CHEMICAL, BIOLOGICAL & MATERIALS ENGINEERING
100 E. Boyd, Sarkeys Energy Center, T-335
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The University of Oklahoma
Norman, Oklahoma

2012 – 2013 Seminar Series

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DR. GEORGE W. HUBER

PROFESSOR, CHEMICAL AND BIOLOGICAL ENGINEERING
UNIVERSITY OF WISCONSIN, MADISON
MADISON, WISCONSIN

Will present a seminar on

"NEW CATALYTIC TECHNOLOGIES FOR PRODUCTION OF RENEWABLE FUELS AND CHEMICALS FROM BIOMASS"

The objective of the Huber research group is to develop processes for the production of renewable fuels and chemicals from biomass that can be used to replace all products currently produced from crude oil. We use a wide range of modern chemical engineering tools to design and optimize these clean technologies including: heterogeneous catalysis, kinetic modeling, reaction engineering, spectroscopy, analytical chemistry, nanotechnology, catalyst synthesis, conceptual process design, and theoretical chemistry. In this presentation we will discuss several new approaches for the production of renewable fuels and chemicals.

Diesel and jet fuel blendstocks can be produced by liquid phase processing of aqueous carbohydrate solutions. We will show how renewable jet and diesel fuel can be produced from waste hemicellulose streams that are byproducts of the pulp and paper industry. The first step in this process is the acid catalyzed dehydration of hemicellulose oligomers into furfural and acetic acid. In the dehydration reactions undesired humins are formed through reactions between the furfural and carbohydrates and self polymerization of the furfural. We have designed a continuous biphasic reactor where a solvent is able to selectively remove the furfural before it reacts further to form undesired humins. An economic analysis shows that this continuous biphasic process can produce furfural at costs of 25% the market value of furfural with energy savings of 75% compared to current industrial processes for furfural production. Solid acid catalysts can be incorporated into this process offering additional cost benefits. The selectivity to the desired furfural product is a function of the Bronstead to Lewis acid site ratio of the catalyst. Bronstead acid sites selectively catalyze the desired dehydration reaction; whereas Lewis acid sites catalyze both furfural production and humin formation. By controlling the catalytic properties solid acid catalysts can be designed for aqueous phase dehydration reactions that have comparable selectivity to homogeneous acids.

Aromatics and olefins can also be produced from biomass by catalytic fast pyrolysis (CFP). Catalytic fast pyrolysis involves the direct production of these petrochemicals in a single catalytic step. Solid biomass is fed into a fluidized bed reactor where the solid biomass thermally decomposes. The biomass vapors then enter a zeolite catalyst where a series of dehydration, decarbonylation and oligomerization reactions occur to form aromatics, olefins, CO, CO_2, coke and water. Coke is formed from homogeneous decomposition reactions or catalytic reactions inside the zeolite. We will discuss how the catalytic properties and reaction conditions can be adjusted to produce the desired aromatics and compare catalytic pyrolysis with standard pyrolysis reactions.

Aqueous phase hydrodeoxygenation (APHDO) converts water soluble biomass derived feedstocks (including aqueous carbohydrates, pyrolysis oils, and aqueous enzymatic products) into alkanes, alcohols and polyols. In this process the biomass feed reacts with hydrogen to produce water and a deoxygenated product using a bifunctional catalyst that contains both metal and acid sites. The challenge with APHDO is to selectively produce targeted products that can be used as fuel blendstocks or chemicals and to decrease the hydrogen consumption. We will discuss the catalytic challenges, chemistry, kinetic modeling and reaction engineering that are involved in APHDO process.

THURSDAY, SEPTEMBER 20, 2012
COOKIES AND COFFEE -- 2:45 P.M.
SEMINAR -- 3:00 P.M.
SARKEYS ENERGY CENTER, ROOM M-204

THIS IS A REQUIRED SEMINAR FOR CHE 5971

Accommodations on the basis of disability are available by contacting the office before the event.