June 2023

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.

Commercial & Policies

- **India's crude oil demand growth to overtake China's by 2027: IEA**

The growth in demand for oil in India will overtake that in China by 2027, said a report by the International Energy Agency (IEA). The United States, China, and India are the world's three largest oil consumers in that order. China will in 2023 account for nearly 60 per cent of global growth in oil demand.
Source: https://www.business-standard.com/economy/news/india-to-overtake-china-as-world-s-second-largest-oil-consumer-by-2027-iea-123061400601_1.html

- **World's Largest Propane Dehydrogenation Unit**

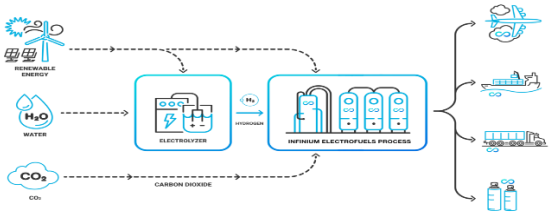
Honeywell announced that it will help SASA Polyester Sanayi A.Ş. to build the world's largest Propane Dehydrogenation (PDH) unit in Turkey, usinng latest generation Honeywell Oleflex™ technology. The facility aims to produce 1 million tons of propylene per year. The Honeywell UOP Oleflex™ process is used for the production of lightweight olefins from lightweight paraffin via catalytic dehydrogenation, while providing a source from which polymer-quality propylene and isobutylene can be obtained.
Source: Source: Honeywell 11/05/2023

- **CO2-conversion catalyst for making 'e-fuels'**

Infinium (Sacramento, Calif.; www.infiniumco.com) recently announced that it has manufactured ton-level quantities of a proprietary catalyst that is integral in the company's process for making liquid fuels from waste CO2 and hydrogen derived from renewable power. Infinium plans to manufacture commercial volumes of CO2-derived diesel, aviation fuel and naphtha — known as electrofuels (e-fuels) — starting at the end of 2023. The catalyst is a key technology for the first

stage of the synthetic fuels process in which waste CO2 from an industrial point source, such as an ethanol- or ammonia-production facility, is reduced to CO in a reverse water-gas-shift (RWGS) reaction. The proprietary RWGS catalyst is now being manufactured in Infinium's Sacramento facility.

In the second stage of the liquid-fuels process, the CO from the first step undergoes a synthesis reaction with renewably generated H2. Infinium also has developed a proprietary conversion catalyst that is an alterative to traditional Fischer-Tropsch catalysts, and is specially engineered to limit the formation of long hydrocarbon chains, keeping molecules in the range that can be used for vehicle fuels. This second catalyst has been operated commercially in gas-to-liquids (GTL) facilities and has been commercially manufactured for several years.



- **This photocatalytic reactor system makes chemicals without fossil fuels**

Syzygy has developed, scaled and integrated its core technologies, incubated at, and licensed from, Rice University (Houston; www.rice.edu), into a universal photocatalytic reactor platform (photo), which includes the Rigel photoreactor and the proprietary photocatalyst that enables light-driven chemical reactions at unprecedented efficiency.

The breakthrough involves embedding a nanoparticle of a traditional catalyst material into the surface of a larger, light-harvesting plasmonic nanoparticle. This two-part nanoparticle structure, known an antenna-reactor complex, provides more efficient capture and transfer of light energy to the reactive sites on the catalyst, effectively replacing the need for thermal energy from the combustion of fossil fuels with light. They could replace traditional rare, expensive catalytic metals, like ruthenium, with abundant, affordable light-reactive metals like iron.

Source: Syzygy Plasmonics

Rigel photoreactors feature a photocatalyst-filled sleeve surrounded by a light box. Each reactor is fully contained in an outer shell. Banks of these reactors can be stacked to offer flexible installation sizes ranging from 1 to 100 ton/d of product, such as H2, methanol and fuels.

Syzygy has three field trials planned for 2023, located in North Carolina, California and South Korea. Last August, for example, the company announced a joint development agreement with Lotte Chemical, Lotte Fine Chemical and Sumitomo Corp. of Americas to test a fully electric

chemical reactor for clean hydrogen production. The reactor will be installed and brought online in the second half of 2023 at Lotte facilities in Ulsan, South Korea.

- **G20 policy paper moots global fund for EV battery mineral recycling capacity**

As the demand for Lithium-ion batteries in electric vehicles (EVs) soars, a policy brief created for an official engagement group of the G20 has suggested setting up a global fund to invest in increasing recycling capacities.
Source: https://www.thehindubusinessline.com/economy/g20-policy-paper-moots-global-fund-for-ev-battery-mineral-recycling-capacity/article66972186.ece

- **Chemical firm Lubrizol to invest $150 mn to build CPVC resin plant in Gujarat**

US-based specialty chemical company Lubrizol Corporation on Monday announced investment commitments of over $150 million across several projects in its portfolio in the country. The proposed investment will go into building the world's largest CPVC resin plant at Vilayat in Gujarat in partnership with Grasim Industires; doubling its CPVC capacity at its Dahej Gujarat plant to 1.4 lakh tonne; opening a second grease lab in Navi Mumbai, the Berkshire Hathaway-owned company said in a statement.
Source: https://www.business-standard.com/companies/news/chemical-firm-lubrizol-to-invest-150-mn-to-build-cpvc-resin-plant-in-guj-123061900465_1.html

- **Sinopec Xinjiang Kuqa green hydrogen pilot project commences operation**

China Petroleum & Chemical Corporation (HKG: 0386, "Sinopec") announced that the Green Hydrogen Pilot Project ("Project") constructed by the company in Kuqa City of Aksu Prefecture, Xinjiang Uygur Autonomous Region, has commenced operation. Green hydrogen is produced by facilities powered by renewable power sources such as solar and wind energy, minimizing the carbon footprint across the entire production process. The Project takes advantage of photovoltaic resources in Kuqa to achieve 20,000 tons per annum of green hydrogen by using solar power to electrolyze water, along with the capacity to store 210,000 cubic meters of hydrogen and transport 28,000 cubic meters per hour.
Source: https://www.prnewswire.com/in/news-releases/sinopec-xinjiang-kuqa-green-hydrogen-pilot-project-enters-operation-leading-chinas-green-hydrogen-development-301868808.html

- **Johnson Matthey partners with Diffusion Alloys to boost supply chain for low carbon hydrogen**

Johnson Matthey (JM) and Diffusion Alloys, a specialist diffusion coatings producer, are partnering to scale-up production and enable the increasing demand for low-carbon hydrogen used to reduce global carbon emissions. By partnering, JM and Diffusion Alloys will share their areas of expertise and ensure a robust supply chain for the coated components deployed in JM's low- carbon (blue) hydrogen offering. Hydrogen corrosion (also called hydrogen embrittlement), occurs when hydrogen atoms diffuse into a metal; diffusion coating puts a protective layer on the surface of the metal to hinder the diffusion of hydrogen atoms into the metal lattice.

Source:https://www.greencarcongress.com/2023/07/20230702-jm.html#:~:text=02%20July%202023,to%20reduce%20global%20carbon%20emissions.

- **LG Chem Starts Mass Production of Single-Crystal High-Nickel Cathodes in Korea**

LG Chem announced that it has started Korea's first-ever mass production of single-crystal high-nickel cathodes for next-generation batteries. Production started on June 26, 2023, at the company's cathode plant located in Cheongju so the first batches of new battery materials will be sent to global clients starting in July. According to LG Chem, which stands behind the LG Energy Solution battery manufacturer, single-crystal cathodes (made from single particles of several metals such as nickel, cobalt, and manganese) are essential for next gen batteries as they can boost the battery lifespan by more than 30 percent and increasing the capacity by 10 percent or more compared to the current solution.
Source: https://insideevs.com/news/674589/lg-chem-production-single-crystal-cathodes/

- **LG Chem plan to expand carbon nanotube market**

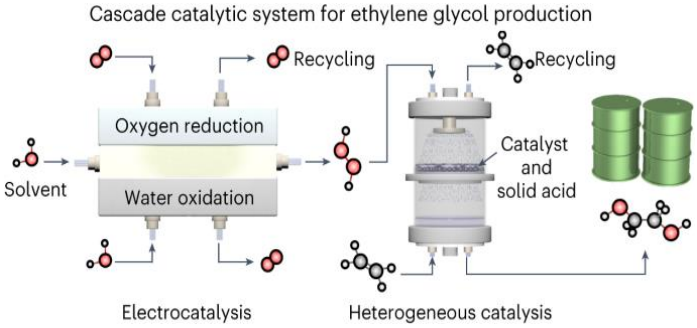
LG Chem announced that it has started construction of its fourth carbon nanotube (CNT) plant at its its Daesan Complex. LG Chem's CNT 4 Plant is slated for operation in 2025 and will contribute to doubling LG Chem's annual CNT production capability to 6,100 tons. Prior to this, LG Chem's 1,200-tons CNT 3 Plant in Yeosu was also recently put into full operation, enabling LG Chem to secure a total production of 2,900 tons/year, adding on to the existing 1,700 tons.
Source: https://insideevs.com/news/674589/lg-chem-production-single-crystal-cathodes/

- **BASF opens battery materials production, recycling plant in German**

BASF has officially opened its co-located battery material production and recycling facility in Schwarzheide, Germany, marking what the German-based chemical and materials company says is the first production facility for high-performance cathode active materials (CAM) in Germany and the first fully automated large-scale CAM production facility in Europe.
Source: https://www.thediplomat.ro/2023/07/04/basf-opens-co-located-battery-materials-and-recycling-center-in-germany/

Scientific Updates

- **Selective production of ethylene glycol at high rate via cascade catalysis**



Ethylene glycol is currently produced via an energy intensive two step thermocatalytic process that results in substantial CO_2 emissions. Sustainable ethylene glycol production via ethylene electro-oxidation powered by renewable electricity is desirable; however, direct ethylene electro-oxidation suffers from unsatisfactory product selectivity, particularly at high production rates. Cascade strategy for efficient and

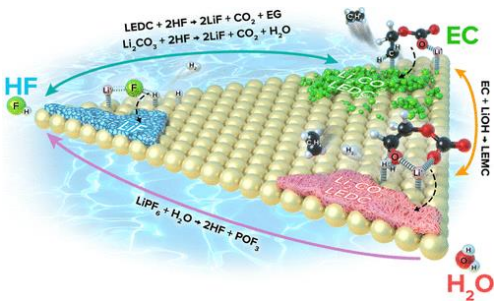
selective production of pure ethylene glycol solution under ambient conditions with no detectable by-product formation is reported. Specifically, ethylene is converted to ethylene glycol on a catalyst/solid-acid composite using electrochemically generated hydrogen peroxide as the oxidant. Using an integrated solid-electrolyte reactor, high electron utilization efficiency of 60–70% at industrially relevant current densities (100–500 mA cm^{-2}) for ethylene glycol production with full product selectivity (~100%) is achieved.
Source: *Nature Catalysis*, 2023, https://www.nature.com/articles/s41929-023-00977-6

- **Methyl formate as a hydrogen energy carrier**

Industrially available bulk chemical (methyl formate, MF) is proposed as an efficient and practical hydrogen storage material. Utilizing appropriate catalysts, hydrogen production from MF is significantly faster than with other established chemical hydrogen carriers, such as formic acid and methanol, under very mild conditions. The optimized MF dehydrogenation system presented here is highly active (maximum turnover frequency (TOF_{max}) > 44,000 h^{-1} and turnover number > 100,000) and selective (CO undetectable). Moreover, the solvent-free MF dehydrogenation demonstrates its application potential.
Source: *Nature Catalysis*, 2023, https://www.nature.com/articles/s41929-023-00959-8

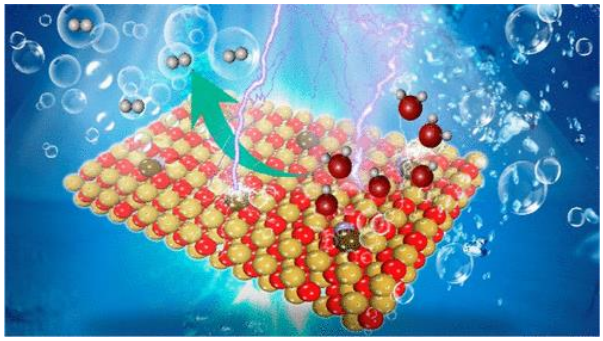
- **Role of Catalytic Conversions of Ethylene Carbonate, Water, and HF in Forming the Solid-Electrolyte Interphase of Li-Ion Batteries**

A detailed experimental and theoretical study of the electrochemistry of ethylene carbonate (EC) and its chemical relationship with trace amounts of water and HF across a vast range of electrode materials, from well-ordered single crystals to realistic graphite electrodes is discussed. The electrocatalytic nature of EC, HF, and water electroreductions at all interfaces, and unveil the catalytic role of water in EC electroreduction is revealed.



Source: ACS Catalysis 2023 https://doi.org/10.1021/acscatal.3c01531

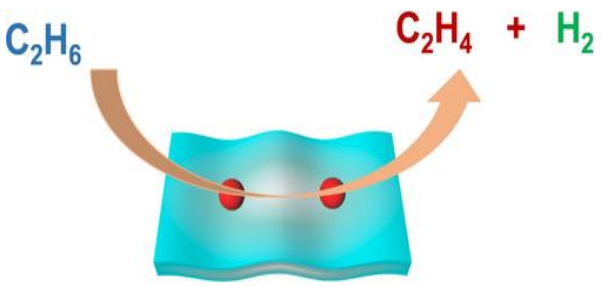
- **Polarization Manipulation of NiO Nanosheets Engineered with Fe/Pt Single Atoms for High-Performance Electrocatalytic Overall Alkaline Seawater Splitting**



A strategy to modulate the anchored metallic single atoms by manipulating the surface polarization of the support, which is demonstrated to be effective in designing alkaline seawater electrocatalysts is reported. Specifically, Mn doping in weak-polarized NiO nanosheets is introduced to modulate its surface polarization and thereby regulate the electronic metal–support interaction between anchored Pt/Fe single atoms and NiO support. The optimized Pt1/MnNiO||Fe1/MnNiO electrode pair

exhibits superior overall alkaline seawater-splitting performance, achieving an impressive low cell voltage of 1.44 V at a current density of 10 mA cm^{-2}.
Source: ACS Catalysis https://doi.org/10.1021/acscatal.3c00915

- **Single-Atom Fe Catalyst for Catalytic Ethane Dehydrogenation to Ethylene**



A simple wet impregnation method was utilized to synthetize of Fe−Al_2O_3 catalysts. The Fourier transformation infrared spectroscopy (FTIR) revealed that abundant OH group attached to the support (Al_2O_3) surface facilitating formation of isolated Fe single atom. High resolution transmission electron microscope (HR-TEM) and extended X-ray absorption fine structure (EXAFS) confirmed the Fe single atom architecture. Fe−Al_2O_3 (4.5 wt %) performed enhanced stability and activity on ethane dehydrogenation reaction.
Source: Chem Cat Chem 2023 https://doi.org/10.1002/cctc.202201612

- **Recent research advances on catalysts for selective hydrogenation of acetylene**

Selective hydrogenation of ethyne to ethylene is of great potential for large and medium-sized ethylene plants. In the reaction of selective hydrogenation of ethyne, catalysts play crucial roles in selectively driving the target reaction while suppressing the occurrence of side reactions. Up to now, a number of catalysts have been designed for selective hydrogenation of ethyne, which could roughly be divided into Pd-based catalysts, Ni-based catalysts, IB metal-based catalysts, bimetallic/trimetallic catalysts, and others, according to the nature of the active centers. The recent progress of these categories of catalysts in selective hydrogenation of ethyne is summarized in this work and the underlying reaction mechanism is unraveled, targeting design of better catalysts for selective hydrogenation of ethyne and advancing this research field.
Source: Catalysis Science and Technology 2023, https://doi.org/10.1039/D3CY00615H

Catalysis Research out of India

1. Ravi Ranjan, Jyoti Tekawadia, Ruchi Jain, Nitin B Mhamane, Thirumalaiswamy Raja, Chinnakonda S Gopinath "Co_3O_4 for sustainable CO2 reduction and possible fine-tuning towards selective CO production" **Chemical Engineering Journal,** 2023, 144459
2. Aniruddha Singha, Anil Chandra Kothari, Rajaram Bal, Biswajit Chowdhury, Dioxygen-Triggered Oxidation of Benzylic C-H Bonds: Insight of the Synergistic Effect of Cu-Fe Bimetallic Oxide, **Reaction Chemistry & Engineering,** 2023, DOI:10.1039/D3RE00116D

3. Priyanka V Jawale, Bhalchandra M Bhanage "Carbonylative Self-Coupling of Aryl Boronic Acids Using a Confined Pd Catalyst within Melamine Dendron and Fibrous Nano-Silica: A CO Surrogate Approach" **Chemistry–A European Journal,** 2023. https://doi.org/10.1002/chem.202301381
4. Babak Jaleh, Aida Moradi, Mahtab Eslamipanah, Sadegh Khazalpour, Haniyeh Tahzibi, Saeid Azizian, Manoj B Gawande, "Laser-assisted synthesis of Au NPs on MgO/chitosan: Applications in electrochemical hydrogen storage, **Journal of Magnesium and Alloys,** 2023 https://doi.org/10.1016/j.jma.2023.05.003
5. Rahul P Gaikwad, Arun D Kute, Manoj B Gawande, "Strategies for the Preparation of Nanocatalysts and Supports Under Solvent-Free Conditions" **Solvent-Free Methods in Nanocatalysis: From Catalyst Design to Applications,** 31-68, 2023, Wiley-VCH GmbH
6. Arjun K Manal, Ganapati V Shanbhag, Rajendra Srivastava, "Design of a Bifunctional Catalyst by Alloying Ni with Ru-Supported H-Beta for Selective Hydrodeoxygenation of Bisphenol A and Polycarbonate Plastic Waste" **Applied Catalysis B: Environmental,** 2023, 338, 123021
7. Rochak Mittal, Vivek Ranade, "Bioactives from microalgae: A review on process intensification using hydrodynamic cavitation" **Journal of Applied Phycology,** 2023, 1129-1161
8. Sujanya Maria Ruban, Kavitha Ramadass, Gurwinder Singh, Siddulu Naidu Talapaneni, Gunda Kamalakar, Chandrakanth Rajanna Gadipelly, Lakshmi Kantham Mannepalli, Yoshihiro Sugi, Ajayan Vinu." Organocatalysis with carbon nitrides" **Science and Technology of Advanced Materials,** 2023, 2188879
9. Rakhi Vishwakarma, Chathakudath P Vinod, Virendra Rathod, Mannepalli Lakshmi Kantam, "Wadsworth–Emmons Reaction by Using the Fluorapatite Catalyst: Kinetic Studies" Industrial & Engineering Chemistry Research, 2023, **Ind. Eng. Chem. Res.** 2023, 62, 20, 7901–7911
10. Rakhi Vishwakarma, C. P. Vinod, Virendra Rathod, Lakshmi Kantam Mannepalli," Imine Oxidation Catalysed by Zinc Hydroxyapatite: Kinetic Studies" 2023 https://doi.org/10.1002/slct.202203503
11. Dhananjay S Doke, Mohan K Dongre, Shubhangi B Umbarkar, "Dehydration of Lactate to Acrylate Using Alkaline Earth Metal Modified Hydroxyapetite" **Catalysis Letters,** 2023 https://doi.org/10.1007/s10562-023-04329-8

▪ Upcoming Symposium/Conferences/Seminars

1. SusChemE 2.0, International Conference on Sustainable Chemistry & Engineering 2023 is being organized in Institute of Chemical Technology (ICT) Mumbai, India along with the Catalysis Society of India during **14th-16th September 2023.**
2. Indian Membrane Society is organizing an International Conference on "Membrane based Separations: Past, Present & Future" during **16th -18th October 2023** at MS University of Baroda along with CSIR-CSMCRI, Bhavnagar.
3. 6th International Oil & Gas Chemistry, Chemicals & Additives Conference (IOGCA 2023) from **12-13th September 2023** at Ahmedabad http://oilfieldchemical.org/
4. 15th European congress on Catalysis [Europacat-15] Prague, Czech Republic, **August 27 – September 1, 2023.** https://www.europacat2023.cz/

5. International Conference on Organometallics and Catalysis from **30th – 2nd Nov 2023** at Goa, India https://www.icoc2023.com
6. 2nd International Conference on Catalysis and Chemical Engineering, November 09-10, 2023 Millennium Hotel Paris Charles De Gaulle, Paris, France https://scisynopsisconferences.com/catalysis/
7. 9th Conference of the Federation of the European Zeolite Associations (FEZA 2023) Portorož-Portorose, Slovenia **02nd - 06 July 2023** https://www.feza2023.org/en/
8. 4th International, Refinery & Petrochemical Technology, Conference & Exhibition on **8th & 9th August** 2023 in New Delhi.
9. International Catalysis Conference ICC 2023 from **15th-17th September 2023** at Miami USA https://www.catalysisworldconference.com/
10. 17th Edition of International Conference on Catalysis, Chemical Engineering and Technology" (Catalysis 2023) will be hosted as Hybrid Event during **October 26th-28th, 2023,** at Boston, Massachusetts, USA.

Announcements

- CSI welcome the following newly joined life members

Sr. No.	Member Name	Life Membership Number
1	Smt. Nandana Chakinala	LM1088
2	Dr. Nitin Chaudhari	LM1089
3	Dr. Eramoni Saikia	M1090
4	Dr. Sushant Kumar	LM1091
5	Dr. Anubendu Adhikary	LM1092
6	Dr. Yuvaraj Gangarajula	LM1093
7	Dr. Bitupon Borthakur	LM1094
8	Dr. Arun Kumar	LM1095
9	Kum. Minu Kumari	LM1096
10	Dr. Soyebkhan Pathan	LM1097
11	Dr. N. Manikanda Prabu	LM1098
12	Dr. Govindhan Perumal	LM1099
13	Dr. Ujjwal Pal	LM1100
14	Shri. KARTHIKEYAN C	LM1101
15	Dr. Sreekala Rugmini	LM1102

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

Name	Achievement
Padma Shri Professor Ganapati D. Yadav, *FTWAS, FNA, FNASc, FRSC (UK), FIChemE (UK), FIIChE* Emeritus Professor of Eminence & Former Vice Chancellor & R.T. Mody Distinguished Professor J.C. Bose National Fellow (Govt. of India), ICT Mumbai 	1) Inducted as a **Fellow of the US National Academy of Inventors (INA)** in Washington DC on June 27, 2023. 2) Declared Second **Nagarjun Award** by Hindu Research Foundation bestowed on him in Nagpur on October 29, 2023.

❖ Quote of the Month

"Success is not final, failure is not fatal:
it is the courage to continue that counts."
*- **Winston Churchill***

Editorial Team

Dr. Sharad Lande

Dr. Raksh Vir Jasra