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Al3+ ion intercalation pseudocapacitance study of W18O49 nanostructure

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ABSTRACT

Intercalation pseudocapacitance is of essential significance for designing high performance electrode materials, which offers exceptional charge storage characteristics. In this study, we elucidate the pseudocapacitive behavior of Al^{3+} ions intercalation within the distinctive tunnels of monoclinic $W_{18}O_{49}$ nanostructure. 3D sea urchin-like $W_{18}O_{49}$ is synthesized through one-step solvothermal approach. Its physicochemical properties are investigated by X-ray diffraction, X-ray photoelectron spectroscopy, Field emission scanning electron microscopy and Brunauer-Emmett-Teller surface area analysis. Cyclic voltammetry, galvanostatic charge-discharge and electrochemical impedance spectroscopy techniques are used to investigate the electrochemical characteristics of $W_{18}O_{49}$ electrode in different electrolyte systems. It shows high specific capacitance of 350 F g^{-1} at 1 A g^{-1}, superior electrochemical long-term stability in the Al^{3+} electrolyte with 92% capacitance retention at 8000 cycles. The excellent electrochemical performance is predominantly due to the Al^{3+} ions intercalation/de-intercalation with $W_{18}O_{49}$ nanostructure that is proven by *ex situ* X-ray diffraction analysis. The work marks a notable achievement in the effort of substituting commonly acidic proton electrolyte for $W_{18}O_{49}$ supercapacitor.

KEYWORDS

Intercalation pseudocapacitance; W18O49; Supercapacitors; Charge storage; Al3þ electrolyte

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