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The enhanced performance of $\text{NaFe}_2\text{PO}_4(\text{SO}_4)_2/\text{C}$ electrode materials in the desalination of brackish water by capacitive deionization

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Abstract

In this study partial substitution of phosphates in $\text{Na}_3\text{Fe}_2(\text{PO}_4)_3/\text{C}$ (NFP/C) by sulphates to prepare $\text{Na}_2\text{Fe}_2(\text{PO}_4)_2\text{SO}_4$ (NFP2S/C) and $\text{NaFe}_2\text{PO}_4(\text{SO}_4)_2/\text{C}$ (NFPS/C) was carried out by dissolution-evaporation method. The idea is to adjust the properties of NFP/C owing to the differences in the inductive effect and sizes of sulphates and phosphates which results the obtained NFPS/C to record excellent electrochemical and desalination performance. Several characterization techniques used to analyse the synthesized materials confirm the successful doping and structure integrity. Electrochemical study reveals NFPS/C to exhibit the highest capacitance of 127.4 F/g when scanned at 10 mV/s. The results show that when the potential of 1.2 V is applied to desalinate 500 mg/L salt solution the salt removal of about 17.3 mg/g is achieved by NFPS/C while NFP/C attaining 9.8 mg/g. The NFPS/C was then tested in the desalination of real Ocean water and promising results obtained. The salt removal performance presented makes the developed materials promising for application in brackish water desalination by capacitive deionization.