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Facile Method to improve desalination properties by introducing C-F bond on activated carbon surface for capacitive deionization

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Herein, C-F bonds were introduced on the activated carbon (AC) surface via fluorination method to investigate the effect of fluorination on desalination properties for capacitive deionization (CDI). To evaluate whether the fluorinated activated carbon (FAC) is suitable for either anode or cathode in CDI cell, the desalination behavior of asymmetric CDI cell assembled with a raw AC (RAC) as the counter electrode and the FAC as the cathode (R||F-) or anode (R||F+) was studied. The specific electrosorption capacity of the R||F- is 1.17 and 1.53 times higher than that of R||R and R||F+, respectively. And FAC with different fluorine content on the AC surface are used as cathode to investigate the effect C-F bonds on desalination performance in detail. The concentration of C-F bonds on the AC surface is a high as 19.5%, but the specific surface area of FAC is reduced by etching of the pore walls. Nevertheless, the specific capacitance of FAC is up to 30% higher than that of RAC. The negative surface charge formed by the electronegativity difference between carbon and fluorine causes an increase in the open circuit potential (OCP) of the CDI cell, which results in a higher charge efficiency. Therefore, the specific electrosorption capacity of FAC is 16.5 mg/g, which increased by 59% compare to that of RAC. These results are attributed to multiple factors of the negative surface charge and the OCP formed by C-F bonds, which diminish the co-ion expulsion effect, thereby enhancing the CDI performance.

Key words: Fluorination; C-F bond; Activated carbon; Capacitive deionization; Desalination