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BIOMASS CONVERSION TO FUELS AND VALUE-ADDED CHEMICALS WITH MAGNETICALLY RECOVERABLE CATALYSTS

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Biomass conversion plays a tremendous role in obtaining value-added chemicals and fuels from renewable sources without use of petrochemicals. In the last decade magnetically recoverable catalysts have received considerable attention due to more environmentally friendly processes, conservation of energy, and cheaper target products. In this talk author will discuss the use of magnetically recoverable catalysts for biomass and biooil related processes, including transformations of cellulose to value-added chemicals, syngas (produced by bio-oil pyrolysis) to methanol and methanol to hydrocarbons (fuels) as well as bio-oil hydrogenation to important chemicals. Figure 1 shows high resolution transmission electron microscopy (HRTEM) image of the magnetic zeolite containing Ni nanoparticles (left), its energy dispersive spectroscopy (EDS) map (superposition of Fe and Ni maps, center), and the methanol-to-hydrocarbon (MTH) reaction pathway (right). Modifying the iron oxide (magnetite, Fe_3O_4) amounts, we were able to control the catalyst activity and the product distribution in MTH. The modification of zeolites with Ni nanoparticles allowed us to significantly improve the catalyst stability due to diminishing coke formation and disordering of the coke formed. As is relevant to many catalytic systems, it will be demonstrated that the presence of magnetic iron oxide nanoparticles can enhance catalytic activity or change the reaction mechanism, allowing for more valuable products. In some instances, however, the presence of iron oxide can be detrimental due to side reactions. In such a case, a proper iron oxide nanoparticle protection/stabilization is required to suppress side reactions.

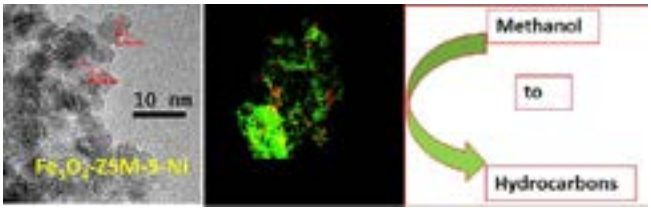

Figure 1: HRTEM image (left) and superposition of Fe and Ni EDS maps (center) of the magnetic zeolite with Ni nanoparticles and the MTH reaction pathway (right)

Recent Publications

1. Das V K, Shifrina Z B and Bronstein L M (2017) Graphene and graphene-like materials in biomass conversion: paving the way to the future. Journal of Materials Chemistry 5:25131.
2. Oracko T *et al.* (2017) Metal ion distribution and oxygen vacancies determine activity of magnetically recoverable catalysts in methanol synthesis. ACS Applied Materials & Interfaces 9:34005.
3. Cherkasov N *et al.* (2017) Hydrogenation of bio-oil into higher alcohols over Ru/Fe_3O_4-SiO_2 catalysts. Fuel Processing Technology 167:738.
4. Alibegovic K *et al.* (2017) Furfuryl alcohol synthesis from furfural over magnetically recoverable catalysts: does the catalyst stabilizing medium matter? Chemistry Select 2:5485.

5. Baird N et al. (2017) Enhancing the catalytic activity of Zn-containing magnetic oxides in a methanol synthesis: identifying the key factors. ACS Applied Materials & Interfaces 9:2285.

Biography

Lyudmila M Bronstein is a Senior Scientist at the Department of Chemistry, Indiana University. During her research career, she published over 210 papers, reviews, and book chapters. Her research program focuses on developing new materials with important applications in the fields of energy, catalysis, and life sciences. Her research group has been working on making solid polymer electrolytes for Li ion batteries with enhanced performance, efficient and selective catalytic systems based on polymers, dendrimers, and mesoporous solids, and multifunctional magnetic nanoparticles for biomedical applications.

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