July 15, 2021

CSI Communication

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Commercial & Policies

- **Swiss Clariant, India Glycols Establish Renewable Ethylene Oxide Joint Venture**

Clariant and India Glycols have created a new joint venture for renewable ethylene oxide (EO) derivatives. The joint venture is now effective and combines India Glycols' renewable bio-ethylene oxide derivatives business, which includes a multipurpose production facility including an alkoxylation plant located in Kashipur, India, with Clariant's local industrial and consumer specialties business in India, Sri Lanka, Bangladesh and Nepal. Clariant will fully consolidate the joint venture from 1 July and expects an incremental addition to the top-line of its care chemicals business in the range of around Swiss francs (Swfr) 50m for the financial year of 2021, it said. Source: ICIS Chemical Business, 7/1/2021.

- **McDermott Wins Two EPCC Refinery Contracts from Indian Oil**

McDermott International, Ltd announced it has received two separate engineering, procurement, construction, and commissioning (EPCC) contract awards from Indian Oil Corporation Limited (IOCL) for the Haldia Refinery and the Barauni Refinery. The first award is an EPCC contract for a new diesel hydrotreating unit and associated facilities for the Barauni Refinery Expansion Project in Bihar, India. The second award is an EPCC contract for the catalytic dewaxing unit and associated facilities at the Haldia Refinery in West Bengal, India. The scope of work across the projects includes project management, residual process design, detailed engineering, fabrication, procurement, construction, transportation, mechanical completion, and commissioning. Work will commence in quarter two 2021. Source: Indian Chemical News, 6/14/2021.

- **Reliance Industries, ADNOC to Jointly Set up Petrochemicals Facility in Abu Dhabi**

Abu Dhabi National Oil Company (ADNOC) on Tuesday announced that Reliance Industries Limited (Reliance), has signed an agreement to join a new world-scale chlor-alkali, ethylene dichloride and polyvinyl chloride (PVC) production facility at TA'ZIZ in Ruwais, Abu Dhabi. The project will be constructed in the TA'ZIZ Industrial Chemicals Zone, which is a joint venture between ADNOC and ADQ.

The agreement continues the momentum of ADNOC's downstream and industry growth plans in line with ADNOC's 2030 strategy. Petrochemical, refining and gas growth projects are currently under construction, with several projects also recently completed across the downstream and industry portfolio.

Under the terms of the agreement, TA'ZIZ and Reliance will construct an integrated plant, with capacity to produce 940 thousand tons of chlor-alkali, 1.1 million tons of ethylene dichloride and 360 thousand tons of PVC annually.

"It is also yet another testimony to the enormous potential in advancing India-UAE cooperation in value enhancement in the energy and petrochemicals sectors. The project will manufacture ethylene dichloride, a key building block for production of PVC in India. This is a significant step in globalizing Reliance's operations, and we are proud to partner with ADNOC in this important project for the region," Ambani added.

Sultan Ahmed Al Jaber, UAE Minister of Industry and Advanced Technology and ADNOC Managing Director and Group CEO, said: "We are delighted to attract an investor of Reliance's caliber to partner with ADNOC and ADQ in accelerating growth at TA'ZIZ. This agreement is a significant milestone, as we continue to grow a globally competitive industrial ecosystem and highly attractive investor value proposition." Source: https://www.business-standard.com/article/companies/adnoc-and-reliance-industries-to-set-up-petrochemical-project-in-abu-dhabi-121062901582_1.html

- **India's TCL Specialties to Build Integrated Petrochemicals Plant in Northeastern U.S.**

TCL Specialties LLC, a subsidiary of Thirumalai Chemicals Ltd. (Mumbai, India), has started implementation of its project to build a chemical facility in the northeastern United States. In Phase 1 of the project, TCL will manufacture maleic anhydride, malic acid and fumaric acid with an annual capacity of about 40,000 metric tons and cater to customers in North America, Europe and Latin America. The plant will be fully integrated from butane to fine chemicals and will be located within the Marcellus/Utica basins. The plant location was selected to be close to large feedstock sources, readily available on-site utilities & services, easy access to large markets in the northeastern and midwestern regions of the U.S. and connected by good logistics networks. TCL will source equipment from the United States, Europe & India. Large sections of the plant will be modularly constructed in shops and moved to the site for installation. The Technology, Design & Engineering services for this phase will be provided by TCL's parent company. The plant is targeted to start operations in late 2023. Source: Chemical Engineering, 6/11/2021.

- **IndianOil Awards $170 Mil Contract for Barauni Polypropylene Plant to Maire Tecnimont**

Tecnimont S.p.A. and Tecnimont Private Ltd, subsidiaries of Italian downstream engineering firm Maire Tecnimont S.p.A., have been jointly awarded an Engineering, Procurement, Construction and Commissioning (EPCC) lump sum contract by Indian Oil Corporation Ltd for the implementation of a new polypropylene plant at its Barauni refining complex in Bihar. The overall value of the contract is about $170 million, Maire Tecnimont said in a statement. The plant will have a capacity of 200,000 tonnes per year and the time schedule is 30 months from the award date up to mechanical completion. The plant is part of Indian Oil's Barauni Refinery capacity expansion project, which entails the installation of large grassroots units as well as revamps and upgrades to increase the capacity of current units.
Source: The Hindu Business Line, 7/5/2021.

- **HPCL Becomes First Company to Bring Ethanol-Blended Petrol In J&K, Ladakh**

Hindustan Petroleum Corporation Ltd (HPCL) has become the first oil firm to start supplies of ethanol-blended petrol in Jammu & Kashmir and Ladakh region. The fuel to the Ladakh region is supplied from its Leh depot, situated at an altitude of 11,500 feet, HPCL said in a statement. 'Conquering the fuel requirement at such high altitude / low temperature and duly backed by robust quality checks, HPCL has become the first oil marketing company in the country to launch ethanol-blended petrol in Ladakh region,' it said. The government has mandated oil companies to mix ethanol in petrol to help cut emissions and reduce oil import bill. A target of mixing 20 per cent ethanol in petrol has been set for 2025. HPCL's Leh depot, which was commissioned in 2018 with total tankage of 4,450 kilolitres, is a crucial oil depot in the northernmost part of the country as it caters to the local demand and requirements of the Indian Armed Forces deployed along the borders. The depot has enough capacity to cater to the entire region during the harsh winter months when supply to the region is not possible due to road blockages.

'HPCL was also the first oil marketing company of the country to start selling ethanol-blended petrol from its retail outlets situated in Jammu and Kashmir region,' the statement said.

Stating that ethanol has become one of the major priorities of 21st century India, HPCL said the focus on ethanol is helping the cause of a better environment and is also bringing in a positive impact on the lives of farmers. 'These initiatives of HPCL will boost the efforts of our country in achieving the target of 20 per cent ethanol blending in petrol by 2025,' the statement added. Source: http://www.businessworld.in/article/HPCL-Becomes-First-Company-To-Bring-Ethanol-Blended-Petrol-In-J-K-Ladakh/18-06-2021-39353

- **Siemens Energy to Electrify First-of-its-kind Biorefinery in Germany**

The Finnish company UPM-Biochemicals has selected Siemens Energy to supply electrification, automation, and digitalization (EAD) packages for a next-generation biorefinery currently under construction in Leuna, Germany. The biorefinery will be the first industrial-scale facility of its type ever built. It will apply novel process innovations to sustainably convert 100% wood into bio-based mono-ethylene glycol (MEG), mono-propylene glycol (MPG) as well as renewable functional fillers (RFF). The Leuna Biorefinery will be a big step for UPM to expand its business into wood-based biomolecular products and solutions. The biorefinery is scheduled for start-up in late 2022. When fully operational, it will have a total annual capacity of 220,000 tonnes. Source: Trade Arabia, 6/23/2021.

- **BASF Expands Chemical Catalyst Recycling Capacity and Capability**

BASF has expanded its chemical catalyst recycling capacity and capability with the acquisition of Zodiac Enterprises LLC in Caldwell, Texas. The site recycles precious metals from industrial scrap, primarily chemical catalysts, and will complement BASF’s existing precious metal recycling operations in Seneca, South Carolina. It will also provide increased smelting capacity in North America. Additional personnel will be hired to expand the site’s production capabilities. The

additional smelting capacity at the Caldwell site will help utilize the recently announced refinery expansion in Seneca. Recycled catalysts go through smelting and are then refined to produce the high purity precious metal needed to make fresh catalysts. Source: BASF, 7/5/2021.

Scientific Updates

- **Scientists Can Predict and Design Single Atom Catalysts for Important Chemical**

Artistic rendering of the propane dehydrogenation process taking place on the novel single Rhodium atom alloy catalyst, as predicted by theory.

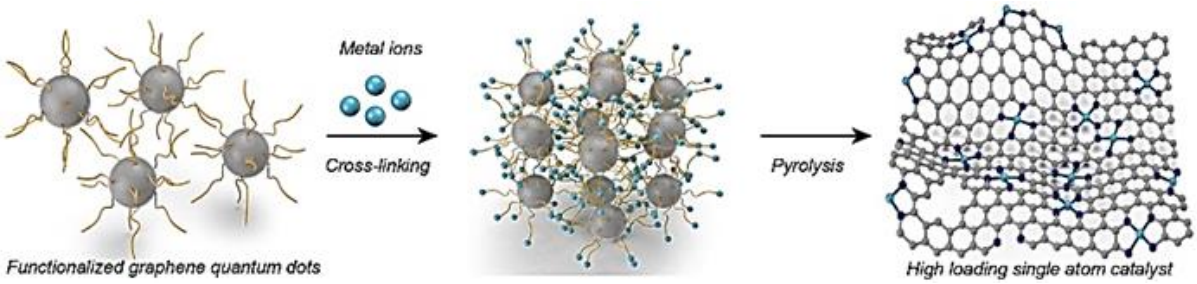
Researchers at Tufts University, University College London (UCL), Cambridge University and University of California at Santa Barbara used quantum chemical simulations run on supercomputers to predict a new catalyst architecture as well as its interactions with certain chemicals, and demonstrated in practice its ability to produce propylene which is critically needed in the manufacture of plastics, fabrics and other chemicals. The improvements have potential for highly efficient, "greener" chemistry with a lower carbon footprint. The single atom Rh catalyst was highly efficient, with 100% selective production of the product propylene, compared to 90% for current industrial propylene production catalysts, where selectivity refers to the proportion of reactions at the surface that leads to the desired product. Not only are the single atom alloy catalysts more efficient, but they also tend to run reactions under milder conditions and lower temperatures and thus require less energy to run than conventional catalysts. Source: Tufts University, 6/24/2021.

- **Quantum Dots Keep Atoms Spaced to Boost Catalysis**

Rice University engineers have assembled what they say may transform chemical catalysis by greatly increasing the number of transition-metal single atoms that can be placed into a carbon carrier. The technique uses graphene quantum dots (GQD), 3-5-nanometer particles of the super-strong 2D carbon material, as anchoring supports. These facilitate high-density transition-metal single atoms with enough space between the atoms to avoid clumping. They proved the value of their general synthesis of high-metal-loading, single-atom catalysts by making a GQD-enhanced nickel catalyst that, in a reaction test, showed a significant improvement in the electrochemical reduction of carbon dioxide as compared to a lower nickel loading catalyst. An international team led by chemical and biomolecular engineer Haotian Wang of Rice's Brown School of Engineering and Yongfeng Hu of Canadian Light Source at the University of Saskatchewan, Canada, detailed the work in *Nature* Chemistry.

The Wang lab achieved transition-metal loads in an iridium single atom catalyst of up to 40% by weight, or 3 to 4 spaced-out single metal atoms per every hundred carbon substrate

atoms. He noted that the synthesis of single-atom catalysts must now been a “top-down” or



“bottom-up” process. The first requires making vacancies in carbon sheets or nanotubes for metal atoms, but because the vacancies are often too large or not uniform, the metals can still aggregate. The second involves annealing metal and other organic precursors to “carbonize” them, but the metals still tend to cluster. The new process takes a middle approach by synthesizing GQDs functionalized with amine linkers and then pyrolyzing them with the metal atoms. The amines crosslink with the metal ions and keep them spread out, maximizing their availability to catalyze reactions. Rice University and The Welch Foundation supported the research. Source: Rice University, 6/24/2021.

- **A Bright Future: Using Visible Light to Decompose CO_2 With High Efficiency**

A team of scientists led by Drs. Shinji Kawasaki and Yosuke Ishii from Nagoya Institute of Technology, Japan, has been at the forefront of efforts to achieve efficient solar-energy-assisted CO_2 reduction. Their recent breakthrough is published in Nature's Scientific Reports. Their research began with the need to solve the limited applicability problem of silver iodate ($AgIO_3$), a photocatalyst that has attracted considerable attention for being useful for the CO_2 reduction reaction. The problem is that $AgIO_3$ needs much higher energy than that which visible light can provide to function as an efficient photocatalyst; and visible light is most of the solar radiation.

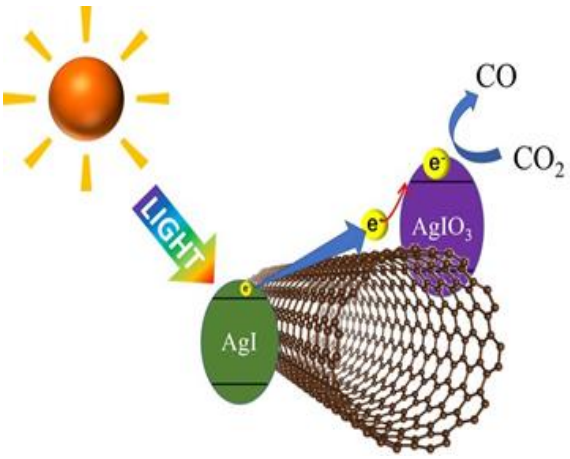


Fig. 2: Mechanism of the novel three-component photocatalyst
The photoexcited electron from silver iodide (AgI) travels along the carbon nanotube to silver iodate (AgIO3) where carbon dioxide (CO2) is reduced to carbon monoxide (CO). Image courtesy: Shinji Kawasaki and Yosuke Ishii from Nagoya Institute of Technology

"We have now developed a new photocatalyst that incorporates single-walled carbon nanotubes (SWCNTs) with $AgIO_3$ and AgI to form a three-component composite catalyst," says Dr. Kawasaki, "The role of the SWCNTs is

multimodal. It solves both the synthesis and the electron transfer pathway problems." The three-component composite's synthesis process is simple and involves just two steps: 1. Encapsulating iodine molecules within the SWCNT using an electrochemical oxidation method; and 2. Preparing the composite by immersing the resultant of the previous step in an aqueous solution of silver nitrate ($AgNO_3$). The incorporation of SWCNTs also allowed for the composite dispersion to be easily spray-coated on a thin film polymer to yield flexible photocatalytic electrodes that are versatile and can be used in various applications. Source: Nagoya Institute of Technology, 6/21/2021.

- **World-First Discovery Could Fuel the New Green Ammonia Economy**

In a world-first, Monash University scientists have developed a new, environmentally friendly process that could drive the future production of green ammonia. A team of Monash University scientists, led by Professor Doug MacFarlane, Dr. Bryan Suryanto and Dr. Alexandr Simonov, have discovered a process based on phosphonium salts that represents a breakthrough. The research, published in the journal Science, unlocks the potential to produce ammonia and fertilizers from renewable energy in reactors, as small as a refrigerator, that could be rolled out at the individual farm or community level.

Direct, zero-carbon ammonia synthesis methods currently being explored include the electrochemical nitrogen reduction reaction. But previous attempts to make this work have previously only been able to demonstrate very small amounts of ammonia, in part because of the need for "sacrificial" sources of protons, said Dr. Suryanto from the Monash School of Chemistry. "In our study, we have found that a phosphonium salt can be used as a 'proton shuttle' to resolve this limitation," Dr. Suryanto said. "Our study has allowed us to produce ammonia at room temperature at high, practical rates and efficiency." Professor MacFarlane added, "Our discoveries have been licensed to a new Monash spin-out called Jupiter Ionics P/L who will be scaling up the process to demonstrate operation in commercial applications." Source: Phys.org, 6/10/2021.

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Quote of the Month

"Strength does not come from physical capacity. It comes from an indomitable will."
Mahatma Gandhi