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ICB PhD public presentations

CHEMICAL RECYCLING OF POLYOLEFIN WASTE VIA CATALYZED HYDROGENOLYSIS

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ETH Hönggerberg, HCI J3 and on Zoom
(https://ethz.zoom.us/j/66725802985)

Project Summary: With plastics being an indispensable part of our everyday lives, their production has grown exponentially in 60 years up to 450 million tons in 2021, making them one of the largest products of the chemical industry by volume. Alarmingly, ca. 75% of all plastic ends up as waste, with polyolefins (e.g., PE, PP) contributing the most. Chemical recycling offers a sustainable alternative to landfilling and incineration with more valuable recyclates than mechanical recycling. However, it accounts for only 1% of all end-of-life treatment methods for plastic waste. Particularly, implementation of catalytic recycling remains scarcely explored with incipient catalyst design and process development. Addressing challenges in these areas, this presentation will showcase our efforts towards investigating catalytic hydrogenolysis to process polyolefins into alkanes. Firstly, the potential of platinum and ruthenium-based catalysts in converting polyolefins into fuel-range alkanes will be discussed. In addition to efforts directed at rationalizing catalyst design, the presentation will discuss a mechanistic tool for ranking catalysts, coined scission preference. This leads to the identification of a highly active catalyst featuring ultrafine ruthenium nanoparticles supported on titania to achieve hydrogenolysis of post-consumer polyolefin waste (e.g., bottle caps). Bimetallic ruthenium-nickel catalysts will be presented next as advanced systems to tune selectivity towards liquid products resulting in more favourable economics and reduced environmental impacts. Pertaining to reactor engineering, the presentation will highlight pioneering efforts to develop a criterion to maximize catalyst effectiveness. The presented findings will thus provide insights into hydrogenolysis with emphasis on the need for integration of catalyst design at the nanoscale with reactor engineering.

CV: Shibashish Jaydev obtained his B. Tech in Chemical Engineering from National Institute of Technology, Tiruchirappalli (2018), and MSc. in Chemical and Bioengineering from ETH Zurich (2020). In the same year, he started his doctoral research in aCe-Catalysis Engineering under the supervision of Prof. Javier Pérez-Ramírez and Dr. Antonio J. Martín, within the framework of an ETH grant.