509f Can We Increase Flux by Patterning the Surface of a Gas Separation Membrane?

Christopher E. Goodyer, Annette L. Bunge, Omar Ishteiwy, Paul Thoen, Fernando Roa, and J. Douglas Way

Hydrogen flux through thin palladium and palladium-copper membranes, either foils or deposited onto ceramic supports, is increased after exposing the membranes to air at temperatures above 350 ^{o}C. It is unlikely that oxidative cleaning of surface carbon is the sole cause of the increased hydrogen flux since multiple air exposures can produce new larger, steady-state pure gas H_2 fluxes. Recent electron microscopy and atomic force microscopy studies have shown that the increased hydrogen flux occurs coincidentally with increasing surface roughness. Significantly though, the surface area increase of the roughened surface was insufficient to explain the increase in steady-state hydrogen flux for the Pd alloy composite membranes. An alternative explanation is that hydrogen flux through the thin regions of the roughened membrane could be disproportionately larger than expected due to two-dimensional diffusion. Thus, a mathematical model was developed to examine whether two-dimensional diffusion through a roughened membrane could explain the observations. Preliminary computations have shown that increasing surface roughness can increase membrane flux by more than would be expected from the increased area alone. These modeling results suggest that improved membrane performance might be achieved by appropriately patterning the surface.