Michigan State University
Science at the Edge
Engineering Seminar

April 1st, 2016
11:30 a.m., Room1400 Biomedical and Physical Sciences Building
Refreshments served at 11:15 a.m.

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Strategies for Biofeedstock Conversions via Tandem Catalytic C-O Hydrogenolysis

Abstract

This lecture focuses on thermodynamics/mechanism-based strategies for converting abundant biofeedstocks into useful fuels and chemicals. New approaches to the hydrogenolysis of the ubiquitous biofeedstock C-O bonds include selective hydrogenolysis of cyclic and linear etheric C-O bonds by tandem catalytic systems consisting of recyclable metal triflates and supported hydrogenation catalysts, in either ionic liquid solvents or in the neat substrates. Kinetic and DFT computational studies show that the turnover-limiting step in these reactions is the retro-hydroalkoxylation, followed by rapid alkenol hydrogenation. The metal triflate catalytic activity scales approximately with the DFT-computed charge density on the metal ion. With the most active catalysts, ethereal substrates are rapidly converted, via the alkenol, to the corresponding saturated hydrocarbons. In similar tandem processes, esters and triglycerides are also rapidly and selectively converted, ultimately, to C3 hydrocarbons and diesters or biodiesel fuel. The kinetics and mechanism of these ester hydrogenolysis processes, as deduced by combined experimental results and DFT computation, are compared and contrasted with those of the corresponding ethers.

Bio

Tobin Marks is Vladimir N. Ipatieff Professor of Chemistry, Professor of Materials Science and Engineering, and Professor of Applied Physics at Northwestern University, and Distinguished Adjunct Professor at Texas A&M Qatar and World Class BK21 Professor at Korea University. He received a B.S. degree in Chemistry from the University of Maryland (1966) and Ph.D. from MIT (1971) in Inorganic Chemistry. His research interests include transition metal and f-element organometallic chemistry; catalysis; vibrational spectroscopy; synthetic facsimiles of metalloprotein active sites; carcinostatic metal complexes; solid state chemistry and low-dimensional molecular metals; nonlinear optical materials; polymer chemistry; tetrahydroborate coordination chemistry; macrocycle coordination chemistry; molecular electro-optics; metal-organic chemical vapor deposition; polymerization catalysis; printed flexible electronics; solar energy; and transparent conductors.

Marks has received American Chemical Society National Awards in Polymeric Materials, 1983; Organometallic Chemistry, 1989; Inorganic Chemistry, 1994; Chemistry of Materials, 2001; Distinguished Service in Inorganic Chemistry, 2008; Organic Chemistry (Cope Senior Scholar), 2010; Catalysis (Somorjai), 2013. He received the 2000 American Chemical Society Cotton Medal; 2001 American Chemical Society Willard Gibbs Medal; 2001 N. American Catalysis Society Burwell Award; 2001 American Chemical Society Linus Pauling Medal; 2002 American Institute of Chemists Gold Medal; 2003 German Chemical Society Karl Ziegler Prize; 2004 Royal Society of Chemistry Frankland Medal, 2005 American Chemical Society Bailar Medal; Member, U. S. National Academy of Sciences (1993); Fellow, American Academy of Arts and Sciences (1993), Member, German National Academy of Sciences (2005); Fellow, Royal Society of Chemistry (2005); US National Medal of Science (2007);

Fellow, Chemical Research Society of India (2008); Fellow, Materials Research Society (2009): Honorary Fellow, Indian Academy of Sciences (2010). He received the 2008 Spanish Principe de Asturias Prize for Scientific Research; 2009 N. American Catalysis Society Pines Award; 2009 Taylor Materials Research Award, Penn. State U.; 2009 Von Hippel Award, Materials Research Society; 2010 American Chemical Society Nichols Medal; 2010 Distinguished Affiliated Professor Award and Wilhelm Manchot Prize, Technical U. of Munich; 2010 American Chemical Society Mosher Award; 2011 Schulich Prize, Technion-Israel Institute of Technology; 2011 Dreyfus Prize in the Chemical Sciences; 2012 American Chemical Society Richards Medal; the 2012 National Academy of Sciences Award in the Chemical Sciences; member, National Academy of Engineering, 2012; Distinguished Alumni Award and Election, Circle of Discovery, University of Maryland, 2012; Alan G. MacDiarmid Medal, University of Pennsylvania, 2013; Wilkinson Medal, Royal Society of Chemistry UK, 2014; Luigi Sacconi Medal, Italian Chemical Society, 2015.

He received Doctor of Science degrees *honoris causa*, from the Hong Kong University of Science and Technology in 2011, the University of South Carolina in 2011, and the Ohio State University in 2012.

Peer-reviewed publications: 1195; h-index = 136 (on 71,500 citations); Issued US Patents: 233.

For further information please contact Prof. Richard Lunt, Department of Chemical Engineering and Materials Science at rlunt@egr.msu.edu

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