PREDICTING PERMEABILITY IN NANOTUBE MEMBRANES

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ABSTRACT

Since their discovery in 1991, carbon nanotubes have been considered as a potential material for liquid filtration applications due to the low tortuosity, smooth structure and the possibility of fine-tuning their diameter.[1] As such, membranes containing carbon nanotubes have been prepared using a variety of techniques, from thin film composite mixed matrix membranes containing randomly aligned nanotubes to inorganic membrane templates with aligned nanotubes.[2] Results, in terms of permeability and selectivity/rejection, show a wide spread, which can be attributed not only to differing alignment but also to the different surface chemistry and structure of the carbon nanotubes used as well as their size.

The precise control of the surface chemistry and structure of nanotube materials coupled with the perfect alignment given by inorganic membrane templates, such as anodic alumina membranes, has enabled investigating nanotube materials other than carbon, expanding the range of materials characteristics and separation mechanisms that can be used.

In this presentation, pure water permeability experimental and modelling studies of membranes with aligned nanotubes made of carbon,[3] alumina,[4] and boron nitride and silicon carbide[5] are reported. The membranes have been prepared by depositing a thin conformal coating of each material in the pores of anodic alumina membranes, resulting in aligned nanotube membranes with precise control over their diameter, length, surface chemistry and structure as well as the membranes' overall porosity.

The experimental data was compared, with good results, to an analytical model that makes explicit the contribution of the nanotubes characteristic dimensions and surface wettability on the membranes' permeability.[6] This allows predicting the permeability of nanotube membranes based on the strength of the solid-liquid interactions between water and the wall of the nanotubes it is flowing through.

KEYWORDS

Carbon nanotubes; boron nitride nanotubes; silicon carbide nanotubes; flow enhancement.

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