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Fabrication and characterization of graphene oxide and graphene oxide/Alumina membranes for desalinization and purification of water

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The development of low-cost ultrafiltration membranes with relatively high flow rate and selectivity is an important goal that can improve access to clean water. Membranes offer several key advantages that include reduced energy requirements, high permeability and selectivity, and low temperature operation in processing thermally unstable solutes (e.g. food and pharmaceuticals). Applications for membrane separations include: water desalination and other processes. Recently, graphene nanomaterials have been discovered to offer extraordinarily high surface area, mechanical durability, atomic thickness, nano-sized pores, and reactivity with polar and non-polar water pollutants. Therefore, they provide excellent efficiency as membranes for water purification. The fabrication of a membrane composed of a matrix of a ceramic material such as alumina and graphene can have extraordinary properties for filtration at the molecular level. In this work, we propose a method to infuse molecular-level compositions of graphene oxide (GO) and alumina nanoparticles in a support of commercial porous membranes (cellulose acetate and polymer nanofiber). The graphene oxide dispersion were prepared by modified Hammer method, while the alumina nanoparticles are prepared by sol gel method. The graphene dispersion were mixed with the alumina nanoparticle suspension, prepared by sol gel method, in the sol phase with various proportions. GO and a mixture of GO/Alumina were deposited in cellulose acetate and polymer nanofibers membranes by vacuum assisted filtrating. The structure of graphene/alumina composite and the membranes were characterized by Raman spectroscopy. Their morphology was analyzed by field emission scanning (SEM-FEG) to visualize the microstructure of the surface. Cellulose acetate and polymeric nanofiber membrane samples were characterized by scanning electron microscopy. The GO samples with a concentration of 1mg/ml were deposited on glass substrates and characterized by electron microscopy (SEM) techniques to observe GO microstructure. The micrographs of the cellulose acetate membranes showed the GO sheets, other regions of the samples showed agglomeration of graphene oxide sheets due to the high concentration of GO and the deposition of more than one drop on the glass substrate. The Raman spectrum obtained for the GO sample confirmed the occurrence of the D band at 1355 cm-1 and the G band at 1590 cm-1. The G band of the spectrum is associated with graphitic carbon and one of the bands that characterize the structure of graphene oxide. The D band is associated with structural defects or partially disordered graphitic domains. It is observed that the D band is quite intense, if compared to the D band, confirming the defects generated by the chemical production of GO. This fabrication process demonstrated potential for use in water desalinization and purification.