DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Spring Seminar Series

Nanotube Membranes for Enhanced Liquid Separations

Davide Mattia
Department of Chemical Engineering
Centre for Advanced Separations Engineering
University of Bath, UK

Wednesday, May 15, 3:00 p.m.
PISB 104

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. 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. Results, in terms of permeance 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 permeance experimental and modelling studies of membranes with aligned nanotubes made of carbon, carbon nitride, alumina, boron nitride and silicon carbide6 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' permeance. This allows predicting the permeance of nanotube membranes based on the strength of the solid-liquid interactions between water and the wall of the nanotubes it is flowing through.

Davide Mattia, FIChemE, CEng, is Professor of Chemical Engineering at the University of Bath. He earned a Meng in Materials Engineering in 2002 from the University 'Federico II, Naples, Italy and a PhD in Materials Engineering from Drexel University, Philadelphia, USA, in 2007. He joined Bath in 2008 as a Lecturer and was promoted to full Professor in 2016. His current research focuses on using membranes to address environmental challenges, including the sustainable manufacturing of materials and the removal of organic micropollutants from water. He is a past Royal Academy of Engineering Research Fellow and currently holds an EPSRC Established Career Fellowship in Water Engineering. He serves as Associate Dean for Research in the Faculty of Engineering at the University of Bath and is a member of the EPSRC Engineering Strategic Advisory Team and Secretary of the European Membrane Society council.