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Permeability Enhancement in Polymer-Grafted Nanoparticle Membranes with Controllable Free-Volume CONNOR BILCHAK, EILEEN BUENNING, SANAT KUMAR, CHRISTOPHER DURNING, Columbia University, BRIAN BENICEWICZ, University of South Carolina, FERRUCCIO DOGHIERI, University of Bologna — Polymer based membranes could play a key role in several industrially important gas separations, for example, separating CO_2 from natural gas, with enormous economic and environmental impact. Here we demonstrate a strategy to rationally create hybrid membranes of nanoparticles grafted with polymer. In a novel PMA-grafted silica (d=14nm) system, membrane permeability as well as material "free volume" is enhanced relative to neat PMA; this is shown through a combination of permeation experiments and a Quartz Crystal Microbalance setup. These equilibrium constructs offer the ability to tune membrane performance through variations in polymer graft density and chain length, while also avoiding the deleterious effect of polymer aging. In addition, the transport properties of PMMA-grafted silica are explored to demonstrate the broad application of these novel grafted systems to different polymer chains with higher intrinsic "free volume". Evidently, these hybrid materials are a new template for designing membranes with readily tunable abilities that may be optimized for vital gas separations.

Connor Bilchak
Columbia University

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