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Self-Assembly of Grafted Nanoparticles for Transport Channels in Membranes CONNOR BILCHAK, ELLIE BUENNING, CHRISTOPHER DURNING, SANAT KUMAR[1], Columbia University — Polymer membranes have seen increased application for vapor separations, particularly for natural gas processing and purification. The addition of nanoparticles to such membranes has led to conflicting findings; conventional (Maxwell) composite theory predicts the addition of inert filler to hinder membrane transport properties. However, our research using silica nanoparticles grafted with Poly (Methacrylate) has shown these grafted systems to possess permeabilities similar to those of a pure polymer system increasing penetrant solubility without compromising diffusivity. This is counterintuitive to Maxwell theory. We propose that the grafted nanoparticles self-assemble into an ordered crystal lattice containing low-density "channels" which facilitate penetrant uptake. Atomic force microscopy and small-angle neutron scattering experiments appear to confirm this theory. Varying polymer grafting density and chain length is also predicted to alter transport properties, allowing for the fabrication of membrane with tunable diffusivity and selectivity. These grafted nanocomposite systems therefore represent a means of creating robust membranes with transport properties similar to those of conventional polymeric films that may be easily adapted for various separations processes.

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