January 2023

CSI Communication (25th Issue)

Monthly Newsletter of Catalysis Society of India

Circulated to all CSI Members

Important Announcement:

CSI newsletter shall be pleased to publish half a page write-up under the title, Centre of Excellence in Catalysis Research in India from any Indian Academics, Research laboratories or Industrial organizations. You may send your brief write-up on your research activities to us which will be published in coming issues of CSI.
You can also share your recent happy moments like publications, granted patents, technology commercialization, fellowship, awards, etc. to highlight in the CSI communication.

We have successfully published 24 CSI communication issues and now celebrating 25th issue.

Prof. (Dr.) A. Sakthivel Research Team @ Inorganic Materials & Heterogeneous Catalysis Laboratory, Department of Chemistry, Central University of Kerala

Prof. A. Sakthivel's research group at the Central University of Kerala is involved in the development of "sustainable heterogeneous catalysts for valorization of various biomass model components and utilization of carbon dioxide to value added chemicals. Zeolite, hydrotalcites, perovskites and multimetal oxide based materials and their nano-composites are developed for the chemical transformation of biomass which will be highly beneficial to the society.
Transition and inner transition metal/metal oxide incorporation into various zeolites and its activity for biomass valorization have been explored. Ce-containing MCM-22 zeolites is found to be potential for selective conversion of isoeugenol (a biomass model compound) to vanillin, a flavoring agent in food industry. ITQ stabilization by designing nanocomposite architecture has been adopted and inspected for biomass conversion. Hetero ions incorporated zeolite-β is utilized for esterification of levulinic acid into levulinate ester which is a well-known biofuel additive. Also, it has been found that zeolite-β supported late transition metal oxides induce strong acidic sites and the effect is explored for biomass conversion into fuels. Copper doped strontium ferrite synthesized by combustion method and the synergistic effect of copper and oxygen vacancies were investigated for the catalytic hydroxylation of anisole, a lignin-derived bio-oil. The hydrogenating ability of noble metal (Pt, Pd, Rh, Ru) doped ferrites has been studied for the conversion of biomass model components. Multimetal oxides derived from transition metal (Ni, Co, Fe, Cr) based hydrotalcite materials were developed by various synthetic routes. Noble metal containing Ni based hydrotalcites were explored for the hydrogenation of biomass model compounds eugenol, cinnamaldehyde, furfural and hydrotreating of anisole. Ruthenium containing Ni-Fe hydrotalcite were also explored for the hydrotreating of anisole. Molybdate

intercalated hydrotalcite materials were explored for the conversion of biomass model compound isoeugenol into vanillin (86% conversion with 83% selectivity) and for the esterification of levulinic acid to levulinate ester. Prof. Sakthivel's group also deals with the development of single site homogeneous catalysts for biomass conversion into value added products.

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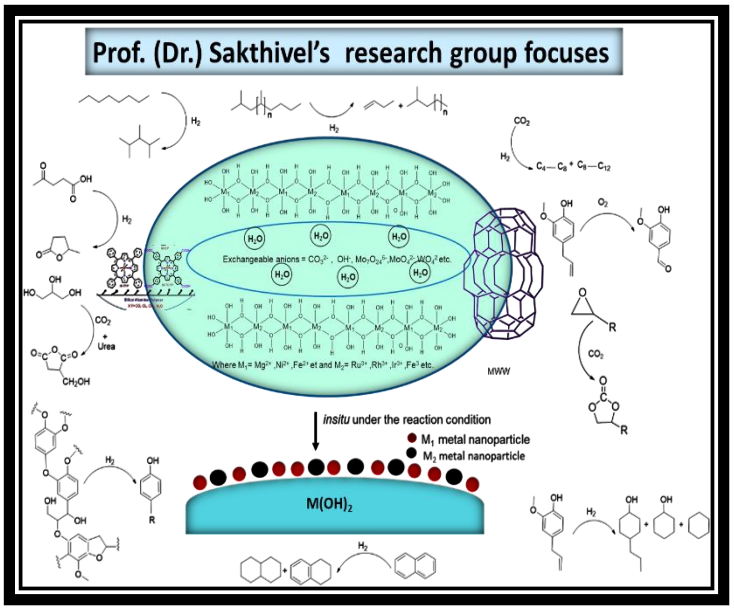

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Commercial & Policies

- **Gulbrandsen Set to Double its Capacity for Polyurethane Tin Catalysts at Dahej**

Gulbrandsen broke ground for a new stannous octoate and stannous neodecanoate manufacturing facility at its site in Dahej, India on the 6th of December 2022. Gulbrandsen is the world's largest manufacturer and supplier of polyurethane tin catalysts from its site in Orangeburg, South Carolina and this new facility, which is expected to be operational in the fall of 2023, will double the existing capacity. This new site also positions Gulbrandsen as the only company in the world with the ability to manufacture stannous octoate and stannous neodecanoate in two different parts of the globe, assuring a reliable and consistent supply of these products to its customers.

Source: https://chemindigest.com/gulbrandsen-set-to-double-its-capacity-for-polyurethane-tin-catalysts-at-dahej/

- **Birla Carbon embarks on a collaborative project to develop Biocrude Derived Graphite for Lithium-ion Batteries**

Birla Carbon, one of the global leaders in the manufacture and supply of high-quality, sustainable carbon black solutions, has collaborated with NC State University, the National Renewable Energy Laboratory (NREL), Ensyn, The Battery Innovation Center (BIC), and Yale University, to develop and scale-up the production of biocrude-derived graphite for lithium-ion batteries – Biocrude Derived Anode Material (BDAM). The increase in demand for electric vehicles is primarily fueling the lithium-ion battery market, and portable electronic devices, power tools, residential energy storage, and grid-level storage are applications becoming increasingly dependent on this technology. Graphite is one of the materials in a lithium-ion battery that stores lithium. Producing battery-grade graphite from biocrude offers a more sustainable pathway toward producing these valuable materials.

Source: https://www.birlacarbon.com/birla-carbon-embarks-on-a-collaborative-project-to-develop-biocrude-derived-graphite-for-lithium-ion-batteries/

- **BPCL signs MOU with the Govt. of Rajasthan for setting up 1 GW renewable energy plant**

Bharat Petroleum Corporation Ltd (BPCL) will set up 1 gigawatt (GW) of renewable energy capacity in Rajasthan to achieve a net zero emission target by 2040.

Source: https://economictimes.indiatimes.com/industry/renewables/bpcl-to-set-up-1-gw-renewable-energy-plant-in-rajasthan/articleshow/97276706.cms

- **L&T signs MoU with H2Carrier for floating green ammonia projects**

Larsen & Toubro and Hi-Tech Manufacturing, and Services, announced today the signing of a Memorandum of Understanding (MoU) with the Norway-based H2Carrier (H2C) to co-operate towards developing floating green ammonia projects for industrial-scale applications with an aim to decarbonise the global economy. H2C has proven expertise in developing and integrating Power-to-X (PtX) projects based on affordable, often stranded, non-commercial renewable power. Under the terms of the MoU, L&T will become a partner for EPCIC of the topsides for H2C's floating process plants.

Source: https://www.larsentoubro.com/pressreleases/2023-01-13-larsen-toubro-and-h2carrier-as-sign-mou/

- **HTL establishes state-of-the-art Polymer Compounding facility at Hosur**

HTL, a material subsidiary of HFCL, has established a state-of-the-art Polymer Compounding facility as backward integration at its Hosur plant in Tamil Nadu for manufacturing of Polyolefin based compounds of various grades and colours which are required as raw material for manufacturing of Optical Fibre Cables.

With an installed capacity of 24,000 MT per annum, this backward integration will ensure seamless availability of various grades of Polymer for the Company and HTL's plants at Goa, Chennai and Hyderabad and improve profitability being a significant cost component in manufacture of Optical Fibre Cable being supplied in Domestic and Export Markets

Source: https://www.business-standard.com/article/news-cm/htl-establishes-state-of-the-art-polymer-compounding-facility-at-hosur-122092700896_1.html

- **AkzoNobel using 100% Renewable Electricity in North America**

All AkzoNobel's locations in North America are now operating on 100% renewable electricity. The move is helping the company to drive the company's ambition of reducing carbon emissions across the full value chain by 50% by 2030 (baseline 2018). The milestone reached at the beginning of the year is the latest in AkzoNobel's ongoing efforts to transition to 100% renewable electricity at all its sites globally, with Europe having achieved the landmark at the start of 2022. The transition to 100% renewable electricity in North America includes manufacturing sites, offices, warehouses and research and development facilities. However, the company is looking much further than its own operations.

Source: https://www.akzonobel.com/en/media/latest-news---media-releases-/akzonobel-using-renewable-electricity-in-north-america

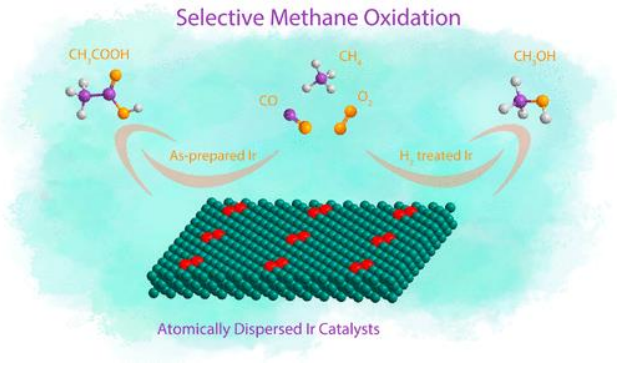
Scientific Updates

- **Cheap, Sustainable Hydrogen: New catalyst is 10 times more efficient than previous sun-powered water-splitting devices**

A new kind of solar panel, developed at the University of Michigan, has achieved 9% efficiency in converting water into hydrogen and oxygen—mimicking a crucial step in natural photosynthesis. Outdoors, it represents a major leap in the technology, nearly 10 times more efficient than solar water-splitting experiments of its kind. The catalyst is made of indium gallium nitride nanostructures, grown onto a silicon surface. That semiconductor wafer captures the light, converting it into free electrons and holes—positively charged gaps left behind when electrons are liberated by the light. The nanostructures are peppered with nanoscale balls of metal, 1/2000th of a millimeter across, that use those electrons and holes to help direct the reaction.

Source: https://techxplore.com/news/2023-01-cheap-sustainable-hydrogen-catalyst-efficient.htmlSource

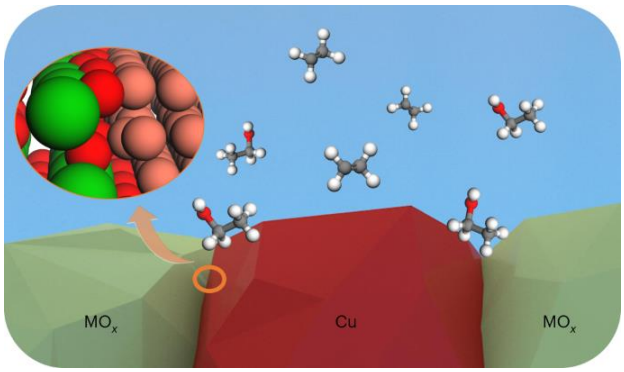
- **Selective Methane Oxidation by Heterogenized Iridium Catalysts**



Oxidative methane (CH_4) carbonylation promises a direct route to the synthesis of value-added oxygenates such as acetic acid (CH3COOH). A strategy to realize oxidative CH_4 carbonylation through immobilized Ir complexes on an oxide support is reported. The immobilization approach not only enables direct CH_4 activation but also allows for easy separation and reutilization of the catalyst. Furthermore, we show that a key step, methyl migration, that forms a C–C bond, is sensitive to the electrophilicity of carbonyl, which can be tuned by a gentle reduction to the Ir centers. While the as-prepared catalyst that mainly featured Ir(IV) preferred CH_3COOH production, a reduced catalyst featuring predominantly Ir(III) led to a significant increase of CH_3OH production at the expense of the reduced yield of CH3COOH.

Source: J. Am. Chem. Soc. 2023, 145, 2, 769–773

- **Copper/alkaline earth metal oxide interfaces for electrochemical CO_2 to alcohol conversion by selective hydrogenation**

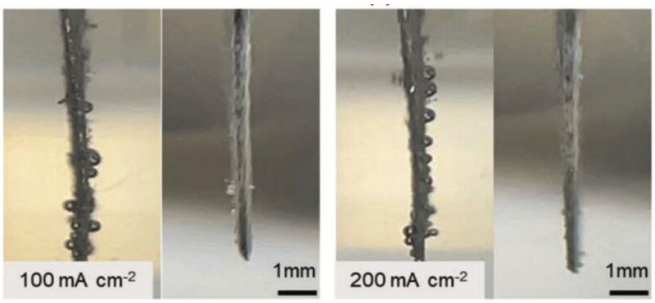


Multicarbon alcohols produced by electrochemical CO_2 reduction (CO2RR) are attractive alternatives to fossil fuels; however, the selectivity towards alcohols in CO2RR remains low, a result of competing hydrocarbon (that is, ethylene) production. Here author report on Cu catalysts decorated with different alkaline earth metal oxides (MOs). It is found that BaO delivers a Faradaic efficiency of 61% towards C2+ alcohols. At an industry relevant current density of 400 mA cm^{-2}, the ratio of alcohols to hydrocarbon reached 3:1. Mechanistic studies, including in operando X-ray absorption spectroscopy, in situ Raman spectroscopy and density functional theory calculations, suggested that the increased selectivity towards alcohols originates from sites at the MO/Cu interface. Furthermore, computational studies indicated that the incorporation of MOs favours a hydroxy-containing C2 intermediate (*HCCHOH) over the hydrocarbon intermediate (*HCC) at interfacial Cu sites on the path to alcohol products. We also propose that the relative bond strengths of Cu–COH and C–OH correlate with the selectivity for alcohol over hydrocarbon.

Source: Nature Catalysis, 5,1081–1088 (2022)

- **High-Rate Alkaline Water Electrolysis at Industrially Relevant Conditions Enabled by Superaerophobic Electrode Assembly**

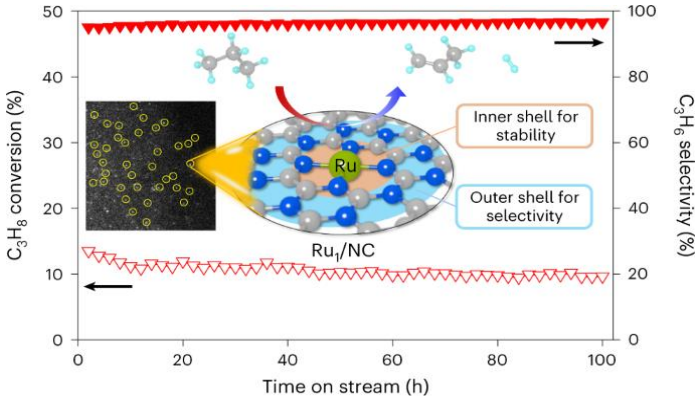
Alkaline water electrolysis (AWE) is among the most developed technologies for green hydrogen generation. Despite the tremendous achievements in boosting the catalytic activity of the electrode, the operating current density of modern water electrolyzers is yet much lower than the emerging approaches such as the proton-exchange membrane water electrolysis (PEMWE). One of the dominant hindering factors is the high overpotentials induced by the gas bubbles. To solve this, researcher designed superaerophobic electrodes that attract water droplets but repel gas bubbles. The new electrolyser can operate at high rates for >300 hours. The patterned Co-Ni phosphide/spinel oxide heterostructure shows complete wetting of water droplet with fast spreading time (≈300 ms) whereas complete underwater bubble repelling with 180° contact angle is achieved. Besides, the current collector/electrode interface is also modified by coating with aerophobic hydroxide on Ti current collector.



Source: Advanced Science Dec 2022 https://doi.org/10.1002/advs.202206180

- **Peripheral-nitrogen effects on the Ru1 centre for highly efficient propane dehydrogenation**

Single-atom catalysts with uniform metal active sites show potential for selectivity control. However, their application to high-temperature propane dehydrogenation remains challenging. Here researcher develop a highly stable and efficient single-atom catalyst for propane dehydrogenation that is based on Ru single atoms on nitrogen-doped carbon (Ru1/NC). The turnover frequency of Ru1/NC is at least three times higher than that of nanoparticle counterparts, resulting in propylene selectivity of around 92% with a lower deactivation rate at 560 °C. Experimental and density functional theory studies reveal the important role of peripheral N species around the Ru1 centre. The inner-shell N stabilizes the atomically dispersed Ru to inhibit structure-sensitive propane cracking, while the outer-shell N promotes electron accumulation at the Ru1 centre, inducing a significant charge repulsion between Ru1 and propylene to facilitate its desorption. The combined functions of inner-shell and outer-shell N species at single-atom Ru sites contribute to the high efficiency of Ru1/NC.



Source: Nature Catalysis, 5, 1145–1156 (2022)

Catalysis Research out of India

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Upcoming Symposium/Conferences/Seminars

1. Catalysis Engineering & Technology (CET) meeting will be held from June-14-16, 2023 in Dubai, UAE along with The Catalysis Society of India (CSI) as Scientific Collaborator. **50% waive off on registration fee to CSI life members.**
2. International Conference on Recent Advances in Material Chemistry & Catalysis from March 1-3, 2022 at Dibrugarh, Assam (India) https://ramccdu2023.com
3. 75th Annual Session of Indian Institute of Chemical Engineers (CHEMCON-2022), Harcourt Butler Technical University, Kanpur 27-30 December 2022. www.chemcon2022.com
4. March 07, 2023-**Applied Catalysis in the Circular Economy,** London, United Kingdom
5. ENSURE-2023 - International Conference on Environmental Sustainability through Waste and Recycling San Francisco, CA. April 10-12, 2023 https://wasteandrecycling.org/

Announcements

- CSI Congratulates the following CSI members on the recognition they have received recently.

Name	Achievement
Dr.Kulamani Parida , FRSC Distinguished Professor in Chemistry & Director, Centre for Nano Science and Nano Technology. Siksha 'O' Anusandhan University Bhubaneswar-751030, Odisha, India 	Awarded Materials Research Society of India (MRSI) Science Annual Prize 2022

Editorial Team

Dr. Sharad Lande

Dr. Raksh Vir Jasra

Quote of the Month

"Perfection is not attainable, but if we chase perfection, we can catch excellence." —**Vince Lombardi**

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