298a Facilitated Transport Membranes: New Directions for Environmental, Bio and Energy Applications (Invited Keynote Speaker)

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This presentation covers recent advances in facilitated transport membranes, including three areas: (1) the removal and recovery of heavy metals from waste waters by supported liquid membranes (SLMs) with strip dispersion, (2) the extraction and recovery of antibiotics and biochemicals from fermentation broths and aqueous solutions by SLMs with strip dispersion, and (3) fuel processing with carbon dioxide-selective membranes for fuel cells. These areas will be discussed together with our research results. New membrane technology based on SLMs with strip dispersion for the removal and recovery of metals, including chromium, copper, zinc, and strontium, from waste waters has been developed. The technology not only removes the targeted 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. The stability of the SLM has been ensured by a modified SLM with strip dispersion, where the aqueous strip solution is dispersed in the organic membrane solution in a mixer. The strip dispersion formed is circulated from the mixer to the membrane module to provide a constant supply of the organic solution to the membrane pores. The SLMs with strip dispersion have great potential for extraction and recovery of antibiotics and biochemicals from fermentation broths and aqueous solutions. For example, penicillin G has been extracted and concentrated significantly with a very high recovery.

Recently, new membranes for the removal of carbon dioxide from hydrogen-containing reformed gases have been synthesized by incorporating amino groups into polymer networks. The membranes are selective to carbon dioxide preferentially versus hydrogen since carbon dioxide permeates through the amine-containing membranes via the facilitated transport mechanism due to its reversible reaction with the amine. The membranes synthesized have shown high carbon dioxide permeabilities and high selectivities of carbon dioxide vs. hydrogen and carbon monoxide. Using the carbon dioxide-selective membrane, recent results from water-gas-shift membrane reactor experiments have shown that carbon monoxide reduction to 10 ppm and significant hydrogen enhancement via carbon dioxide removal are achievable. The data have been in good agreement with modeling predictions. The future directions of research in facilitated transport membranes will be discussed.