**Synthesis and electrochemical properties of nanostructured nickel–cobalt oxides as supercapacitor electrodes in aqueous media**


ABSTRACT

Co-precipitation method was adopted in the preparation of nickel–cobalt oxides for potential application in supercapacitors. The formation of spinel nickel–cobalt oxide, NiCo2O4 started below 400 °C as confirmed by X-ray diffraction analysis. Pure phase nickel cobaltite with cation ratio of 1:2 (Ni:Co) was obtained at calcination temperature of 400 °C. The spinel phase decomposed gradually until 700 °C. The calcination time for the formation of NiCo2O4 was found to be between 2 to 4 h. The particle size of the prepared sample studied by transmission electron microscopy showed a value of 9.47 nm. The electrochemical properties of the metal oxide were measured in various acidic, neutral and alkaline electrolyte systems (1.0 M HCl, 1.0 M KCl and 1.0 M KOH) by employment of cyclic voltammetry, galvanostatic charge–discharge test and electrochemical impedance spectroscopy. Ideal capacitor behaviour with the largest operating voltage of 1.0 V and good electrochemical stability were observed in NiCo2O4 using neutral KCl aqueous electrolyte. Meanwhile, the prepared sample displayed the highest surface redox activity in 1.0 M KOH alkaline electrolyte but showed the lowest electrochemical performance in acidic electrolyte. At the current density of 0.5 A g−1, 1.0 M HCl, 1.0 M KCl and 1.0 M KOH gave specific capacitance values of 3.8, 41.9 and 249.8 F g−1 respectively.



**Keyword:** Electrochemical impedance spectroscopy; Electrochemical reactions; Nanostructured materials; Precipitation; Transmission electron microscopy; X-ray diffraction