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Investigation on the Capacitive Deionization of Functionalized Carbon Nanotubes (F-CNTs) and Silver-Decorated F-CNTs for Water Softening

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Abstract : The impending water shortage drives us to find alternative sources of water. One of the possible solutions is desalination of seawater. There are numerous processes by which it can be done and one if which is capacitive deionization. Capacitive deionization is a relatively new technique for water desalination. It utilizes the electric double layer for ion adsorption. Carbon-based materials are commonly used as electrodes for capacitive deionization. In this study, carbon nanotubes (CNTs) were treated in a mixture of nitric and sulfuric acid. The silver addition was also facilitated to incorporate antimicrobial action. The acid-treated carbon nanotubes (f-CNTs) and silver-decorated f-CNTs (Ag@f-CNTs) were used as electrode materials for seawater deionization and compared with CNT and acid-treated CNT. The synthesized materials were characterized using TEM, EDS, XRD, XPS and BET. The electrochemical performance was evaluated using cyclic voltammetry, and the deionization performance was tested on a single cell with water containing 64mg/L NaCl. The results showed that the synthesized Ag@f-CNT-10 H could have better performance than CNT and a-CNT with a maximum ion removal efficiency of 50.22% and a corresponding adsorption capacity of 3.21 mg/g. It also showed antimicrobial activity against E. coli. However, the said material lacks stability as the efficiency decreases with repeated usage of the electrode.

Keywords : capacitive deionization, carbon nanotubes, desalination, acid functionalization, silver
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