

## UC SAN DIEGO NANOENGINEERING SEMINAR

Wednesday, January 10, 2018

Seminar Presentation: 11:00am - 12:00pm

**Cymer Conference Room (SME 248)**

### **“Converting CO<sub>2</sub> via Thermocatalysis and Electrocatalysis”**

#### **Jingguang Chen**

*Thayer Lindsley Professor of Chemical Engineering  
Columbia University*

**Abstract:** Rising atmospheric concentration of CO<sub>2</sub> is forecasted to have potentially disastrous effects on the environment from its role in global warming and ocean acidification. Converting CO<sub>2</sub> into valuable chemicals and fuels is one of the most practical routes for reducing CO<sub>2</sub> emissions while fossil fuels continue to dominate the energy sector. The catalytic reduction of CO<sub>2</sub> by H<sub>2</sub> can lead to the formation of three types of products: CO through the reverse water-gas shift (RWGS) reaction, methanol via selective hydrogenation, and methane by the methanation pathway. In the current talk we will first describe our efforts in controlling the catalytic selectivity for the three products using a combination of DFT calculations and surface science studies over single crystal surfaces, catalytic evaluation of supported catalysts, and in-situ characterization under reaction conditions. Next, we will discuss our efforts in converting CO<sub>2</sub> without using H<sub>2</sub>. This is motivated by the fact that ~95% of H<sub>2</sub> is generated from hydrocarbon-based feedstocks, producing CO<sub>2</sub> as a byproduct. We will present two approaches to avoid using H<sub>2</sub> for CO<sub>2</sub> conversion. The first approach involves the utilization of light alkanes, such as ethane, to directly reduce CO<sub>2</sub> via the dry reforming pathway to produce synthesis gas ( $C_2H_6 + 2CO_2 \rightarrow 4CO + 3H_2$ ) and the oxidative dehydrogenation route to generate ethylene ( $C_2H_6 + CO_2 \rightarrow C_2H_4 + CO + H_2O$ ). The second approach is the electrolysis of CO<sub>2</sub> to produce synthesis gas with controlled CO/H<sub>2</sub> ratios. We will conclude our presentation by providing a perspective on the challenges and opportunities in converting CO<sub>2</sub> via various routes in thermocatalysis and electrocatalysis.

**Biosketch:** Jingguang Chen is the Thayer Lindsley Professor of chemical engineering at Columbia University, with a joint appointment as a senior chemist at Brookhaven National Laboratory. He received his PhD degree from the University of Pittsburgh and then carried out his Humboldt postdoctoral research in KFA-Julich in Germany. After spending several years as a staff scientist at Exxon Corporate Research, he started his academic career at the University of Delaware in 1998 and rose to the rank of the Claire LeClaire Professor of chemical engineering and the director of the Center for Catalytic Science and Technology. He moved to Columbia University in 2012. He is the co-author of over 20 US patents and over 350 journal publications. He is currently the president of the North American Catalysis Society and an associate editor of *ACS Catalysis*. He received many catalysis awards, including the 2015 George Olah award from the American Chemical Society and the 2017 Robert Burwell Lectureship from the North American Catalysis Society.