Center for Catalytic Science & Technology

JUNGHO JAE

PUSAN NATIONAL UNIVERSITY

MONDAY, APRIL 29, 2024

1:00 P.M. | 366 CLB

Jungho Jae is an Associate Professor of Chemical & Biomolecular Engineering at Pusan National University (PNU) in Korea. He obtained his Ph.D. in chemical engineering from University of Massachusetts Amherst (2012) where he studied the zeolite catalyst for biomass conversion under the guidance of Prof. George Huber. Then he did his postdoctoral research at the Catalysis Center for Energy Innovation at the University of Delaware (2012-2013) where he studied the transfer hydrogenation of biomass with Prof. Dion Vlachos and Raul Lobo. Prior to his appointment as a professor, he worked as a Senior Researcher at the Korea Institute of Science and Technology (KIST) from 2014 to 2018. His current research field is catalysis and reaction engineering for converting biomass/plastic waste/carbon dioxide into usable fuels and chemicals. He has coauthored more than 120 articles and 20 patents on these subjects. He has been awarded with the young scientist award in PNU (2021) and Best Paper Award from the Korea Society of Industrial and Engineering Chemistry (2019,2021).

HETEROGENEOUS CATALYTIC TECHNOLOGIES TO DECARBONIZE PLASTIC INDUSTRY

Decarbonization of chemical industry has been increasingly emphasized due to the worsening of global warming and climate change. Especially, plastics are said to be one of the biggest contributors to increasing carbon emission due to their daily and single-use culture as well as the massive use of fossil fuels to produce them. Two potential solutions to this plastic problem are: to recycle the plastic to its original monomers to be re-used for the synthesis of plastics and to produce plastic monomers from the carbon-neutral feedstock such as biomass, called bio-based polymer. In this presentation, I will discuss specific two catalytic technologies to decarbonize plastic use.

First, the acrylic acid (AA) production by the gas-phase dehydration of lactic acid (LA) and the design of new solid acid catalyst based on zeolites for high AA selectivity (>90%) will be discussed. Lactic acid (LA) is a key C3 biorenewable platform molecule, which can be mass-produced via the fermentation of biomass-derived cellulose at nearly theoretical yields, while AA is a high volume (~8×10^6 tons/year) and multipurpose plastic monomers for adhesives, coatings, and absorbent polymers and currently produced from petrolle-derived propylene. Due to the

CENTER FOR CATALYTIC SCIENCE AND TECHNOLOGY

For more information: ***https://sites.udel.edu/ccst/***

structural similarity between LA and AA, the dehydration of LA to AA has received considerable attention for the sustainable AA production. However, achieving high AA selectivity remains challenging, because high reactivity of the carboxyl groups adjacent to the hydroxyl groups leads to various side reactions. Alkali-exchanged zeolites can be an ideal candidate material for selectivity control in LA-to-AA reaction due to their tunable acid-base properties and hydrophobic/hydrophilicity as well as the shape selectivity. I will discuss recent new findings on the site requirement for the high AA selectivity obtained from the controlled zeolite synthesis and in-situ IR spectroscopy.

Second, I will talk about the catalytic hydrogenolysis of polyethylene terephthalate (PET) to aromatic chemicals or cyclic fuels. PET can be depolymerized and deoxygenated directly into gasoline- and jet-fuel range cycloalkanes in nearly quantitative yield (~99%) on Ru/TiO_2 catalyst in water/dodecane bi-phasic medium. The hydrophilicity of the catalyst and the related Pickering emulsion formation are the key catalytic descriptors to dictate the overall PET conversion and aromatic selectivity. I will discuss how these oil/water emulsion interface meditated by the catalyst particles can be manipulated by the reaction parameter and catalyst properties, eventually turning the product selectivity toward the more desired and unsaturated products of benzene, toluene, xylenes (BTX) in >90% selectivity.