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Enhanced electrosorption capacity of activated carbon electrodes for deionized water production through capacitive deionization

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Abstract

The deionized water (DI) of high purity standards is used in several industrial processes to manufacture products and technologies for high end applications. Currently, DI water is produced by either reverse osmosis or continuous electrodeionization systems, however; both of them are facing several limitations. Therefore there is an urgent need for the alternative technologies for DI water production. This study investigated suitability of producing DI water by using capacitive deionization (CDI) with nitric acid treated activated carbon electrodes (NTAC). Activated carbon (AC) was etched in nitric acid solution to introduce various oxygen functional groups on its surface. The Fourier transform infrared spectroscopy and X-ray photoelectron spectroscopy were used to confirm the increased surface oxygen containing groups on AC after nitric acid treatment that enhanced its salt adsorption capacity. CDI experiments were conducted using water solution of 12.0 μS/cm as a result DI water with the conductivity of 1.6 μS/cm (DI water grade III, according to International Organization of Standards) was produced. Also, electrochemical tests revealed good capacitive behavior due to improved conductivity with NTAC having highest specific capacitance of 381.7 F/g compared to 106.6 F/g of AC electrode. This study provides an insight of the electrosorption performance of materials in desalination of solutions of low ionic strength.

Keywords

Capacitive deionization; CDI; Deionized water; Activated carbon; Enhanced electrosorption; Oxygen functional groups