C_3N_5 framework provides a narrower bandgap than g- C_3N_4 for enhanced visible-light harvesting. The optimal composition, M10G67 (10 wt% WB + g- C_3N_4 : g- C_3N_5 = 1:2), exhibited the lowest Tauc bandgap (1.58 eV) versus g- C_3N_4 (2.63 eV), g- C_3N_5 (1.71 eV), and M10G100 (1.68 eV) (Figure 1). In 100 mM furfural / 200 mM H_2SO_4 / 20 vol% acetonitrile, M10G67 delivered the highest reduction current density ($j \approx -10.14 \text{ mA cm}^{-2}$) and the lowest onset potential ($\sim -0.37 \text{ VAg/AgCl}$) among all MYGX compositions. Under simulated solar irradiation, j increased to $-13.83 \text{ mA cm}^{-2}$, a ca. 38% PEC enhancement over dark conditions, and the potential required to reach -10 mA cm^{-2} dropped from -1.12 to -1.01 VAg/AgCl , corresponding to an electrical energy saving efficiency (η_{EES}) of ca. 11%.

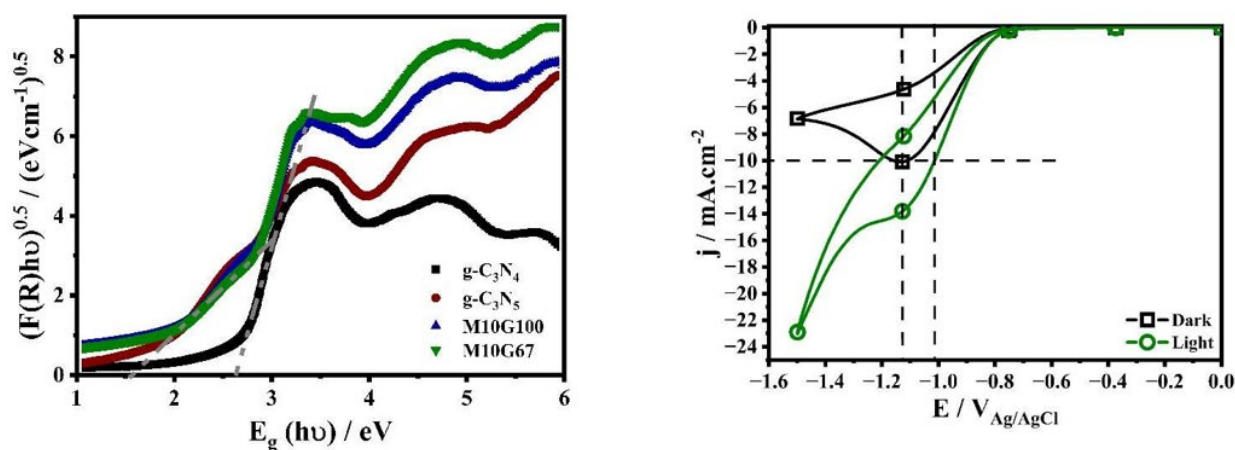


Figure 1. (a) Tauc plots of g- C_3N_4 , g- C_3N_5 , M10G100, and M10G67 obtained from Kubelka–Munk-transformed UV-vis diffuse reflectance, with dashed extrapolations yielding optical bandgaps of 2.63, 1.71, 1.68, and 1.58 eV, respectively. **(b)** Cyclic voltammograms of M10G67 in 100 mM furfural + 200 mM H_2SO_4 + 20 vol% acetonitrile under dark (black) and simulated solar illumination (green); dashed guides at $j = -10 \text{ mA cm}^{-2}$ mark the potentials of -1.12 VAg/AgCl (dark) and -1.01 VAg/AgCl (light).

pH-controlled product selectivity: GC-MS analysis of bulk H-cell electrolysis revealed a strong pH-steering effect on the product pool. Acidic media (pH 0.5) channelled ca. 53.4% of carbon into polymerized humins; near-neutral conditions (pH 6) maximized ring-

opening (ca. 86%) but produced mainly oxygenates (ca. 90% of the ring-opened fraction). Basic conditions (pH 8.5) inverted this split, yielding ca. 64% deoxygenated species within the ring-opened pool, i.e. ~57% of all products are fully deoxygenated ring-opened hydrocarbons, with carbon numbers C3–C24 dominated by C5–C18, directly aligned with the SAF carbon range and requiring only minimal downstream hydrotreatment.

Conclusions: A scalable, HF-free hydrothermal route to 2D-on-2D MBene@g-C₃N₄/g-C₃N₅ photo(electro)catalysts is established. Composition-tuned M10G67 combines a 1.58 eV bandgap, a ca. 38% photo-enhancement of the reduction current, and pH 8.5-controlled selectivity yielding ~57% C3–C24 deoxygenated ring-opened products. The platform is generalizable to other bio-oil furans (e.g. 5-HMF) for renewable transportation-fuel production.

Keywords: MBene, g-C₃N₄/g-C₃N₅ Heterojunction, Furfural Electroreduction, Photo-Electrocatalysis, Sustainable Aviation Fuels.

Biography

Dr. Muhammad Ashraf Sabri is a Postdoc in Chemical and Petroleum Engineering at Khalifa University in Abu Dhabi, UAE. Under the supervision of Prof. Lourdes Vega and affiliated with the Research and Innovation Center on CO₂ and Hydrogen (RICH Center), his research focuses on decarbonization, clean energy, and sustainable fuels. Dr. Sabri obtained his Ph.D. in Engineering from Khalifa University in 2024 and completed his master's in chemical engineering from the American University of Sharjah in 2017. He was a visiting scholar at the same institution in 2017 and 2019. Before his postdoctoral work, Dr. Sabri served as a Lecturer at MNS-University of Engineering and Technology, Multan, Pakistan, from 2012 to 2015, where he also managed sports activities and founded a sports society. With over 28 publications, he is recognized for his expertise in heterogeneous catalysis, biofuel production and upgradation, and wastewater treatment, with a current focus on CO₂ capture and utilization, and sustainable fuels.



Osman Adiguzel

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Memory characteristics and diffusionless phase transformations in shape memory alloys

Shape memory alloys are multifunctional materials and take place in a class of advanced smart materials by exhibiting dual memory characteristics, shape memory effect and superelasticity. Shape memory effect is a multidisciplinary subject and initiated with thermomechanical processes on cooling and deformation and performed thermally on heating and cooling, with which shape of the material cycles between original and deformed shapes in reversible way, and this behavior can be called thermoelasticity. This phenomenon is governed by diffusionless phase transformations in crystallographic level, thermal and stress induced martensitic transformations.

Thermal induced martensitic transformation occurs on cooling with cooperative movement of atoms in $\langle 110 \rangle$ -type directions on $\{110\}$ -type close packed planes of austenite matrix, along with lattice twinning and ordered parent phase structures turn into the twinned martensite structures, and twinned structures turn into detwinned martensite structures by means of stress induced martensitic transformations with deformation. Atomic movements are confined into the nearest atom distances, and martensitic transformations have diffusionless character. Superelasticity is performed with stressing and releasing the material in elasticity limit at a constant temperature in the parent austenite phase region, and shape recovery occurs immediately upon releasing, by exhibiting elastic material behavior. Superelasticity is also result of stress induced martensitic transformation, and the ordered parent phase structures turn into the detwinned martensite structures with stressing. Lattice twinning and detwinning reactions play important role in martensitic transformations, and they are driven by internal and external forces, by means of inhomogeneous lattice invariant shears. These alloys are functional materials and used in many fields in biomedical application to the building industry as the energy absorber against the seismic events.

Copper based alloys exhibit this property in metastable β -phase region. Lattice twinning is not uniform in these alloys, and the ordered parent phase structures undergo the layered structures with martensitic transformation.

In the present contribution, X-ray and electron diffraction studies were carried out on ternary copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections. A series of X-ray diffractogram were taken during aging. X-ray diffractograms taken in a long-time interval show that locations and intensities of diffraction peaks change with the aging time at room temperature, and this result refers to the redistribution of atoms in diffusive manner.

Keywords: Shape Memory Effect, Martensitic Transformation, Thermoelasticity, Superelasticity, Twinning, Detwinning.

Biography

Osman Adiguzel graduated from the Department of Physics, Ankara University, Turkey in 1974 and received a PhD degree from Dicle University, Diyarbakir, Turkey, then studied at Surrey University, Guildford, United Kingdom, as a post-doctoral research scientist in 1986-1987 on shape memory alloys. Adiguzel worked as research assistant from 1975 to 1980 at Dicle University and shifted to Firat University, Elazig, Turkey in 1980, became professor in 1996, and retired on November 28, 2019, due to the age limit of 67, following an academic life of 45 years. Adiguzel published over 80 papers in international and national journals, joined over 120 conferences and symposia at international and national level as participant, invited speaker or keynote speaker with contributions of oral or poster, served as program chair or conference chair and co-chair in some of these activities, joined over 60 conferences as Keynote Speaker and Conference Co-Chair in the last six years and over 230 online conferences in the pandemic period of 2020-2024, and supervised 5 PhD theses and 3 MSc theses. Adiguzel received a certificate awarded in recognition of significant contribution of 2 patterns to the Powder Diffraction File Release 2000, and the International Centre for Diffraction Data (ICDD) also appreciates the cooperation of the group and interest in the Powder Diffraction File.



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The Fe-PNP-15%-H₂O catalyst reduction catalytic test and its valorisation as acid catalyst to the methylal synthesis

Pozzolana is a volcanic silico-aluminous material that is widely found in Madagascar, especially in the Vakinankaratra region. Black citric acid polymer (PN) is a material synthesized by polymerizing citric acid, a non-toxic, biodegradable, and eco-friendly raw material. Pure iron is a metal that is widely available in Madagascar, either in its natural form or as a product of recycling scrap iron and metal waste. The valorization of these three raw materials leads to the synthesis of the Fe-PNP-15%-H₂O catalyst, on which 15% iron (Fe) is dispersed by using distilled water as a synthesis solvent.

A catalytic test based on the aqueous phase reduction of hydrogen peroxide H₂O₂ to H₂O with the formation of oxygen O₂ was carried out to evaluate the reducing capacity of the Fe-PNP-15%-H₂O catalyst. This method was established to try to bypass the catalytic test of reducing power with NO₂ gas, a very harmful gas which can disrupt ecosystems and air quality. Indeed, hydrogen peroxide H₂O₂ is a molecule naturally secreted by the body with disinfectant, antiseptic, and bleaching properties that are widely used in many chemical products, including cosmetics. The results of catalytic tests using hydrogen peroxide H₂O₂ not only enable the reducing power of catalysts to be determined, but also allow their subsequent ability to treat NO_x gases to be compared.

In addition, the eco-friendly Fe-PNP-15%-H₂O acid catalyst was used in the synthesis of methylal, a chemical used in several areas of the chemical and automotive industries. The results of the experiments show that this Fe-PNP-15%-H₂O heterogeneous acid catalyst is much more active than the H⁺/H₂SO₄ homogeneous protonic acid catalyst.

Biography

Rabeharitsara Andry Tahina is a Malagasy chemical engineer graduated from École Polytechnique d'Antananarivo in 1999, and obtained a PhD in applied organic chemistry at Poitiers University, France in 2003, under the supervision of Professors Michel Guisnet and Patrick Magnoux, specializing in zeolite acid catalysis. Since 2008 Rabeharitsara has been a lecturer in the chemical engineering department at ESPA-Antananarivo University, with research focused on the valorization of citric acid and its derivatives, the esterification with citric acid to extract bioactive molecules, heterogeneous catalysis, and valorisation of Madagascar's natural resources, and has published more than 20 scientific articles in international journals.



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DFT insight into Rh-stabilized oxygen-vacancy ensembles on In_2O_3 for selective propanal hydrogenation to 1-propanol

Rhodium-modified In_2O_3 has shown promising performance for selective alcohol formation in reductive hydroformylation, where experimental characterization suggests a strong connection between dispersed oxidized Rh species, oxygen-defective In_2O_3 , and enhanced 1-propanol selectivity. In this work, Density Functional Theory (DFT) calculations were used to clarify the atomistic role of Rh and oxygen vacancies on In_2O_3 (111), with reference to experimental XPS, Raman, and H_2 -TPR results.

The calculations first examined Rh anchoring and oxygen-vacancy formation on stoichiometric and defective In_2O_3 surfaces. Rh was found to interact cooperatively with surface oxygen vacancies. Oxygen-deficient sites strengthen Rh binding compared with the vacancy-free surface, supporting the stabilization of isolated Rh species on defective In_2O_3 . In turn, Rh promotes local surface reduction: formation of an additional oxygen vacancy, which is unfavorable on bare In_2O_3 , becomes thermodynamically favorable adjacent to Rh. This leads to a stable Rh-divacancy motif and provides a molecular-level explanation for the experimentally observed Rh-assisted reducibility and oxygen-defective nature of $\text{Rh@In}_2\text{O}_3$.

This Rh-stabilized oxygen-deficient ensemble was then used to model propanal hydrogenation to 1-propanol, a key step governing alcohol selectivity. Reaction profiles were compared for vacancy-free, single-vacancy, and double-vacancy $\text{Rh-In}_2\text{O}_3$ models prior to propanal adsorption. The DFT results show that increasing local oxygen deficiency around Rh facilitates hydrogen transfer to the aldehyde intermediate and lowers the barrier for C-O hydrogenation. The double-vacancy Rh site provides the most favorable pathway, consistent with the higher alcohol selectivity observed experimentally for the most oxygen-defective $\text{Rh@In}_2\text{O}_3$ catalyst.

Overall, the calculations identify an oxidized Rh-oxygen-vacancy ensemble as the catalytically relevant interfacial motif. Rh acts not only as a hydrogenation center, but also as a promoter of local oxygen-vacancy formation, while the defective In_2O_3 surface tunes the Rh site for selective propanal hydrogenation. These findings highlight the importance of cooperative metal-defect interactions in designing oxide-supported single-site catalysts for selective C-O hydrogenation reactions.

Biography

Rafia Ahmad is a Research Scientist at the KAUST Catalysis Center, specializing in computational chemistry, heterogeneous catalysis, and materials modeling. Ahmad's research uses density functional theory and machine-learning-based approaches to understand catalytic surfaces, oxygen vacancies, reaction mechanisms, and energy-relevant transformations, and earned a PhD in Materials Science from the Indian Institute of Science, Bangalore, with extensive experience in oxide catalysts, metal-support interactions, carbon capture and utilization, and sustainable energy innovation.



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Catalytic hydrogen production: Unlocking ammonia as a hydrogen carrier

As a clean energy carrier with high gravimetric energy density, hydrogen is expected to find various applications in fuel cell systems and other renewable energy technologies. Nevertheless, large-scale hydrogen utilization still faces many obstacles related to its production, storage, transportation, and safe handling. Traditionally, hydrogen has been stored using high-pressure compression or cryogenic liquefaction, leading to higher energy costs, complex technological processes, and higher cost. Thus, significant efforts have been devoted to developing hydrogen rich chemical hydrogen carriers that could provide effective hydrogen storage and generation.

Ammonia (NH₃) is one of the hydrogen carriers with a high hydrogen content of 17.6 wt%, well-established facilities for production and transportation and convenient storage conditions relative to hydrogen. The most important advantage is that ammonia can be converted into hydrogen via catalytic decomposition ($2\text{NH}_3 \rightarrow \text{N}_2 + 3\text{H}_2$) with no direct CO₂ emissions and thus can be used as the feedstock for on-site hydrogen generation. The key requirement for ammonia decomposition is highly active and stable catalysts providing high conversion rate at low reaction temperatures.

In several studies performed on different catalysts used for the ammonia decomposition reaction, Ruthenium (Ru) catalysts have shown outstanding catalytic activity. The efficiency of Ru, however, is highly dependent on physicochemical characteristics of the support such as the surface area, metal-support interactions, electronic characteristics, dispersion of active Ru, and surface basicity. CeO₂ is one of the effective supports due to its unusual redox properties, oxygen storage capability, and interaction capability with the metal on the support. The major downside of CeO₂, however, is its high price that limits its wide usage as a bulk support.

In the present study, catalytic decomposition of ammonia was explored for the generation of CO_2 -free hydrogen using Ru catalysts. In order to minimize the usage of CeO_2 while keeping its advantages in catalysis intact, a core-shell type support configuration was adopted in which CeO_2 was used to modify metal oxide supports. Ru catalysts were prepared using such modified metal oxide supports. It was observed that the composition and nature of the support played an important role in the activity of ammonia decomposition. The prepared core-shell supported Ru catalysts showed good hydrogen yield. It is evident that the use of CeO_2 strategically allows the benefit of its promotion without using it as the main support material. Therefore, these prepared catalysts were suggested as cost-effective efficient catalysts.

Biography

Rahat Javaid was awarded a Gold Medal for obtaining a first-class position in MSc Chemistry, and completed a PhD at Tohoku University, Japan, as a recipient of the MEXT Scholarship. Following postdoctoral research at the Tokyo Institute of Technology, Japan, Javaid joined the Fukushima Renewable Energy Institute, AIST, Japan, as a Research Scientist, and additionally served as program staff for TAC-MI at Tokyo Institute of Technology, Japan. In 2023 Javaid joined the University of South Carolina as a Research Scientist, and for over a decade has been conducting research in the field of catalysis for environmental and energy-related applications. Javaid's research contributions have been acknowledged through publications in esteemed peer-reviewed journals, and Javaid has actively participated as a reviewer and technical committee member for various peer-reviewed journals and international conferences.



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Nanometer-thin DALP®-Pt electrocatalysts with ultralow platinum loading for efficient hydrogen evolution reaction

Hydrogen production through Proton Exchange Membrane (PEM) water electrolysis requires highly active and stable electrocatalysts while minimizing noble metal consumption. Here, we present Direct Atomic Layer Processing (DALP®) as a rapid, maskless, and material-efficient manufacturing platform for fabricating ultrathin Pt electrocatalysts with precise nanoscale thickness control for the Hydrogen Evolution Reaction (HER).

Using DALP®, Pt thin films with thicknesses ranging from 2–50 nm were directly fabricated on glassy carbon substrates within a single deposition process under atmospheric conditions. The resulting Pt loadings ranged from approximately 0.004–0.10 mg cm⁻², significantly lower than conventional PEM electrolyzer cathodes. Electrochemical measurements in acidic media (0.5 M H₂SO₄) demonstrated strong thickness-dependent HER activity. Films in the 10–30 nm range exhibited near-bulk Pt catalytic behavior, achieving current densities of 10 mA cm⁻² at overpotentials of approximately 45–50 mV with Tafel slopes of 30–40 mV dec⁻¹. The 30 nm DALP-Pt film showed the highest Electrochemically Active Surface Area (ECSA), lowest charge-transfer resistance, and exchange current density of 0.5–0.6 mA cm⁻², indicating optimal Pt utilization.

Morphological and electrochemical analyses revealed a transition from discontinuous Pt islands at 2 nm to continuous nanostructured films at intermediate thicknesses, followed by grain coarsening and reduced utilization at 50 nm. Notably, increasing Pt thickness beyond 30 nm produced minimal improvements in HER performance, demonstrating that DALP enables substantial reduction in Pt usage without compromising catalytic activity. Stability testing further confirmed excellent electrochemical durability over prolonged cycling.

These findings establish DALP® as a powerful platform for high-throughput fabrication and optimization of low-loading electrocatalysts with atomic-scale precision. The demonstrated combination of ultralow Pt loading, near-bulk HER kinetics, and scalable direct-write manufacturing offers a promising pathway toward cost-effective hydrogen production technologies and accelerated catalyst discovery for clean energy applications.

Biography

Ruchi Sharma is a Senior Application Scientist at ATLANT 3D, specializing in catalysis and advanced materials, and earned a PhD in Chemistry from IIT Roorkee, India, and completed postdoctoral research at Aarhus University, Denmark, focusing on catalytic materials, reaction mechanisms, and process development. At ATLANT 3D, Sharma applies this expertise to advance Direct Atomic Layer Processing (DALP) technology, collaborating with interdisciplinary teams to develop atomic-scale solutions for catalysis, batteries, and microdevices, and is dedicated to bridging the gap between research and industry, ensuring that scientific breakthroughs evolve into real-world solutions.



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Unraveling the critical role of surface intermediates in methane reforming over Mo-based catalysts

Sustaining catalytic activity remains a fundamental challenge in methane reforming technologies, where uncontrolled reaction pathways and surface fouling typically lead to rapid deactivation. Dry Methane Reforming (DMR) offers a sustainable route to convert CO₂ and CH₄ into syngas, yet commercialization is severely constrained by coking and sintering. Ni-based catalysts are cost-effective but poorly stable, while noble metals, though more resistant, are economically unviable. Similarly, H₂S-Assisted Methane Reforming (H₂SMR) provides a dual-purpose strategy to valorize sour natural gas into H₂ and sulfur products, but suffers from sulfur poisoning, coke deposition, and sintering under aggressive conditions.

In this study, we investigate the reaction mechanism over Mo-based catalysts using H₂S as a co-reactant. At 1173 K, the catalyst exhibited robust performance for 5 hours, maintaining a methane conversion of 63.7% and H₂ production of 688.8 μmol g⁻¹ min⁻¹, in stark contrast to pure methane cracking, where conversion plummeted from 43.6% to 14.3%. In situ DRIFTS analysis revealed that the reaction is governed by specific surface intermediates, wherein activated methane interacts with surface sulfur to form CH₃S* species. This distinct pathway effectively channels carbon toward product formation rather than allowing accumulation on the catalyst surface, thus preserving active sites and sustaining catalytic cycles.

Our findings elucidate the pivotal role of these intermediates in mitigating deactivation and provide a fundamental mechanistic basis for designing durable methane reforming catalysts. By integrating experimental insight with rational catalyst design, this work paves the way toward more resilient and efficient reforming technologies, particularly for processing sour feeds, and offers a promising strategy to overcome the long-standing trade-off between activity and stability in harsh reforming environments.

This research was supported by RSF 25-43-00131 grant.

Biography

Rustem Zairov is a leading researcher at the Arbuzov Institute of Organic and Physical Chemistry, Russian Academy of Sciences, and an Associate Professor at Kazan Federal University. Zairov's research centers on developing multifunctional colloidal systems, encompassing rare-earth and carbon-based nanomaterials, with expertise spanning coordination chemistry and materials science and a focus on applications derived from their magnetic and optical properties. Zairov has a strong publication record with a Scopus h-index of 27, contributing over 160 documents, and recent work includes developing catalysts for hydrogen production from sour natural gas, methane reforming and investigating nanomaterials for practical applications.



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Enhancing corrosion resistance and adhesion properties of acrylic-epoxy composite coatings on steel substrates using graphene-based nanomaterials

Corrosion is often referred to as the degradation of a material upon its interaction with the surrounding environment. Furthermore, the industrial challenges associated with corrosion has resulted an immense impact on the global economy. Hence, significant efforts were devoted towards developing new corrosion prevention strategies to increase the lifespan of the material. Due to its superior chemical stability, mechanical, thermal and electrical properties along with high corrosion resistance, graphene and its nanomaterials have been broadly used to produce effective and efficient coatings.

This investigation demonstrates the significance of graphene-based materials to enhance the barrier performance of the acrylic-epoxy based PolyDiMethylSiloxane (PDMS) nanocomposite coatings. Via the solution intercalation approach, the Graphene Oxide (GO) nanoparticles in the increment of 0.5-3 wt.% were added to the blended resins. In order to investigate the surface wettability, adhesion strength, anti-corrosion performance and surface morphology of the coatings, the fabricated coatings were characterized using Water Contact Angle (WCA), Cross-Hatch Test (CHT), Electrochemical Impedance Spectroscopy (EIS) and Field Emission Scanning Electron Microscopy (FESEM) respectively.

The WCA results revealed the enhancement of the surface hydrophobicity of the coatings. The CHT confirmed that all the coatings had exhibited excellent surface adhesion characteristics. The EIS studies and FESEM micrographs confirmed that all the coatings had exhibited a strong anticorrosion barrier over a period of 90 days of immersion. However, it was noteworthy to point out that the inclusion of smaller content of GO enhanced the corrosion protection performance of the coatings. Throughout the immersion time, the 0.5% GO coating sample

exhibited the best corrosion resistance. In summary, due to the outstanding properties of graphene-based materials, the inclusion of GO nanofillers in the matrix resulted in the overall enhancement of the corrosion protection performance of the coatings.

Biography

Sachin Sharma Ashok Kumar is a material scientist, recognised for pioneering contributions on advanced functional materials, energy storage, corrosion applications, sustainable technologies and 3D composites for numerous engineering applications, currently attached to the Department of Mechanical Engineering at Taylor's University, Malaysia and a visiting Professor at Lincoln University College, Malaysia. Ashok Kumar received both a BSc (Hons) and an MSc (Hons) in Mechanical Engineering minor in Materials Science from Wichita State University, USA in 2011 and 2012 respectively, and a PhD in Advanced Materials Science Engineering from University Malaya in 2023, and is widely recognised for research on the synthesis of super-hydrophobic graphene-based composite coatings for corrosion applications and graphene thin films for lightning strike protection for aircraft applications. Ashok Kumar has published over 60 articles in various high-ranked ISI/WoS and Scopus-listed journals with an H-index of 20, participated in over 70 international conferences as a keynote, distinguished or oral speaker, has received several prestigious awards at international and national exhibitions, and is a member and a licensed Professional Engineer registered with the Board of Engineers Malaysia (BEM) and Institution of Engineers Malaysia (IEM) and a Professional Technologist with the Malaysia Board of Technologists (MBOT).



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Antibody-proteases as a generation of unique biomarkers, biocatalysts, potential targets and translational tools towards nanodesign-driven biochemical engineering and precision medical practice

High impact of Antibody-proteases (Ab-proteases) can be used to monitor both clinical and subclinical courses of chronic autoimmune inflammation to predict stepwise transformations of the course, starting from the pre-illness and to prognosticate the clinical illness finally. This information can allow to design the algorithms for combinatorial preventive, prophylactic, therapeutic and rehabilitative treatment, whilst developing unique tools for individually therapy for a number of diseases, such as a group of autoimmune diseases which holds a particular position.

Abs endowed with enzymatic properties have been isolated from the serum of patients with different autoimmune conditions. Disease-associated abzymes may have been induced by the Ag implicated in the disease and might precisely control a wide variety of physiological processes and thus are important drug targets. Regarding abzymes, their phenomenal property mentioned is buried in the Fab-fragment of the Ig molecule and is appearing to sound as a functional, Ag-binding and enzymatic, property of the Ab molecule.

The primary translational potential of abzymes, Ab-proteases predominantly, and thus of this knowledge is in the rational design of new therapeutics to exploit the role of the key pathways in influencing disease. The latter is a brand-new field of chemical engineering. For instance, abzymes can selectively cleave the peptide bonds of the virus coat protein, thereby preventing the virus from binding to target cells.

Of tremendous value are Ab-proteases directly affecting remodeling of tissues. By changing sequence specificity one may reach reduction of a density of the negative proteolytic effects within the myelin sheath and thus minimizing scales of demyelination.

Selective chemical modification of abzymes can be used to create novel proteins, particularly enzymes and Abs, with altered specificities and catalytic activities. Abzymes can be chemically engineered to make proteins of higher affinity or smaller molecular variants that retain or change the functional properties of the original Ab. In this context, targeted Ab-mediated proteolysis could thus be applied to isolate from Ig molecules catalytic domains containing segments to exert proteolytic activity and then be used as therapeutic modifiers. Ab-based therapeutics have entered the central stage of drug discovery as a result of a major shift in focus of many biotech and biopharma companies. Modification strategies should soon yield a wide spectrum of novel biomolecules whose activities are optimized for therapeutic applications.

Ab-proteases can be programmed and reprogrammed to suit the needs of the body metabolism or be designed for the development of principally new catalysts with no natural counterparts. Thus, abzyme study has an important value in theory and practice for biology, chemistry and medicine. So, further studies on targeted Ab-mediated proteolysis may provide biomarkers of new generations and thus a supplementary tool for assessing the disease progression and predicting disability of the patients and persons-at-risks. And the new approach is needed to secure artificial or edited Ab-proteases as unique translational probes to diagnose, to monitor, to control and to treat and rehabilitate autoimmune conditions patients at clinical stages and to prevent the disorder at subclinical stages in persons-at-risks to secure the efficacy of preventive, prophylactic and restorative manipulations.

Biography

Sergey Suchkov was born in the City of Astrakhan, Russia, in a family of dynasty medical doctors. In 1980 Suchkov graduated from Astrakhan State Medical University and was awarded MD, in 1985 maintained a PhD as a PhD student of Sechenov University and the Institute of Medical Enzymology, and in 2001 maintained a Doctor Degree at the National Institute of Immunology, Russia. From 1989 to 1995 Suchkov was Head of the Lab of Clinical Immunology, Helmholtz Eye Research Institute in Moscow, and from 1995 to 2004 Chair of the Dept for Clinical Immunology, Moscow Clinical Research Institute (MONIKI). At present Sergey Suchkov, MD, PhD, is Professor in Medicine and Immunology and Director of the Center for Biodesign of N.D. Zelinskii Institute for Organic Chemistry, Russian Academy of Sciences, Moscow, Russia; R&D Director, InMedStar, Russia-UAE; Senior Scientific Advisor of China Hong Kong Innovation International Business Association, Hong Kong; and Secretary General, United Cultural Convention, Cambridge, United Kingdom.



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Catalytic CO₂ hydrogenation over additively manufactured metal structures under ambient conditions

Catalytic hydrogenation of carbon dioxide (CO₂) is considered as a promising approach of converting CO₂ into valuable chemicals and fuels, however developing an active catalyst remains a challenge. This present work demonstrated the application of NiGa intermetallic phase functionalized 3D printed structured catalysts (Inconel 625, TiAlV, and Brass) for the first time towards CO₂ hydrogenation. 3D printed metallic structures were functionalized with NiGa intermetallic phase, by dip coating and catalysts were activated by reducing under hydrogen atmosphere at 550 °C to obtain the active intermetallic phase.

CO₂ hydrogenation over these catalysts were screened in a tubular fixed-bed stainless steel reactor at 300°C, 400°C, and 500°C under atmospheric pressure for continuous 5 hours. Reaction products were analyzed using a PerkinElmer GC-TCD. The catalytic performance showed a distinct temperature-dependent selectivity: CO was predominantly formed at lower temperatures via the Reverse Water-Gas Shift (RWGS) reaction, while CH₄ production became dominant at higher temperatures due to enhanced CO₂ methanation activity.

The use of 3D printed open framework metallic structures as structured supports provided several advantages, including improved heat and mass transfer, reduced diffusion limitations, and enhanced structural stability during reaction. Among the tested supports, variations in thermal conductivity and surface properties were found to influence product distribution and catalyst stability. Overall, the results demonstrated that NiGa catalysts supported on 3D metallic frameworks present an effective and scalable route for selective CO₂ hydrogenation at ambient conditions. The study underscores the potential of intermetallic catalysts on engineered monolithic architectures as new generation of catalysts, offering valuable insights for the development of advanced catalytic systems for sustainable CO₂ utilization.

Biography

Shailza Sharma received an MSc degree in chemistry from Kurukshetra University, Haryana, India, and is now pursuing a PhD degree (RMIT-CSIRO) under the supervision of Dist. Prof. Suresh K. Bhargava and Dr PR. Selvakannan at the School of Science, RMIT University. Major research interests include heterogeneous catalysis, CO₂ capture and conversion, and thermocatalysis.



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One-step strategy to maximize single-atom catalyst utilization in nitrate reduction via bidirectional optimization of mass transfer and electron supply

Single-atom catalysts offer exceptional performance but face practical challenges due to complex synthesis and low efficiency caused by mass transfer resistance. In this study, based on a simple one-step pyrolysis method, we designed a Cu single-atom catalyst with high active site exposure and a locally electron-deficient environment (HE Cu₁-N₄) to achieve maximum utilization efficiency in electrocatalytic Nitrate Reduction (NO₃RR). Using advanced characterization techniques, we confirmed that its unique 3D structure enhances Cu atom exposure and reduces nitrate (NO₃⁻) mass transfer resistance.

Synchrotron radiation and DFT calculations showed that adjusting the coordination environment induces a local electron-deficient effect in Cu atoms, increasing the electrostatic attraction to NO₃⁻. HE Cu₁-N₄ achieved 100% NH₃ selectivity across a wide range of NO₃⁻ concentrations, with an NH₃ yield of 5.09 mg h⁻¹ mgcat⁻¹, nearly 7-fold higher than that of the conventional unmodified Cu single-atom catalyst (Cu₁-N₂, 0.73 mg h⁻¹ mg_{cat}⁻¹).

Under pilot-scale conditions, HE Cu₁-N₄ demonstrated strong resistance to interference and excellent stability in complex water systems. A simple modification method enhanced the utilization efficiency of single atoms in single-atom catalysts, significantly improving the catalytic activity of the material. Moreover, this straightforward synthesis strategy holds promise for the large-scale production of single-atom catalysts, paving the way for practical engineering applications.

Biography

Xianhu Long is a PhD candidate in Environmental Engineering at Sun Yat-sen University, supervised by Prof. He Chun, with research focused on electrocatalytic resource recovery technologies. Long has published 27 papers and served as Principal Investigator for a National Natural Science Foundation doctoral basic research project in China.



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One hydroxyl flip: Biocatalytic isomerization unlocks high-value chemicals

Stereochemical inversion at a single hydroxyl group can profoundly alter the physicochemical properties, biological functions, and application value of carbohydrate molecules. D-Tagatose, a rare sugar with growing interest in food, health, and biomanufacturing, differs from D-fructose only in the configuration of the hydroxyl group at C4. This subtle structural change provides an attractive model for understanding how enzymes achieve precise stereochemical control and how such catalytic principles can be translated into practical manufacturing processes. In this work, we focus on C4 epimerization as a stereoselective biocatalytic process, integrating enzyme discovery, molecular engineering, catalytic mechanism analysis, and process intensification. Tagatose 4-epimerase (T4E)-mediated catalysis involves ring opening, proton abstraction, formation of a cis-enediol intermediate, stereoselective reprotonation at C4, and subsequent ring closure, highlighting the critical role of active-site architecture in controlling stereochemical outcome. Enzyme screening and engineering strategies were therefore employed to improve catalytic efficiency, stability, and substrate compatibility, followed by optimization of catalytic and bioprocess conditions toward efficient tagatose production. More broadly, this study illustrates how flipping one hydroxyl can be treated as a fundamental catalytic design problem rather than merely a sugar-conversion reaction. Understanding and engineering hydroxyl epimerization may provide a general framework for developing selective biocatalysts for rare sugars and other stereochemically complex molecules, bridging molecular catalysis with sustainable chemical manufacturing.

Keywords: Biocatalysis; C4 Epimerization; D-Tagatose; Rare Sugars; Stereoselectivity; Enzyme Engineering.

Biography

Cai Xue, Associate Professor and Doctoral Supervisor at Zhejiang University of Technology, is a recipient of the Young Science and Technology Talent under the Zhejiang Provincial High-level Talent Special Support Program. Her research focuses on bioisomerization. She has led six projects including the National Natural Science Foundation of China and Zhejiang Provincial Natural Science Foundation Key Program. As the first author, she has published 17 SCI papers in journals like Engineering and Biotechnology Advances, and obtained 22 authorized Chinese invention patents. She serves on the editorial boards of BMC Biotechnology and Engineering Food.

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Polyoxometalate-derived molybdenum catalysts for the reverse water–gas shift reaction

The Reverse Water–Gas Shift (RWGS) reaction was investigated using catalysts derived from Keggin-type PolyOxoMetalates (POMs), including $\text{H}_3\text{PMo}_{12}\text{O}_{40}$ and $\text{H}_3\text{PW}_{12}\text{O}_{40}$, along with their Co(II) and Ni(II) salts. Under reaction conditions, molybdenum-based POMs decompose to form active Mo oxide species, which exhibit high catalytic activity, selectivity, and stability in the RWGS reaction.

Catalysts derived from $\text{H}_3\text{PMo}_{12}\text{O}_{40}$ supported on SiO_2 , TiO_2 , and $\gamma\text{-Al}_2\text{O}_3$ achieved 100% CO selectivity at CO_2 conversions of 31–33% at 600 °C and a $\text{CO}_2\text{:H}_2$ ratio of 1:1, approaching the thermodynamic equilibrium of 39%. Among these, $\text{H}_3\text{PMo}_{12}\text{O}_{40}/\text{SiO}_2$ showed higher activity compared to $\text{MoO}_3/\text{SiO}_2$ with equivalent Mo loading, indicating a phosphorus-induced enhancement effect. This improvement is attributed to better dispersion of Mo oxide species, as confirmed by STEM analysis.

Mechanistic studies using chemical looping and H_2 -TPR suggest that the RWGS reaction proceeds via a redox pathway, involving reduction of Mo(VI) to Mo(IV) by H_2 , followed by reoxidation with CO_2 to produce CO, consistent with a reverse Mars–van Krevelen mechanism. In contrast, tungsten-based POMs exhibited negligible activity due to their resistance to reduction under reaction conditions.

Biography

Asma M. O. Aldajani is currently a PhD student in the Department of Chemistry at the University of Liverpool, with research focused on heterogeneous catalysis and particular emphasis on the preparation and development of catalysts for the Reverse Water Gas Shift

(RWGS) reaction, working on designing efficient catalytic systems for CO₂ conversion and utilization. Aldajani has experience in catalyst synthesis and characterization techniques, including X-Ray Diffraction (XRD) and BET surface area analysis, and through this research aims to contribute to the development of sustainable catalytic processes and cleaner energy solutions.



Zhongsheng Lee

Zhengzhou Commercial Technician College, China

How much do you know about isotopes? 2,787 pieces

I am the founder of the Three-Dimensional Periodic Law of Elements, and its development involved three distinct stages: the first stage (the budding stage), the second stage (the formation stage), and the third stage (the expansion stage).

During the initial development phase, Roy Alexander, a designer for the South Carolina State University Science and Technology Exhibition, created the Alexander's Elemental Arrangement, a three-dimensional teaching aid; Professor Yoshiteru Maeno, a physicist specializing in superconductivity at Kyoto University, invented the Ring-Spring Elemental Table, which resembles a pen holder; Fernando Dufour, a retired chemistry professor at the Ahuntsic College in Montreal, Canada, together with William B. Jenson of the University of Cincinnati, USA, proposed a 3D periodic table; K. Hagino and Y. Maeno from the Department of Physics at Kyoto University developed the Nuclear Periodic Table (Elementouch); the author also designed a three-dimensional prototype featuring horizontal (X-axis), vertical (Y-axis), and longitudinal (Z-axis) axes; alongside 3D models developed by researchers from other countries. Refer to the Four Stages of the Development of the Periodic Law of Chemical Elements: Point, Line, Plane and Volume released at the 6th World Chemical Congress. Among these 3D models of many countries, it is undeniable that some are variations of the planar periodic table of elements. Some are teaching AIDS or toys about the periodic table of elements. All of them were attempts to explore the three-dimensional periodic law, but in the end, no three-dimensional periodic law of elements was formed. To form the 3D periodic law of elements, the first step is to collect, count and screen how many existing natural and artificial elements are in the same position? Because the planar periodic table of elements is the arrangement rule of chemical elements, while the three-dimensional periodic law of elements is the study of the arrangement rule of elements in the same position. The chemical elements have been identified as 118 kinds. To construct the 3D periodic law of elements, it is necessary to count down to the unit's place. So far, no exact statistics have been seen.

Since the author proposed the construction of the three-dimensional periodic law of elements in his sophomore year of university in 1957, he has begun to collect isomorphous elements. I have begun collecting isotopes. In addition to my regular efforts to gather such data, the following six major sections of the Isotope Handbook are listed in chronological order.

1. Edited by Ma Chongzhi et al. Manual of Radioactive Isotopes [M]. Beijing: Science Press, 1979.
2. Editor in Chief Ren Fuzuo Middle School Chemistry Handbook [M]. Xi'an: Shaanxi Science and Technology Press. 1983
3. Dai Nengxiong is waiting Handbook of Subatomic Physics [M]. Beijing: Science Press, 1995
4. Wang Yuying et al. square nuclide map (S-H) [J]. Beijing: Science Press, 1997[12].
5. Edited by Lu Yukai. A Concise Manual of Radioactive Isotope Applications. [M]. Shanghai Science Popularization Press. January 2004.
6. T.B. Grashvili et al. (Russia) and Zhao Zhixiang et al. (center), totaling 9 people. Nuclide Data Manual. [M]. Atomic Energy Press. October 2004.
7. Cai Shanyu Artificial elements [M] Shanghai Science Popularization Press, 2006

After statistics, screening, proofreading and error correction, there are currently a total of 2,787 elements in the same position. There are detailed statistics and list records in Constructing the Three-dimensional Periodic Law of Elements.

A reference book contains thousands of isotopes, while six reference books contain tens of thousands of isotopes. Statistics, proofreading, and error correction are also very time-consuming and expend effort. The author works alone, without assistants, advanced tools, or equipment. Computers are still advanced tools that were only available in 2006. Sometimes my 80-year-old wife takes time to help.

The Planar periodic table of Elements is the arrangement rule of chemical elements (118 kinds).

The 3D Periodic Law of Elements is the ranking rule of elements in the isotopic elements (2787).

The three-dimensional formation stage can be found in the Brief Handbook of Isotopes in the 21st Century. Moreover, the author discovered two important rules of isotope sequencing, and thus proposed the Isotope Center Theory. As for the expansion stage, due to space limitations, it can only be reproduced next time.

Biography

Zhongsheng Lee was born in 1937 in a class enemy family in Chinese mainland, where he was discriminated against and endured many hardships. Class enemies are not allowed to have friends. There are no human rights, let alone freedom of speech and publication. When he was in college, his family was in great poverty, but his love for chemistry never waned. In 1957, when he was a sophomore, he discovered that the two-dimensional periodic table of Elements had 13 major flaws and deficiencies. It is the limitation of being unable to accommodate 2,787 isotopes. He created a unique topic to construct the three-dimensional periodic law of elements. Therefore, he is the founder of the three-dimensional element periodic law. He graduated in 1960 as one of the first students from the Department of Physics at Zhengzhou University.

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