# 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

- **ONGC to become Net Zero by 2038**

Oil Natural Gas Commission (ONGC) will become Net-Zero by 2038 and invest Rs 1 lakh crore by 2030 on energy transition projects to reduce carbon emissions, Arun Kumar Singh, Chairman & CEO, ONGC announced during an interaction with the journalists in Mumbai on 29 May 2023. By doing so, the Energy Maharatna will prepare roadmaps for net zero emissions as part of the nation's commitment to deal with the climate challenge crisis.

Source: https://www.indianchemicalnews.com/petro-chemical/ongc-to-become-net-zero-by-2038-17688

- **Honeywell Introduces UOP eFining Technology for New Class of Sustainable Aviation Fuel (SAF)**

Honeywell has unveiled its UOP eFining technology, a ready-now solution for producing low-carbon SAF. The methanol to jet fuel (MTJ) processing technology can convert eMethanol to eSAF reliably and at scale, reducing greenhouse gas (GHG) emissions by 88%. HIF Global is slated to deploy the technology at its second US eFuels facility. This is an important industry development, as it extends renewable fuels to next generation, $CO_2$ + $H_2$ into efuels. This is the next step beyond Methanol (Alcohols) to Jet (SAF) and renewable diesel (RD), perhaps eventually gasoline.

Source: Source: Honeywell 11/05/2023

- **GAIL Plans $4.9-Billion Ethane Cracker in West India**

GAIL (India) Ltd reportedly plans to build a $4.89 -Billion ethane cracker near its liquefied natural gas (LNG) import plant in Western India. GAIL is looking for land in the coastal region of Dabhol in Maharashtra state for the 1.5 million tons a year (mtpa) cracker project.

Source: GAIL 11/05/2023

- **Indian Oil to Pursue Bio-naphtha Options for Refinery Crackers**

Indian Oil Corp. announced it is looking to decarbonize its petrochemical feedstocks by introducing bio-naphtha at its crackers. Characterizing it as “the natural transition for the petrochemical industry,” the company indicated that research and development is underway at its Faridabad facility in northern India.

Source: Indian Oil Corp., 25/05/2023

- **Rosneft Seeks Joint Venture Opportunities for Greenfield Refinery Projects in India**

Rosneft has stated its ambition to build a new refinery in India in collaboration with regional state-owned refiners. The project’s goal is to offer an alternative to the nation’s long delayed, $44 billion west coast refinery, which has experienced delays for years.

Source: Rosneft , 18/05/2023

- **Fischer-Tropsch (FT) CANS™ technology for Bio-fuels**

Johnson Matthey (JM) and bp announced that their co-developed, award-winning Fischer-Tropsch (FT) CANS™ technology has been selected by strategic biofuels for a project in Louisiana. The technology converts syngas into long-chain hydrocarbons. Plans include the conversion of 1 million tons of forestry waste feedstock into cleaner- burning renewable diesel, thereby producing 31.8 million gallons of biofuels per year.

- **Shell Catalysts & Technologies Expands World-scale Facility in Louisiana**

Shell Catalysts & Technologies announced a final investment decision (FID) of $121.7 million to expand its West Baton Rouge Parish facility in Louisiana. The location is the largest refining catalyst plant in the world and the expansion will increase manufacturing capacity by an additional 15,000 tons per year.

Source: Shell Catalysts & Technologies, 18/05/2023

- **Chandra Asri appointed licensor for EDC plant in USA**

PT Chandra Asri Petrochemical Tbk (Chandra Asri) through its subsidiary, PT Chandra Asri Alkali has signed a License, Basic Engineering and Technical Services Agreement with a leading vinyl technology from United States of America, to develop ethylene dichloride (EDC) plant.

The CA-EDC plant, which will be operated by CAP2's subsidiary, PT Chandra Asri Alkali, will produce 500,000 metric tons per annum of ethylene dichloride (EDC) and more than 400,000 metric tons per annum of caustic soda. The EDC plant is expected to serve the shortage of the material in Southeast Asia due to growing demand in the vinyl products chain.

Source: https://www.indianchemicalnews.com/technology/chandra-asri-appointed-licensor-for-edc-plant-in-usa-17689

- **BPCL's R&D Center Introduces Ethanol-diesel blend for Cleaner Emissions**

BPCL R&D Centers have been at the forefront of technological advancements. Since its establishment in 2001, the Corporate R&D Centre has provided a platform for breakthrough

research and development. Aligned with Bharat Petroleum's sustainability agenda and Net Zero Mission, BPCL R&D has undertaken initiatives like the Diesel-Ethanol blend to reduce emissions.
Source:https://www.indianchemicalnews.com/research/bpcls-rd-center-introduces-ethanol-diesel-blend-for-cleaner-emissions-17683

- **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, 80 kilometers southwest of Seoul. 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://www.indianchemicalnews.com/battery/lg-chem-plan-to-expand-carbon nanotube-market-17687

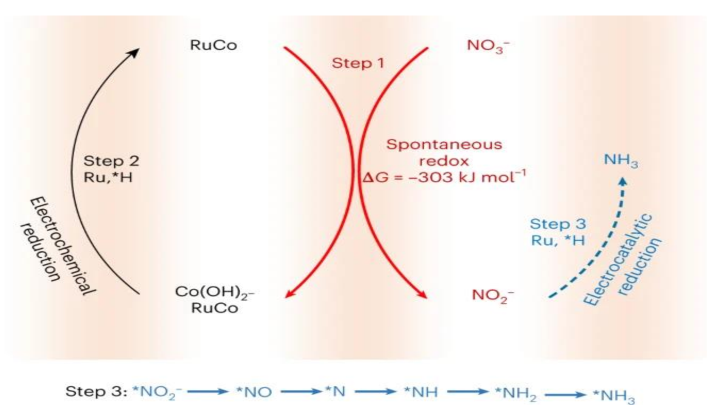
- **Study on the World's First Commercialization of Polycarbonate Resin Chemical Recycling**

The Mitsubishi Chemical Group (the MCG Group) has started a study aimed at realizing a processing capacity of approximately 10,000 tons per year by 2030, seeking to commercialize the world's first chemical recycling by depolymerization of polycarbonate resin (PC resin). A bench facility for a verification study is currently under construction at the Fukuoka Plant, with completion scheduled for August 2023. The MCG Group plans to complete demonstration experiments during the same fiscal year and then proceed with specific commercialization studies. The MCG Group aims not only to establish chemical recycling technology, but to build a recycling system for used PC resin. It plans to actively cooperate with companies that use PC resin in their products.
Source: https://www.mcgc.com/english/news_release/01528.html

## Scientific Updates

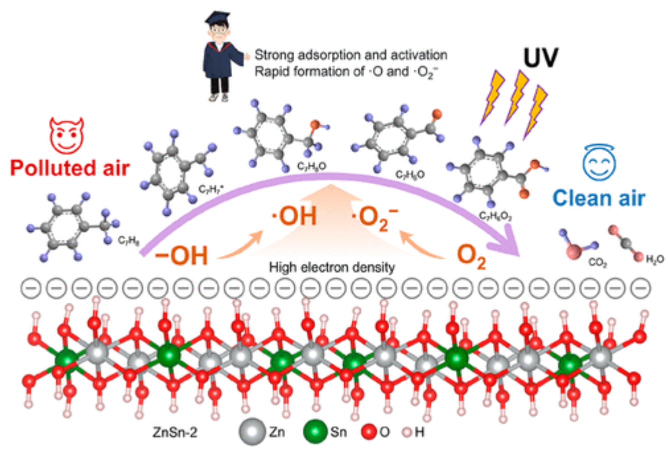
- **Ultralow overpotential nitrate reduction to ammonia via a three-step relay mechanism**

Ammonia plays a substantial role in agriculture and the next generation of carbon-free energy supply. Electrocatalytic nitrate reduction to $NH_3$ is attractive for nitrate removal and $NH_3$ production under ambient conditions. However, the energy efficiency is limited by the high reaction overpotential. Here researcher propose a three-step relay mechanism composed of a spontaneous redox reaction, electrochemical reduction and electrocatalytic reduction to overcome this issue. RuxCoy alloys were designed and adopted as model catalysts. Ru15Co85



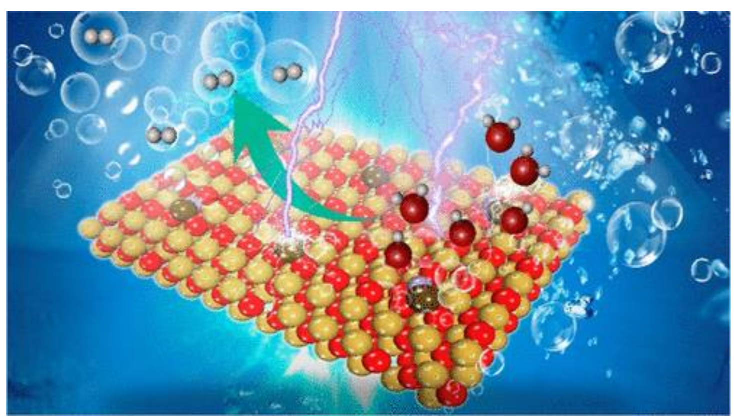
exhibits an onset potential of +0.4 V versus reversible hydrogen electrode, and an energy efficiency of 42 ± 2%. The high-performance results in a low production cost of US$0.49 ± 0.02 per kilogram of ammonia. The high nitrate reduction performances on Ru15Fe85 and Ru15Ni85 also highlight the promising potential of the relay mechanism.
Source: *Nature Catalysis*, 6, 402–414 (2023)

- **Deep Photocatalytic Oxidation of Aromatic VOCs on ZnSn LDH: Promoting Role of Electron Enrichment of Surface Hydroxyl**




Deep oxidation of aromatic VOCs including toluene, styrene, and chlorobenzene by electron enrichment of surface hydroxyl (OH) over ZnSn LDH photocatalyst is reported. By means of regulation of electron donation of Sn atom to OH, the electron density of OH is effectively increased. The electron-rich OH greatly enhanced the interaction between the aromatic VOCs and the photocatalyst, concurrently promoting the reactive oxygen species formation including •OH and •$O^{2-}$, which allowed rapid opening of the aromatic ring and deep oxidizing into $CO_2$. 100% of toluene removal and mineralization efficiency was attained on ZnSn LDH at a high weight hourly space velocity (WHSV) of 60 000 mL $gcat^{-1}$ $h^{-1}$.
Source: ACS Catal. 2023, 13, XXX, 5529–5537

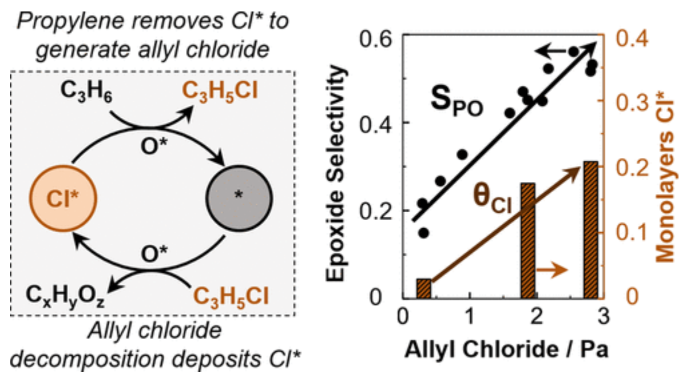
- **Polarization Manipulation of NiO Nanosheets Engineered with Fe/Pt Single Atoms for High-Performance Electrocatalytic Overall Alkaline Seawater Splitting**



Scientists have put forward 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. Specifically, Mn doping is introduced in weak-polarized NiO nanosheets to modulate its surface polarization and thereby regulate the electronic metal–support interaction between anchored Pt/Fe single atoms and NiO support. The optimized $Pt_1$/Mn_NiO||$Fe_1$/Mn_NiO 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 $cm^{-2}$. Moreover, the charge redistributions and the changes in coordination structure induced by Mn doping in $Pt_1$/Mn_NiO and $Fe_1$/Mn_NiO account for the decreased Gibbs free energy for the ratedetermining steps in the HER and oxygen evolution reaction processes. This work demonstrates an effective method to design efficient alkaline seawater electrocatalysts by modulating electronic metal–support interaction over surface polarization regulation.

Source: ACS Catalysis 2023 https://doi.org/10.1021/acscatal.3c01101

- **Critical Role of Chlorinated Hydrocarbons in Propylene Epoxidation over K-Ag/$CaCO_3$**

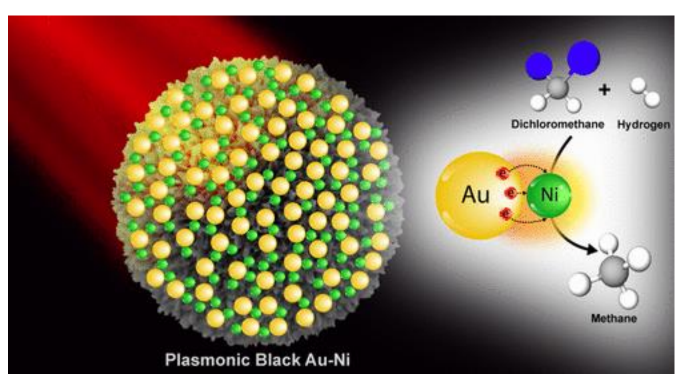



Selective propylene epoxidation over K-promoted Ag/$CaCO_3$ features promotion by surface-bound chlorine adatoms (Cl*) deposited by trace alkyl chlorides co-fed continuously in a fashion similar to ethylene epoxidation over promoted Ag/α-$Al_2O_3$ catalysts. Steady-state propylene epoxidation over K-Ag/$CaCO_3$ in the presence of gaseous promoters (NO, $CO_2$, and $C_2H_5Cl$) at varied contact times in flow reactors as well as transient, low-conversion batch epoxidation reveal allyl chloride, formed via propylene oxychlorination, to be a highly unstable intermediate.

In situ allyl chloride formation and decomposition are in turn observed to control Cl* coverages and induce substantial bed-scale Cl* gradients during propylene epoxidation by (i) reducing Cl* coverage upstream in the catalyst bed via propylene oxychlorination and (ii) increasing downstream Cl* coverages by allyl chloride decomposition. This is supported by postreaction batch titrations of K-Ag/$CaCO_3$ beds after steady state propylene epoxidation at varying contact times which reveals bed-average Cl* coverages increasing from ∼0.03 to ∼0.2 monolayers (moles Cl per surface Ag) with propylene conversion increasing from ∼0.05% to 2.3%. Control of Cl* coverages by in situ generated allyl chloride is highly consequential for selective epoxidation with epoxide selectivity (∼25 to 55%) and site-time yield (∼20 to 54 nmol $gcat^{-1}$ $s^{-1}$) increasing substantially with bed-averaged Cl* coverages as propylene conversion increases (∼0.05% to 2.3%).

Source: ACS Catalysis https://doi.org/10.1021/acscatal.3c00915

- **Black Gold-Based "Antenna–Reactor" to Activate Non-Plasmonic Nickel: Photocatalytic Hydrodechlorination and Hydrogenation Reactions**

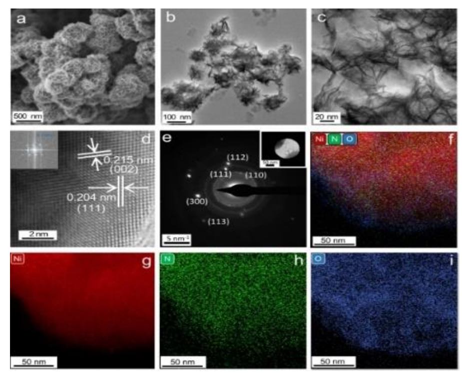



Activation of organic chlorides is a challenging reaction due to their chemical inertness, while hydrogenation of alkene and alkynes faces poor selectivity. In this work, we have demonstrated the use of nickel-loaded black gold (black Au–Ni) that absorbs broadband light from visible to near-infrared of the sunlight due to plasmonic coupling between Au NPs, for photocatalytic hydrodechlorination and propene and acetylene hydrogenation reactions. Hot carriers, the polarizing electric field, and the photothermal effect generated in these catalysts enabled photocatalytic bond activation of these two challenging reactions using visible light at lower temperatures and atmospheric pressure. The black Au–Ni catalyst showed a multifold increase in its activity as compared to black Au. The plasmon-assisted reaction mechanism of hydrodechlorination was supported by intensity-dependent catalysis, kinetic isotope effect (KIE), competitive C–Cl bond activation with one-electron ferricyanide reduction, finite-difference time-domain (FDTD) simulations, and quantum chemical studies. Cluster model-based density functional theory studies show that the reactions have substantial barriers, which were bypassed via an excited state accessed through plasmonic excitations. These observations indicated the hot carrier involvement in the hydrodechlorination reactions in addition to the photothermal effect.

Source: ACS Catalysis 2023 Source: https://doi.org/10.1021/acscatal.3c00568

- **Surface plasmon-enhanced photo-driven $CO_2$ hydrogenation by hydroxy-terminated nickel nitride nanosheets**

This work shows hydroxy-terminated nickel nitride ($Ni_3N$) nanosheets as an alternative to these metals. The $Ni_3N$ nanosheets catalyze $CO_2$ hydrogenation with a high CO production rate (1212 mmol $g^{-1}$ $h^{-1}$) and selectivity (99%) using visible light. Reaction rate shows super-linear power law dependence on the light intensity, while quantum efficiencies increase with an increase in light intensity and reaction temperature. The transient absorption experiments reveal that the hydroxyl groups increase the number of hot electrons available for photocatalysis. The in- situ diffuse reflectance infrared Fourier transform spectroscopy shows that the $CO_2$ hydrogenation proceeds via the direct dissociation pathway. The excellent photocatalytic performance of these $Ni_3N$ nanosheets (without co-catalysts or sacrificial agents) is suggestive of the use of metal nitrides instead of conventional plasmonic metal nanoparticles.



Source: Nature Communication **14**, 2551 (2023).

## Catalysis Research out of India

1. Alexander Klyushin, Manoj Ghosalya, Esko Kokkonen, Calley Eads, Rosemary Jones, Naresh Nalajala, Chinnakonda S Gopinath, Samuli Urpelainen, "Photocatalytic setup for in situ and operando ambient-pressure X-ray photoelectron spectroscopy at MAX IV Laboratory" **Journal of Synchrotron Radiation** 30 (3), 2023.
2. Priyanka V Jawale, Bhalchandra M Bhanage "Kinetic and docking study of synthesis of glyceryl monostearate by immobilized lipase in non-aqueous media" **Biocatalysis and Biotransformation,** 41(2) 123-132, 2023.
3. Anurag Jaswal, Piyush Pratap Singh, Ashish Kumar Kar, Tarak Mondal, Rajendra Srivastava "Production of 2-methyl furan, a promising 2nd generation biofuel, by the vapor phase

hydrodeoxygenation of biomass-derived furfural over TiO2 supported Cu single bond Ni bimetallic catalysts", **Fuel Processing Technology,** 245, 107726, 2023.

4. Apoorva M Ranjekar, Ganapati D Yadav, "Steam reforming of ethanol for hydrogen production: Efficacy of ceria promoted Cu–Co on mesoporous cellular foam silica" **International Journal of Hydrogen Energy**, 2023 https://www.sciencedirect.com/science/article/pii/S0360319923021067
5. Poonam Sutar, Ramdas Kadam, Ganapati D Yadav, "Process simulation-based life cycle assessment of the six-step Cu-Cl Cycle of green hydrogen generation and comparative analysis with other Cu-Cl cycles" **The International Journal of Life Cycle Assessment,** 28, 651–668, 2023.
6. Ganapati D Yadav, "In Pursuit of The Net Zero Goal and Sustainability: Hydrogen Economy, Carbon Dioxide Refineries, and Valorization of Biomass & Waste Plastic" **AsiaChem Magazine,** 110-123, 2023.
7. Kumer Saurav Keshri, Biswajit Chowdhury, "Ceria-Based Nanocomposites: A Comparative Study on Their Contributions to Important Catalytic Processes" **Synthesis and Applications of Nanomaterials and Nanocomposites**, 361-394, 2023, Springer Nature Singapore
8. 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
9. Rahul P Gaikwad, Dhanaji R Naikwadi, Ankush V Biradar, Manoj B Gawande," Photocatalytic One-Pot Conversion of Aldehydes to Esters and Degradation of Rhodamine B Dye Using Mesoporous Graphitic Carbon Nitride" **ACS Applied Nano Materials,** 6(3),1859-1869, 2023
10. Peter Delaney, Varaha P Sarvothaman, Sanjay Nagarajan, David Rooney, Peter KJ Robertson, Vivek V Ranade, "Oxidation of Sulphur pollutants in model and real fuels using hydrodynamic cavitation" **Ultrasonics Sonochemistry,** 95, 106405 2023
11. Satish D. Shewale & Aniruddha B. Pandit, "Multiphase Phenomena and Design of Gas – Liquid Stirred Tanks" Handbook of Multiphase Flow Science and Technology, 2023, Springer Publication

## Announcements

- **Upcoming Symposium/Conferences/Seminars**

1. 6th International Oil & Gas Chemistry, Chemicals & Additives Conference (IOGCA 2023) from 12-13th September 2023 at Ahmedabad http://oilfieldchemical.org/
2. The 28th North American Catalysis Society Meeting Providence, Rhode Island, June 18-23, 2023
3. 15th European congress on Catalysis [ Europacat-15] Prague, Czech Republic, August 27 – September 1, 2023. https://www.europacat2023.cz/
4. International Conference on Organometallics and Catalysis from 30th – 2nd Nov 2023 at Goa, India https://www.icoc2023.com
5. 2nd International Conference on Catalysis and Chemical Engineering, November 09-10, 2023

Millennium Hotel Paris Charles De Gaulle, Paris, France
https://scisynopsisconferences.com/catalysis/

6. 9th Conference of the Federation of the European Zeolite Associations (FEZA 2023) Portorož-Portorose, Slovenia 02 - 06 July 2023 https://www.feza2023.org/en/
7. 4th International, Refinery & Petrochemical Technology, Conference & Exhibition on 8th & 9th August 2023 in New Delhi.
8. International Catalysis Conference ICC 2023 from 15th-17th September 2023 at Miami USA https://www.catalysisworldconference.com/
9. 17th Edition of International Conference on Catalysis, Chemical Engineering and Technology" (Catalysis 2023) will be hosted as Hybrid Event during October 26-28, 2023, at Boston, Massachusetts, USA.

## ❖ Quote of the Month

*"If your actions inspire others to dream more, learn more, do more and become more, you are a leader."* **— John Quincy Adams**

**Editorial Team**

**Dr. Sharad Lande**

**Dr. Raksh Vir Jasra**

***Disclaimer: The information presented in this newsletter is published in open domain***