386a Fundamentals and Applications of Pervaporation through Zeolite Membranes (Invited Keynote Speaker)

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Zeolite membranes have uniform, molecular-sized pores, and separate molecules based on differences in their adsorption and diffusion properties. Zeolite membranes are thus well suited for separating liquid-phase mixtures by pervaporation, and the first commercial application of zeolite membranes has been for dehydrating organics. Because of the large number of zeolites that can be prepared, zeolite membranes have also been used to remove organics from water, separate organic mixtures, and remove water from acid solutions on the laboratory scale. The fundamental aspects of separations by pervaporation through zeolite membranes are reviewed, and examples of the selectivities and fluxes obtained are presented. Some aspects of these separations are similar to gas-phase separations using zeolite membranes, but feed-side coverages are close to saturation during pervaporation, making competitive adsorption and molecule-molecule interactions more important during multicomponent diffusion. Some of the topics that are discussed include: (1) the use of feed fugacities to predict separations selectivities, (2) the effects of coverage, competitive adsorption, heats of adsorption, molecular sizes, temperature, membrane structure, nonzeolite pores, concentration polarization, and support resistance on transport and separations, (3) the ability of one molecule to slow down or speed up another molecule in the zeolite pores, and (4) the techniques used to measure adsorption and diffusion properties. Several possibilities for improving understanding and effectiveness of pervaporation through zeolite membranes are also suggested.