

Chemical and Biomolecular Engineering

Fall 2009 Seminar Series

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“Designing Adsorbent Materials for Capture of CO₂ from Dilute Gases: Potential Technologies for Slowing Growth of the Atmospheric CO₂ Concentration”

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 CO₂ concentration will continue to rise rapidly. The Intergovernmental Panel on Climate Change (IPCC) has stated that anthropogenic CO₂ has contributed measurably to climate change over the course of the last century. Some have hypothesized that increasing atmospheric CO₂ 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 CO₂ 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 CO₂ from dilute gas streams.

Hyperbranched aminosilica materials (HAS) have been developed in our laboratory as selective CO₂ 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 CO₂ from simulated flue gas streams, and the CO₂ capacities are actually enhanced by the presence of water, which is found in all flue gas streams, unlike in the case of physisorbents such as zeolites. Interestingly, the heat of adsorption for these sorbents is sufficiently high that the sorbents are also capable of capturing CO₂ from extremely dilute gas streams, such as atmospheric CO₂. Indeed, our HAS adsorbents are quite efficient at the direct “air capture” of CO₂ and we will describe our investigations into development of air capture technologies as well

Wednesday, November 4, 2009, 3:00 P.M.

Wu and Chen Auditorium, Levine Hall

