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PREC
Professorship of Renewable Energy Carriers

Energy Science Center

Invitation to a Seminar

Date: Wednesday, Nov. 12, 2014

Time: 16:00-17:00

Place: ETH Zürich, LEE E-101

Speaker: **Prof. Christopher W. Jones**
School of Chemical & Biomolecular Engineering
Georgia Institute of Technology
http://jones.chbe.gatech.edu/

Title: CO_2 Capture with Supported Amine Materials: Materials and Process Chemistry Advances for Greenhouse Gas Mitigation and CO_2 Utilization

Abstract – Worldwide energy demand is projected to grow strongly in the coming decades, with most of the growth in developing countries. Even with unprecedented growth rates in the development of renewable energy technologies such as solar, wind and bioenergy, the world will continue to rely on fossil fuels as a predominant energy source for at least the next several decades. Given this premise, the atmospheric CO_2 concentration will continue to rise rapidly. The Intergovernmental Panel on Climate Change (IPCC) has stated that anthropogenic CO_2 has contributed measurably to climate change over the course of the last century. Some have hypothesized that increasing atmospheric CO_2 concentrations pose a significant risk of additional climate change that could adversely affect human lives. To this end, there is growing interest in new technologies that might allow continued use of fossil fuels without drastically increasing atmospheric CO_2 concentrations beyond currently projected levels. In this lecture, I will describe the design and synthesis, characterization and application of new aminosilica materials that we have developed as potential cornerstones of new technologies for the removal of CO_2 from dilute gas streams. Hyperbranched aminosilica materials (HAS) have been developed in our laboratory as selective CO_2 adsorbents. Porous silica or other support materials with suitably reactive surface groups are used as substrates for the surface polymerization of aziridine, leading to surface-tethered hyperbranched polymers with a high density of amine groups. Adjusting the synthesis conditions allows the control of the aminopolymer loading, allowing direct control of important thermodynamic (equilibrium capacity) and kinetic (adsorption rate) characteristics of the adsorbent. These chemisorbents efficiently remove CO_2 from simulated flue gas streams, and the CO_2 capacities are actually enhanced by the presence of water, which is found in all flue gas streams, unlike in the case of physisorbants such as zeolites. Interestingly, the heat of adsorption for these sorbents is sufficiently high that the sorbents are also capable of capturing CO_2 from extremely dilute gas streams, such as the ambient air. Indeed, our HAS adsorbents are quite efficient at the direct "air capture" of CO_2 and we will describe our investigations into development of air capture technologies as well. Overall materials chemistry and process needs for effective CO_2 capture and utilization will be discussed.

Biosketch –. Prof. Jones is the New-Vision Professor of Chemical & Biomolecular Engineering and the Associate Vice President for Research at Georgia Tech. There he leads a research group that works in the broad areas of materials, catalysis and adsorption. In particular, his group currently studies (i) the generation of a molecular-level understanding of supported organic and organometallic catalysts, (ii) the catalytic conversion of biomass and biomass-derived molecules into fuels and chemicals, and (iii) the engineering of materials for adsorptive or membrane separations, with specific applications in CO_2 capture. Prof. Jones earned a BSE in chemical engineering at Michigan in 1995, followed by his MS (1997) and PhD (1999) at Caltech. Following post-doctoral studies in chemistry at Caltech, he joined Georgia Tech in 2000. Since joining Georgia Tech, Dr. Jones has been recognized with a number of awards for his research and teaching. In 2008, he was named a Hesburgh Teaching Fellow at Georgia Tech. He has been recognized for his catalysis research by the American Chemical Society with the *Ipatieff Prize* in 2010, and by the North American Catalysis Society with the *Paul H. Emmett Award in Fundamental Catalysis* in 2013. Also in 2013, he was recognized by the American Society of Engineering Education for his work in CO_2 capture with the *Curtis McGraw Research Award*. Dr. Jones is the founding Editor-in-Chief of the new journal, *ACS Catalysis*, which just was recognized with the 2012 *Prose Award* as the Best New Journal in Science, Technology or Medicine, by the American Association of Publishers. In 2014, it became the catalysis journal with the highest Impact Factor in only its fourth year of existence.

Host: Prof. A. Steinfeld, www.pre.ethz.ch