217g Engineering Membranes for Environmental and Energy Applications

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This talk covers two areas using facilitated transport membranes: (1) the removal and recovery of heavy metals from waste waters by supported liquid membranes (SLMs) with strip dispersion and (2) hydrogen purification with carbon dioxide and hydrogen sulfide-selective membranes for fuel cells. New membrane technology based on SLMs with strip dispersion for the removal and recovery of metals, including chromium, copper, and zinc, from waste waters has been developed. The technology not only removes the target metal in the treated effluent allowable for discharge or recycle, but also recovers the metal at high concentration and purity suitable for resale or reuse. In other words, the goals of zero discharge and no sludge have been achievable. The SLMs contain selected complexing agents/carriers for the facilitated transport of the target species. The stability of the SLM has been ensured by engineering the modified SLM with strip dispersion. Recently, new membranes for the removal of carbon dioxide and hydrogen sulfide from hydrogen-containing synthesis gas have been synthesized by incorporating amino groups into polymer networks. The membranes are selective to carbon dioxide and hydrogen sulfide preferentially versus hydrogen since the acid gases permeate through the amine-containing membranes via the facilitated transport mechanism due to their reversible reactions with the amine. The membranes synthesized have shown high carbon dioxide and hydrogen sulfide permeabilities and selectivities vs. hydrogen or carbon monoxide. This type of membranes has the potential for hydrogen purification for environmentally friendly fuel cells, including the use of the membrane in the membrane reactor configuration to enhance water gas shift reaction. Results from water-gas-shift membrane reactor experiments have shown carbon monoxide reduction to 10 ppm as well as significant hydrogen enhancement via carbon dioxide removal. The data have been in good agreement with modeling prediction. In addition, the modeling based on permeability data has shown that less than 10 ppb hydrogen sulfide is achievable from typical synthesis gas with small membrane area requirement.