Embedded high-hydrophobic CNMs prepared by CVD technique with PVDF-co-HFP membrane for application in water desalination by DCMD

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ABSTRACT

In this work, conditions for fabricating high-hydrophobic carbon nanomaterials (CNMs) by chemical vapor deposition technique on nickel-doped powder activated carbon such as reaction temperature, reaction time, and H 2:CH 4 gas ratio were optimized to achieve the optimum contact angle (CA). The results showed that the optimal reaction temperature, H 2:CH 4 gas ratio, and reaction time for the highest CA of 145° were 950°C, 1:1, and 20 min, respectively. The CNM with a CA of 145° was embedded with poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-co-HFP) membrane to improve its hydrophobicity and, in turn, its seawater desalination performance by direct contact membrane distillation (DCMD). Various CNM contents (i.e., 1.0, 3.0 and 5.0 wt.%) were embedded with 22:78 (wt.%) of PVDF-co-HFP/N-Methyl-2-pyrrolidone solution to prepare flat-sheet membranes via phase inversion. CNM content plays an important role in the membrane preparation and thus affected the DCMD performance. Particularly interesting was the membrane prepared from dope mixture with the 5 wt.% CNMs, which resulted in an increase in CA from 83° to 133°, and porosity from 45.3% to 96.94%, along with a decrease in the membrane thickness from 210 to 165 µm. However, CNM embedding into the casting mixture also affected the membrane’s mechanical properties. Finally, DCMD permeation was enhanced from 10 to 16 L/hm 2 by embedding 5 wt.% of CNMs at the feed temperature of 45°C with salt rejection >99.9%.

Keywords: Chemical vapour deposition; Carbon nanomaterials; Hydrophobicity; PVDF-co-HFP; Direct contact membrane distillation; Desalination

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