Seminar

Wednesday, April 26, 2017

11:00 AM – 206 Furnas Hall

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New Membranes for CO2 Separation and Water Purification

This presentation covers new advances in membranes for carbon dioxide separation and water purification. The membranes for carbon dioxide separation include CO2-selective membranes for hydrogen purification for fuel cells and post-combustion carbon capture from flue gas in coal- and/or natural gas-fired power plants. Highly CO2-selective membranes comprise fixed-site and mobile carriers and involve the facilitated transport mechanism based on reversible CO2 reactions with amine carriers. The membranes remove H2S even faster than CO2 (~3 times). In general, the membranes need to be tailor-made and tuned specifically for those applications. For example, hydrogen purification for fuel cells demands the membrane with a very high CO2/H2 selectivity of 100 along with a modest CO2 permeance of about 100 GPU (1 GPU = 10-6 cm3 (STP)/(cm2 • s • cmHg)). On the other hand, post-combustion carbon capture requires a high CO2/N2 selectivity of 140 together with a very high CO2 permeance of about 700 GPU or higher in order to use a stand-alone membrane process. In order to achieve the membrane performance, highlighted are composite membranes comprising a high-selectivity layer on a highly permeable polymeric or inorganic/polymer support; the latter with zeolite nanoparticles can be used as the seed layer for continuous roll-to-roll fabrication of zeolite membranes. Also highlighted are the effects of amine steric hindrance and SO2 on membrane performance as well as the scale-up of the membranes through continuous roll-to-roll fabrication. On water purification, novel interfacially polymerized reverse osmosis (RO) membranes have been synthesized with the new concept of incorporating hydrophilic groups chemically into membrane structure to provide an additional pathway for water transport and to overcome the low hydrophilicity/flux issue inherent in interfacially polymerized membranes. This has resulted in about 100% increase in water flux vs. the industry standard membrane while maintaining a high NaCl rejection of >99% for desalination of seawater and brackish water, in addition to improving fouling resistances.

Refreshments at 10:45

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