SYNTHESIS AND CHARACTERIZATION OF CARBON NANOTUBE MEMBRANES FOR WATER TREATMENT

Nozipho N. Gumbi, Nanotechnology and Water Sustainability Research Unit, College of Science, Engineering and Technology, University of South Africa Science Campus, South Africa ; Institute of Functional Interfaces (IFG), Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, Germany
noziphongumbi@gmail.com
Bhekie B. Mamba, Nanotechnology and Water Sustainability Research Unit, College of Science, Engineering and Technology, University of South Africa Science Campus, South Africa
Edward N. Nxumalo, Nanotechnology and Water Sustainability Research Unit, College of Science, Engineering and Technology, University of South Africa Science Campus, South Africa
Andrea I. Schäfer, Institute of Functional Interfaces (IFG), Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, Germany

Key Words: carbon nanotubes, nebulized spray pyrolysis, phase inversion

This work presents the synthesis and characterization of carbon nanotube (CNT) incorporated polyethersulfone (PES) membranes. Firstly, CNTs were prepared via a nebulized spray pyrolysis of toluene (carbon source) and ferrocene (catalyst) mixture at a temperature of 850 ^{0}C. The CNTs produced were then purified and functionalized by acid treatment to aid their interaction with the solvent and polymer during membrane preparation. Characterization techniques used for CNTs include scanning electron microscopy (SEM) analysis, Raman spectroscopy analysis, thermogravimetric analysis and X-ray photoelectron spectroscopy analysis. The outer diameters of CNTs measured from SEM micrographs using Image J software were in the range of 10 – 14 nm. TGA analysis revealed that the CNTs undergo complete thermal degradation after acid treatment; *i.e.* no catalyst particle residues were detected after 600 ^{0}C.
A conventional phase inversion method was used for the preparation of CNT membranes in which various CNT loadings (0.1; 0.5 and 1.0 wt%) were added into a casting solution comprising of 15 wt% PES polymer dissolved in *N*-methyl-2-pyrrolidinone solvent. An Elcometer Adjustable Bird Film Applicator was set to a film gap of 200 µm for solution casting and deionized water was used as a non-solvent coagulation bath at room temperature (typically 25 ^{0}C). SEM images of the various PES and CNT/PES membranes depicted in Figure 1 show that the membrane pore sizes decreased with increasing CNT content from 74 nm for pristine PES membranes to 41 nm for 1.0 wt% CNT/PES membranes. This is attributed to the increase in the viscosity of the casting solution, hence a delay in the mixing-demixing reaction during coagulation with water (non-solvent) which then lead to reduced pore sizes [1]. Our results have demonstrated that the influence of the addition of CNTs onto the polymeric membranes is altering the membrane pore sizes. Permeability and retention characterization studies are currently underway to investigate the impact of CNTs on effective membrane pore sizes and retention of organic molecules.

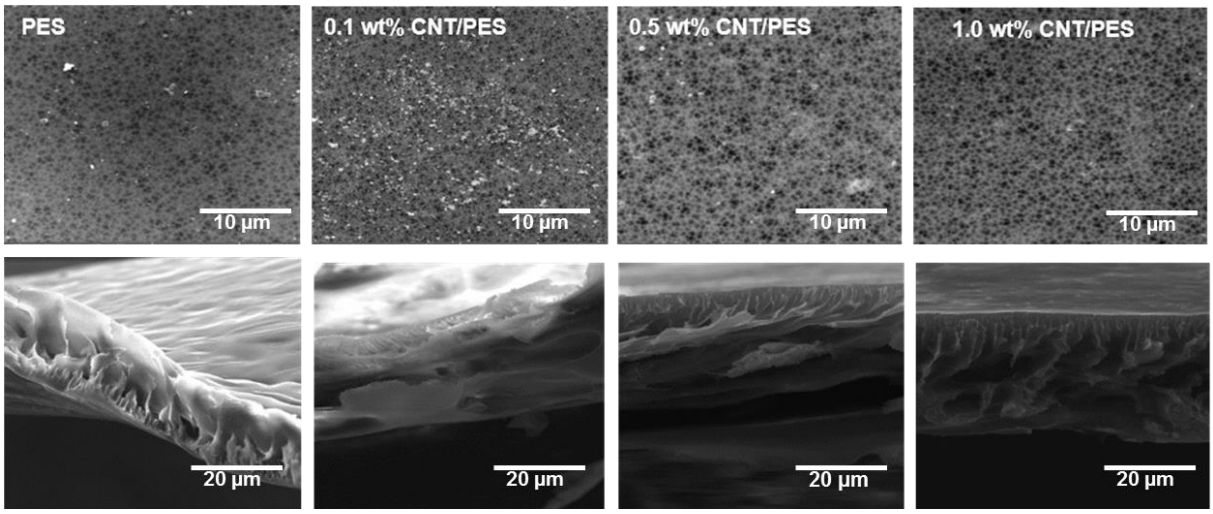

Figure 1 – SEM images of PES and CNT/PES membranes top and side view

[1] V. Vatanpour, S. S. Madaeni, R. Moradian, S. Zinadini, B. Astinchap, S. Siavash, R. Moradian, S. Zinadini, and B. Astinchap, *Journal of Membrane Science*, 375 (2011) 284–294