

# Importance Of Catalysis Technology From Academia To Industry

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## *Abstract*

There is mammoth interest for new innovative improvement, new plan of impetus materials, and more up to date and practical method of integrating materials. Remembering the developing interest, there should be more mindfulness in the understudies about this subject and more examination commitment should be there from India.

*Keywords:* Catalysis, industry, technology

## **INTRODUCTION**

Since Berzelius instituted the expression "catalysis", the reactant science and innovation have gone over far. Almost 95% of the compound assembling measures including creation of energizes and synthetic substances, composts, plastics, drugs use impetuses [1]. Other than compound creation, there is a goliath utilization of impetuses in natural insurance and energy change measures [2]. Catalysis is a quickly developing multibillion-dollar industry. The complete impetus market esteem, which was 7.4 billion dollar in 1997, has now transformed into 16.3 billion dollars [3,4], among which, 40% is dedicated to car area and natural catalysis. In United States synthetic industry alone, the catalysis represents around three billion dollars for every annum and count shows that each US\$1 spent on impetuses created US\$155 worth of items [5,6]. In view of the usage of rigid natural laws, it is anticipated that by 2015, auto motive discharge control impetus it self will constitute more than \$7 billion. The significance of catalysis will keep on filling in our century because of truly expanding energy interest, to continue the climate and furthermore because of the advancements in material science like the development of meso-permeable and nano materials.

Synergist responses are completed utilizing homogeneous, heterogeneous and protein impetuses however the creation of most of the mass synthetics includes strong (heterogeneous) impetuses. Despite the fact that homogeneous impetuses are inherently more dynamic and particular contrasted with the vast majority of the heterogeneous impetuses, still heterogeneous catalysis is the decision in industry for complex focal points like: impetus recuperation is savvy and simple, and great warm dependability. The critical accomplishment of mechanical heterogeneous catalysis relies upon the reactant materials. The blend and preparing of materials play a crucial role. There fore, the essential accentuation is given on improving the reactor, compelling method of integrating mass impetus materials and portraying the materials. These days, the consistently expanding research endeavors have now prompted a circumstance where the limits between the three parts of catalysis, to be specific, homogeneous, heterogeneous and bio are not, at this point inflexible and have gotten penetrable.

## INDUSTRIES IN INDIA

Being the fastest growing economy, India attracts many chemical industries to start their ventures in India. Many of these chemical industries not only manufacture chemicals, but also have their research and development units in India. Companies like General Electric, USA, or SABIC, Saudi Arabia, have established their own R&D centers in Bangalore. Their focus research areas include: non-conventional feedstock, solar-energy-related materials, flexible electronic materials, polymeric responsive materials, microalgae, bio-aromatics, bio-specialties, cost-effective production of H<sub>2</sub>, the use of CO<sub>2</sub> as a reactant, and CH<sub>4</sub> activation. Shell Technology Center in Bangalore is extensively involved in development and performance evaluation of catalytic materials. UOP India Private Limited in Gurgaon has established a well-equipped material characterization laboratory. The leading catalyst manufacturers like Johnson Matthey and BASF have opened their units in India. General Motors in India has started computational research on automotive catalysis. Süd-Chemie in Kerala has developed catalysts for high pressure ammonia cracking for applications in heavy water plant, for naphtha reforming, for ethanol dehydrogenation to acetone and many other useful reactions.

India's own catalysis research and development has geared to serve the needs of the nation on the one hand and the more challenging international requirements on the other. The research is focused, as elsewhere in the world, on innovative solutions to the problems of environmental pollution, safety in industrial practice and nil or low byproducts formation (higher selectivities) in chemical reactions, with ways of saving energy. Reliance Industries Limited, Vadodara, develops adsorbents and adsorptive processes for petrochemical, refinery and retail applications. Hindustan Lever Ltd. in Mumbai works on hydrogenation of oils, FCC and zeolites. Indian petrochemical industries are heavily working on development of catalytic materials and indigenous technologies. Indian Oil Corporation, in Faridabad works on auto-exhaust catalysis, FCC and hydrocracking. Indian Petrochemical Corp. Ltd, Vadodara is engaged in various reactions like Alkylation, dehydrogenation, isomerization, reforming or transalkylation.

## ACADEMICS IN INDIA

### Research

The CSIR laboratories in India are doing forefront research in catalysis and materials related to catalysis. The CSIR laboratories like National Chemical Laboratories in Pune, Indian Institute of Chemical Technology in Hyderabad, Indian Institute of Petroleum in Dehradun, Central Salt and Marine Chemicals Research Institute in Bhavnagar or Central

Fuel Research Institute in Dhanbad aim at the development of innovative catalysts and focus their research programs on integrated approach to develop catalyst materials and process routes involving catalysis, surface science and chemical reactor engineering. Various catalyst materials like zeolites, molecular sieves, metallosilicates, novel materials, supported catalysts are synthesized and performance assessments are carried out. The numerous ongoing research programs in CSIR labs includes petroleum refining, biomass to fuels and chemicals, energy efficient products and processes, fuels and lubricants, chemicals and petrochemicals, CO<sub>2</sub> capture and utilization, value addition to refinery systems, etc. National Environmental Engineering Research Institute, Nagpur, focus their research on auto-exhaust catalysts, zeolite synthesis and also has commercialized non-noble metal catalysts for exhaust purification. The leading academic institutes like IISc, Bangalore, and different IITs are involved in fundamental aspects of understanding the catalytic science. In IISc, Bangalore, the chemistry departments have done significant work on primary understanding of the synthesis process on catalysts and reaction mechanism. At the Department of Chemistry, IIT-Madras, the Department of Science and Technology in 2006 established The National Center for Catalysis Research (NCCR). Many other IITs also have a virtual center for catalysis in energy sector. Institute of Chemical Technology in Mumbai primarily works on catalytic reaction engineering, fundamental studies and phase transfer catalysis. The catalysis society of India is well matured now and encourages catalysis

research in India, organizes professional meetings between researchers to enhance mutual interactions and encourages cooperation between industry and academia.

The society also publishes a peer-reviewed journal on catalysis. However, to cope up with the growth of catalysis technology used in Industries, academic research should be more in number and more funding is required to speed up and popularize this field of research in Indian academia.

### Teaching

The undergraduate and postgraduate chemical engineering courses have the chemical reaction engineering, where students study about catalysis technology. However, in spite of its huge importance, the chemistry graduates particularly from the Indian universities have little exposure to catalysis, heterogeneous catalysis and the catalytic materials in particular. The materials related with chemistry, like metal support catalysts, or mesoporous or microporous materials are neither studied in technical courses nor in science courses. Heterogeneous catalysis is an inter-disciplinary subject and teaching this to undergraduates and postgraduates is a formidable challenge. Courses should be designed in such a way that students get the idea of synthesizing catalytic materials, characterizing materials and understand the surface properties and structural properties of solid materials with catalytic activity and selectivity. Surface engineering is another most important aspect of heterogeneous catalysis. Minute details of adsorption processes and knowledge about surface morphologies are a must. Acquaintance in solid state chemistry enhances the understanding of the structural aspects of the catalytic materials. Nano chemistry is another important subject, which should be essential to appreciate the reaction kinetics and mechanism.

### CONCLUSION AND OUTLOOK

*This article emphasizes the importance of catalysis technology and catalysts particularly in Indian perspective. The growth of the catalysis technology used in the existing industries in India is enormous and also the catalysis research in Indian academia is significant. However, in pedagogical teaching catalysis is always being neglected in the chemistry syllabus in this country. A conclusion has been drawn addressing the importance of teaching catalysis to the undergraduates and postgraduates and in demand of more research contribution in this field.*

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