October 2022

CSI Communication

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 request all CSI members listed among top 2% scientists in the World in this year's list published by Stanford University so that we can display the list in next issue of Communication.

Commercial & Policies

- **BASF Completes E15x Series with New Hydrogenation Catalysts Increasing Efficiency and Performance**

BASF completed its well-established selective hydrogenation catalyst E 15x series with two innovative product lines. The new sulfur resistant E 15x S catalyst family aims at facilitating the processing of contaminated feedstocks, enabling reliable process operation, and thereby increasing the flexibility of producers to use low-quality feedstocks containing higher amounts of impurities. Source: BASF, 10/4/2022.

- **India Requires $10 Billion Investment to meet Domestic Li-Ion Battery Demand By 2030: Arthur D Little Study**

In a recent report published by Arthur D Little titled "e-Mobility: Cell Manufacturing in India" highlighted that India would require an investment of $ 10 billion into EV battery manufacturing and raw material refining industries if it wanted to meet domestic demand for Li-ion batteries by 2030.The report stated that current India met 70% of its Li-ion battery needs through imports from China. The country current demand for Li-ion batteries stood at 3 GWh which is estimated to grow to 70 GWh by 2030.

Source: https://www.carandbike.com/news/india-requires-10-billion-investment-to-meet-domestic-li-ion-battery-demand-by-2030-arthur-d-little-study-3202551

- **Coal to Chemical Products project by Coal India Ltd aims 100 million Ton Gasification by 2030**

Easing the way for setting up of coal-to-chemical projects through Surface Coal Gasification (SCG) route, Coal India Limited (CIL), plan to ink three major Memorandum of Undertaking (MoU).
CIL will be joining hands with three other major PSUs of the country Bharat Heavy Electricals Limited (BHEL), Indian Oil Corporation Limited (IOCL) and GAIL (India) for setting up four SCG projects.
Through SCG route coal is converted into syngas that can be subsequently processed for downstream production of value-added chemicals. These are otherwise produced through imported natural gas or crude oil. Envisaged end products would be di-methyl ether, synthetic natural gas, and ammonium nitrate.
With the twin objectives of self-reliance and energy independence, Ministry of Coal has set a target for achieving 100 million ton coal gasification by 2030. This will provide opportunity for development of catalysts for syn gas chemistry in the country.
Source: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1861727

- **Carbon Recycling International and Dastur Energy join hands to develop CO_2-to-methanol projects in India**

Carbon Recycling International (CRI) of Iceland and Dastur Energy Pvt Ltd, the Indian subsidiary of US-based Dastur Energy and a part of the Dastur group of companies, have signed an important partnership agreement for marketing, business development, technology licensing, design, and engineering of CO_2 to Methanol projects in India based on CRI's ETL technology.
Methanol sales in India are quickly increasing, reaching roughly 2.5 million tonnes per year. Within the next ten years, the market is predicted to grow to more than 7.5 million tonnes per year. The Indian government encourages expanded methanol fuel use to reduce air pollution and greenhouse gas emissions while expanding the role of domestic energy sources in the economy.
Source: https://www.knowesg.com/tech/carbon-recycling-international-cri-and-dastur-energy-collaborate-to-develop-15092022

- **UPL establishes JV to build a wind-solar power project in Gujarat**

UPL announced a joint venture with CleanMax Enviro Energy Solutions to establish a hybrid solar-wind energy power plant of 61.05 megawatt (MW) in Gujarat, India. Under this JV, the companies will set-up and operate a hybrid captive power plant with a capacity of 28.05 MW of solar power and 33 MW of wind power.
https://www.saurenergy.com/solar-energy-news/upl-burnishes-green-cred-with-green-power-deal

- **Carbon Capture Begins at NTPC's Power Plant in India**

Carbon capture is underway at NTPC's 500MW coal-fired power plant at Vindhyachal Super Thermal Power Station, in Madhya Pradesh, India. This plant is designed to capture 20 tonnes of CO_2 per day, which will use a modified tertiary amine to capture CO_2, from the flue gas of the power plant. The CO_2 will eventually be combined with hydrogen to produce 10 tonnes per day of methanol through a catalytic hydrogenation process. Carbon Clean's CDRMax™ carbon capture technology (CCT) can be used with point source gases that contain CO_2 concentrations between 3% and 25% by volume and produces CO_2 with purities greater than 99%, which can then be sold, re-used, or sequestered. The CDRMax™ process uses the company's proprietary solvent, process equipment design, and advanced heat integration to significantly reduce both capital and operating costs. Source: Carbon Clean, 9/29/2022.

- **Johnson Matthey technology qualified to support Shell green hydrogen production**

Shell has qualified Johnson Matthey's (JM) **PURAVOC GREEN™** purification catalysts for use in its global hydrogen production projects. JM's catalysts will be used to remove trace oxygen to meet oxygen specifications in the production of high purity, zero carbon hydrogen. Removal of oxygen is critical to make the process safer and more efficient. Deoxygenation is an essential step in the production of green hydrogen and requires a flexible and robust catalyst that can operate under a variety of pressures, relatively low temperatures, and intermittent feed flows. Green hydrogen has a low carbon footprint compared to alternative fuels and can be used as clean energy and in the production of chemical building blocks such as ammonia and methanol.

Source: https://www.chemengonline.com/johnson-matthey-technology-qualified-to-support-shell-green-hydrogen-production/

- **LanzaTech Produces Ethylene from CO_2, Changing the Way Products Are Made Today**

LanzaTech NZ, Inc. announced it has successfully engineered specialized biocatalysts to directly produce ethylene from CO_2 in a continuous process. This breakthrough in bacterium bioengineering from LanzaTech represents a potential source of advancement towards the company's mission of replacing fossil-based feedstocks used in the manufacture of everyday consumer goods with waste carbon. In addition to the potential broad reaching implications for global carbon reduction and sustainability, the development represents a significant opportunity for LanzaTech to further penetrate the global ethylene market, which is estimated at approximately $125 billion in 2022. Source: LanzaTech, 10/11/2022.

Scientific Updates

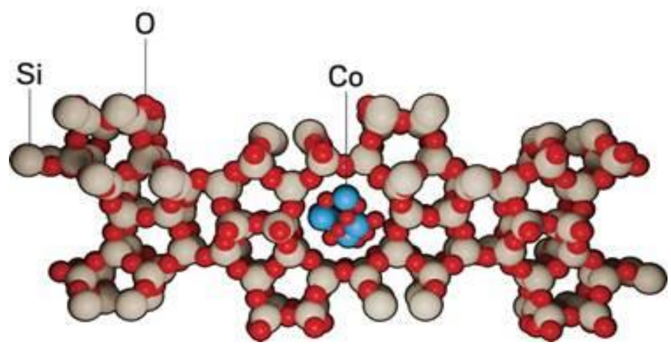
- **Catalytic deconstruction of waste polyethylene with ethylene to form propylene**

The conversion of polyolefins to monomers would create a valuable carbon feedstock from the largest fraction of waste plastic. However, breakdown of the main chains in these polymers requires the cleavage of carbon–carbon bonds that tend to resist selective chemical transformations. The production of propylene by partial dehydrogenation of polyethylene and tandem isomerizing ethenolysis of the desaturated chain. Dehydrogenation of high-density polyethylene with either an iridium-pincer complex or platinum/zinc supported on silica as catalysts yielded dehydrogenated material containing up to 3.2% internal olefins; the combination of a second-generation Hoveyda-Grubbs metathesis catalyst and [PdP(tBu)3(μ-Br)]2 as an isomerization catalyst selectively degraded this unsaturated polymer to propylene in yields exceeding 80%. These results show promise for the application of mild catalysis to deconstruct otherwise stable polyolefins. Source: Science 2022, DOI: 10.1126/science.add1088).

- **Cobalt-zeolite Catalyst Makes Propane out of Polymers**

Researchers at MIT have designed a cobalt catalyst that transforms polymers into propane selectively and efficiently. This method could provide an alternative to other proposed chemical recycling solutions that rely on more-expensive metals, such as platinum and ruthenium. In the study, researchers investigated different cobalt compounds and catalytic supports.

The majority yielded a mixture of mostly methane, a greenhouse gas with relatively low value; however, cobalt supported on the zeolite ZSM-5 converted about 30% of polypropylene and 80% of polyethylene including postconsumer polyethylene bottles into propane. Source: Chemical & Engineering News (C&EN), 10/5/2022.



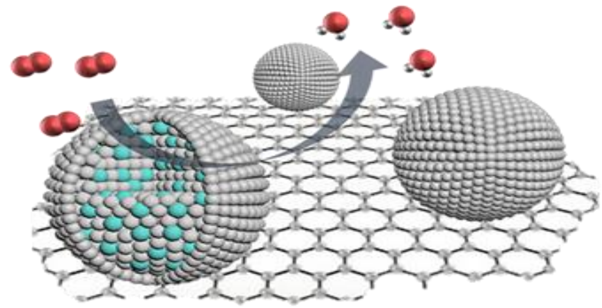
Cobalt supported on ZSM-5 zeolites enables the conversion of polyethylene and polypropylene into propane with high selectivity. Co = blue, Si = beige, O = red. Credit: JACS Au

- **Carbon-neutralizing Propylene Production Catalyzes Change in Petrochemical Engineering**

Hokkaido University material chemist Shinya Furukawa and his team recently developed a new catalyst that allows them to use carbon dioxide to turn propane into propylene instead of the more commonly used oxygen. It is demonstrated that the catalyst was highly efficient, very selective, and stable under high temperatures, its use also had the side effect of turning carbon dioxide into carbon monoxide. The researchers achieved this feat by building on their previous studies on catalyst design, but this time chose a unique new way: Using an alloy of platinum and tin on a ceria support as the base, they replaced a fraction of these atoms with the metals cobalt, nickel, indium, and gallium. Each of these elements was chosen for a specific purpose: Platinum-tin alloys had already been known as good catalysts for the reaction, but including nickel and cobalt increased both the catalyst's ability to activate carbon dioxide and its selectivity to the desired reaction. On the other hand, inserting indium and gallium was beneficial for the catalyst's temperature stability. Finally, the ceria support made carbon dioxide capture and catalyst purging easier. The research team also confirmed that the catalyst can be regenerated and reused without a loss of performance. Source: EurekAlert, 9/26/2022,

- **Platinum and Lanthanum Combined to Serve as Catalyst in Fuel Cells**

Scientists have devised a method for integrating expensive platinum and a cheap rare earth element, lanthanum, as an alloy to function as a catalyst in the following generation of fuel cells that will reduce their cost and enhance their performance. The scientists devised a method for producing an alloy between platinum and (rare earth elements) lanthanum. Two easy steps are involved in the technique. First, the scientists gained readily accessible lanthanum salts and trimesic acid, and then these two precursor materials self-assembled into nano scale "rods." Following that, these nanorods were impregnated at 900 °C with platinum. Such a high temperature is essential to ensure a seamless process of alloying the two metals. Subsequent platinum-lanthanum nanoparticles were stress-tested for their functioning in a fuel cell. The alloy electrocatalyst overcomes scientists' expectations, offering high stability and activity beyond 30,000 fuel-cell cycles. Source: AZO Materials, 10/12/2022.

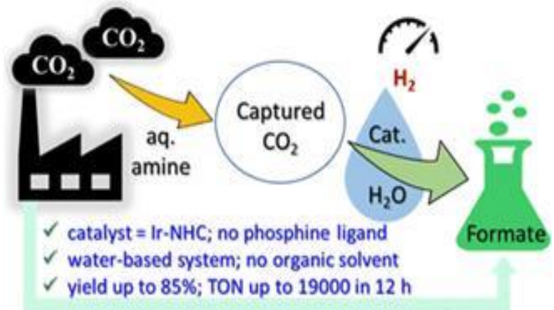


Platinum-lanthanum nanoparticles acting as electrocatalysts to speed up the chemical reaction in a hydrogen fuel cell to produce electricity and water. Image Credits: Nano Research, Tsinghua University Press

- **Can We Viably use Continuous Flow Single-atom Catalysis?**

Recent research has indicated the viability of single-atom catalysis for applications such as water electrolysis, hydrogen fuel cells, and chemical manufacturing. The industrial and commercial uptake of single-atom catalysis will depend on the development of single-atom catalysts with sufficient metallic load and sufficient stability over prolonged periods of time. Research has revealed that single-atom catalysts employed under flow conditions display the same stability as those under batch conditions. This proof of concept is incredibly important for the industrial uptake of this method for chemical production. Two major methods have been developed for the large-scale production of suitable single-atom catalysts, which opens the route toward employing several potential leach-proof single-atom catalysts under flow. Source: AZO Materials, 10/7/2022.

- **An All-aqueous and Phosphine-free Integrated Amine-assisted CO_2 Capture and Catalytic Conversion to Formic Acid**



Source: Chemical Communications

A phosphine-free Ir(III)-NHC-based efficient catalytic system was developed for integrated CO_2 capture with tetramethylguanidine as a capturing agent and conversion to formate with H_2 gas, conducting both the steps in water, affording product yield up to 85% and TON up to 19,171 in just 12 h. In the segment of "integrated CO_2-capture and conversion to formate", this system represents not only the first phosphine-free module, but also one of the few best known homogeneous catalysts. Source: Chemical Communications, 9/26/2022.

Catalysis Research out of India

1. Anjani Dubey, Abhaya Kumar Mishra, Sanjay Singh Negi, Chinnakonda S Gopinath, "Facile, sustainable and unassisted plain water oxidation on Au/Ce0. 9Ti0. 1O2 nanorods in direct sunlight", **Journal of Chemical Sciences**, 2022, 134(2), 1-10.
2. MS Khan, M Mane, AA Kulkarni, "Evaluating suitability of confined impinging jet reactor for exothermic reactions: Hydrodynamics, residence time distribution, and heat transfer", **AICHE Journal** 2022, 68 (10), 1-16.
3. Meghana Munagala, Yogendra Shastri, Sanjay Nagarajan, Vivek Ranade, "Production of Bio-CNG from sugarcane bagasse: Commercialization potential assessment in Indian context", **Industrial Crops and Products,** 2022, 188, 115590.
4. Vivek V Ranade, V. M Bhandari, Sanjay Nagarajan, Varaha P Sarvothaman, Alister A Simpson, "**Hydrodynamic Cavitation: Devices, Design and Applications**" John Wiley & Sons 2022.
5. Dipti Prava Sahoo, Kundan Kumar Das, Sriram Mansingh, Sabiha Sultana, Kulamani Parida, "Recent progress in first row transition metal Layered double hydroxide (LDH) based electrocatalysts towards water splitting: A review with insights on synthesis", **Coordination Chemistry Reviews,** 2022, 469, 214666.
6. Suraj Prakash Tripathy, Satyabrata Subudhi, Asheli Ray, Pragyandeepti Behera, Jayashree Panda, Srabani Dash, Kulamani Parida, "Hydrolytically stable mixed ditopic linker-based Zirconium metal organic framework as a robust photocatalyst towards Tetracycline Hydrochloride degradation and Hydrogen evolution", **Journal of Colloid and Interface Science,** 2022, 629, 705-718.
7. Lekha Paramanik, Satyabrata Subudhi, KM Parida, "Visible light active titanate perovskites: An overview on its synthesis, characterization and photocatalytic applications," **Materials Research Bulletin,** 2022, 155, 111965.

8. Manjunath S Lokolkar, Manoj K Pal, Sandip Dey, Bhalchandra M Bhanage,"POP-Pincer Xantphos Pd Complex of 4-Pyridylthiolate: Cyclocarbonylative Reaction for the Synthesis of Flavones Using Cobalt Carbonyl as a C1 Source", **Catalysis Letters,** 2022,1-9.

Upcoming Symposium/Conferences/Seminars

1. Conference on Advances in Catalysis for Energy and Environment (CACEE -2022) & CO_2India Network 1st Annual Meet from 31st October to 4th November 2022 at Tata Institute of Fundamental Research (TIFR), Mumbai, INDIA, https://www.cacee.org/
2. 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.**
3. The 2nd International Conference on **"NanoMaterials and Sustainable Applications" (NANO-SA-2023)** organized by the Institute of Chemical Technology Mumbai, Marathwada Campus, Jalna (ICT-MARJ), India on 10th–11th January 2023, https://www.ictsusnanomaterials.com/speakers/
4. International Conference on Recent Advances in Material Chemistry & Catalysis from March 1-3, 2022 at Dibrugarh, Assam (India) https://ramccdu2023.com

Quote of the Month

"Some people dream of success, while other people
get up every morning and make it happen."
— Wayne Huizenga

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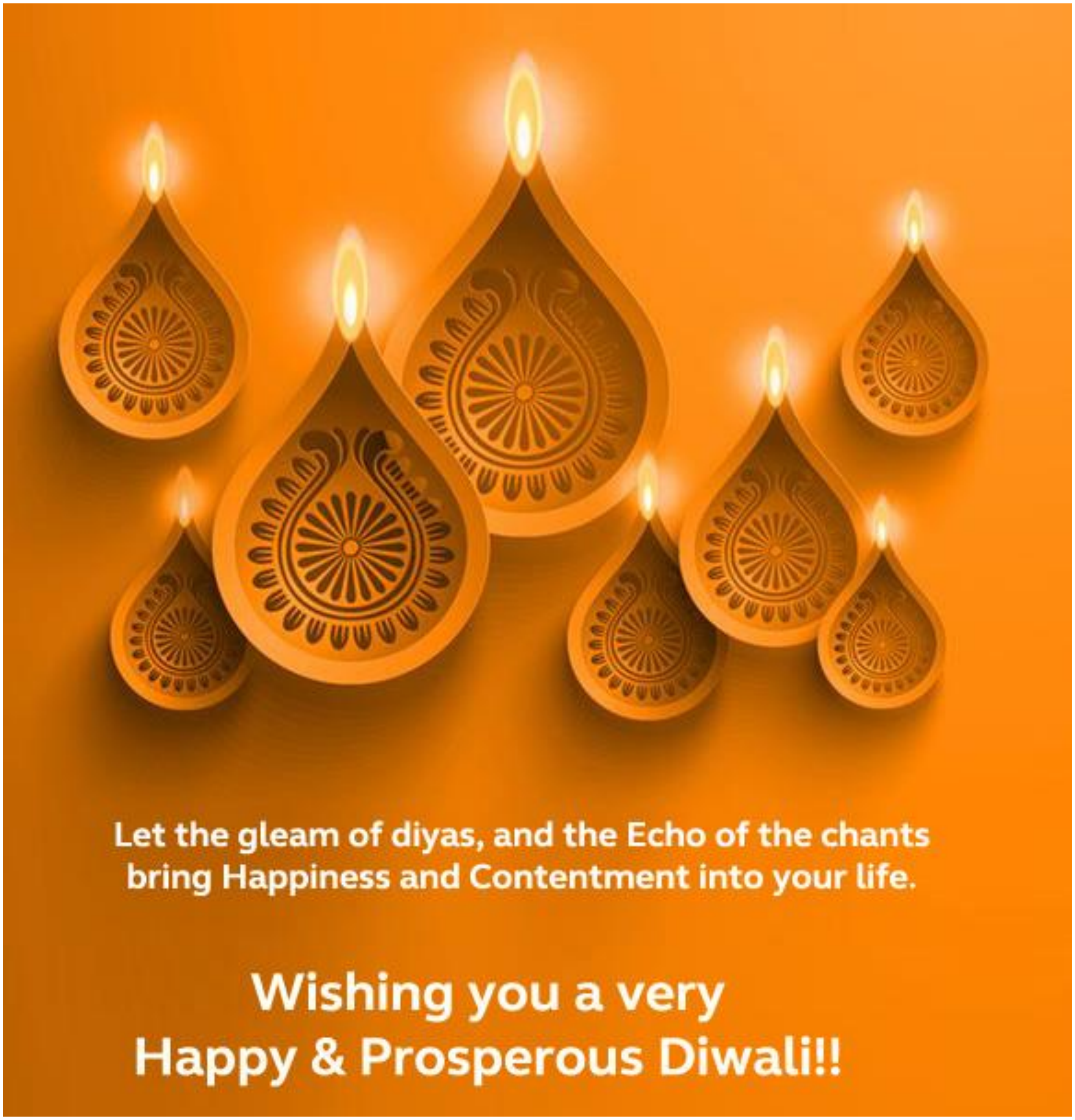

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