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Porous Alumina-Carbon Nanotubes Nanocomposite Membranes Processed via Spark Plasma Sintering for Heavy Metal Removal from Contaminated Water

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Abstract : The purpose of the present study was to use the adsorption mechanism with microfiltration synergistically for efficient heavy metal removal from contaminated water. Alumina (Al2O3) is commonly used for ceramic membranes development while recently carbon nanotubes (CNTs) have been considered among the best adsorbent materials for heavy metals. In this work, we combined both of these materials to prepare porous Al2O3-CNTs nanocomposite membranes via Spark Plasma Sintering (SPS) technique. Alumina was used as a base matrix while CNTs were added as filler. The SPS process parameters i.e. applied pressure, temperature, heating rate, and holding time were varied to obtain the best combination of porosity (64%, measured according to ASTM c373-14a) and strength (3.2 MPa, measured by diametrical compression test) of the developed membranes. The prepared membranes were characterized using X-ray diffraction (XRD), field emission secondary electron microscopy (FE-SEM), contact angle and porosity measurements. The results showed that properties of the synthesized membranes were highly influenced by the SPS process parameters. FE-SEM images revealed that CNTs were reasonably dispersed in the alumina matrix. The porous membranes were evaluated for their water flux transport as well as their capacity to adsorb heavy metals ions. Selected membranes were able to remove about 97% cadmium from contaminated water. Further work is underway to enhance the removal efficiency of the developed membranes as well as to remove other heavy metals such as arsenic and mercury.

Keywords : heavy metal removal, inorganic membrane, nanocomposite, spark plasma sintering
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