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On the behavior of polysiloxane nanocomposite oxygen-nitrogen separation membrane

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Mixed matrix membranes were prepared with polydimethylsiloxane (PDMS) and different weight percent surface-treated fumed silica (SiO_2) to investigate the influence of SiO_2 on transport behavior of O_2 and N_2 gases in the nanocomposite membranes. Fourier transform infrared spectroscopy (FTIR) showed that OH functional group on the surface of SiO_2 was consumed upon incorporation of the silica into the polymer matrix. Thermogravimetric analysis (TGA) results revealed that SiO_2-PDMS has improved thermal property over neat PDMS, supporting the argument that there is good interaction between the polymer and the fumed silica. Scanning electron microscopy (SEM) images of SiO_2-PDMS membranes showed uniform dispersion of SiO_2 nanoparticles in PDMS matrix. SiO_2 nanoparticles disrupted and altered the PDMS polymer chains packing arrangement resulting in different membrane transport behavior of both O_2 and N_2 gases in SiO_2-PDMS compared to the neat PDMS membrane. While the O_2 flux through SiO_2-PDMS membranes was observed to increase with time, N_2 flux decreased with time before attaining steady state. The 10wt%SiO_2-PDMS membrane exhibited improved performance compared to neat PDMS membranes with O_2/N_2 selectivity and O_2 permeability increased from 2.43 to 3.46 and 590 Barrer to 640 Barrer, respectively, at 30 psig. This improvement is attributed to the influence of the well dispersed SiO_2 nanoparticles in the PDMS matrix.

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