Al3+ ion intercalation pseudocapacitance study of W18O49 nanostructure

Thalji, Mohammad R. and Ali, Gomaa A. M. and Algarni, H. and Chong, Kwok Feng

[a]Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Gambang, 26300, Kuantan, Malaysia
[b]Chemistry Department, Faculty of Science, Al–Azhar University, Assiut, 71524, Egypt
[c]Research Centre for Advanced Materials Science (RCAMS), King Khalid University, P. O. Box 9004, Abha, 61413, Saudi Arabia
[d]Department of Physics, Faculty of Sciences, King Khalid University, P. O. Box 9004, Abha, Saudi Arabia

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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