Chemical and Petroleum Engineering

SEMINAR NOTICE

Dr. Raul F. Lobo

Claire D. LeClaire Professor of Chemical Engineering
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Raul F. Lobo is the Claire D. LeClaire professor of Chemical and Biomolecular Engineering at the University of Delaware. His research interests span development of catalysts for energy and the environment, development of novel porous materials for catalysis and separations, the chemistry of zeolites, and the scientific aspects of catalyst synthesis. He has published over one hundred eighty refereed reports and he is co-inventor in six US patents. He obtained his undergraduate degree in Chemical Engineering at the University of Costa Rica in 1989 and later moved to California to pursue graduate studies with Prof. Mark Davis. He worked for one year at Los Alamos National Laboratory, New Mexico, as a postdoctoral fellow and started his academic career at the University of Delaware in 1995. He was director for the Center for Catalytic Science and Technology from 2012 to 2020.

Prof. Lobo has conducted research in the use of zeolites for nitrogen/oxygen separations, and carbon dioxide separations from flue gases. He has contributed to the fundamentals of zeolite nucleation and crystal growth and to the application of zeolites for a number of catalytic applications. In particular his group research helped understand the mechanisms of reaction and stability of zeolite catalysts used for the removal of NOx gases from combustion exhaust, developed catalytic materials for the transformation of biomass-derived furans into commodity aromatic molecules, and discovered new materials for the selective activation of methane using copper oxide clusters.

From C5 Sugars to Industrial Chemicals Through Catalysis

Much effort has been devoted to the transformation of glucose, a 6-carbon sugar, into new and known species that can be incorporated in the existing chemical industry infrastructure. All these processes, however, go through the dehydration of glucose to form hydroxymethylfurfural (HMF), a molecule that is unstable under hydrolytic conditions limiting yield and increasing costs. In contrast, an established industry already exists based on the dehydration of 5-carbon sugars into furfural, all of it from non-edible biomass precursors such as bagasse and corn stover. More than 300,000 tons of furfural are produced yearly that today go mostly into the production of furfurylalcohol, furoic acid and other C5 derivatives.

As part of the Catalysis Center for Energy Innovation, we have been investigating catalytic processes to produce valuable molecules from these C5 intermediates motivated by their wide availability and relative low cost. This talk will summarize our efforts in this direction. We use an array of catalytic processes, homogeneous and heterogeneous, to make molecules for which there is already an existing market, such as benzoic acid and □-methylstyrene, starting from furfural or methylfuran. We will also show that furfural can be a precursor to the production of interesting molecules that are very difficult to produce from petroleum-based precursors. Among these, we will discuss our investigations in the synthesis of vinylfurans, bifuran-dicarboxylic acids and a highly selective synthesis of 4,4'-dimethylbiphenyl from C5 sugars, a precursor to polymer precursors with exceptional physical and chemical properties. These results show there is ample room for innovation through the synergy of catalysis and process chemistry to find new and interesting ways to use renewable carbon sources helping to produce a more sustainable chemical industry.

Tuesday, March 16th | 1:00 – 1:50PM (CST)

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