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Synthesis and characterization of mixed hydroxide NiCo(OH)2 and NiCoMnO2 nanocomposites for high performance supercapacitors

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Currently, energy storage devices materials with controlled morphology and properties can be prepared using simple and low temperature stirring technique. The technique is relatively simple, cost effective and suitable for sample preparation.

In this work, we report the synthesis and characterization of environmentally friendly mixed hydroxide NiCo(OH)2 and NiCoMnO2 electrodes successfully fabricated via a low temperature, simple and effective stirring process. The electrodes were prepared by force-driven hydrolysis of hydrated nitrates of nickel, cobalt and manganese salt at a temperature of 40℃ for 2 hours. The structure and morphology of the sample were characterized using X-Ray powder diffraction (XRD) and high magnification scanning electron microscopy (HM-SEM). The electrochemical performance of the samples was characterized by using galvanostatic charge-discharge test on the prepared electrodes in alkaline electrolyte. X-ray diffraction and scanning electron microscopic studies showed that the materials are crystalline and well distributed. XRD results indicate that the composite material is fairly crystalline and multiple phase structure. SEM images reveal a fairly correlated morphological differences between the samples with the NiCo(OH)2 having agglomerated bigger grains compared to the less crystalline NiCoMnO2 with smaller but evenly distributed grains. The electrochemical performance showed a significant difference with the NiCoMnO2, which displays higher capacity and better cycling stability which is considered to be as a result of its smaller grains size and the large specific surface area.

Summary

NiCoMnO2 composite electrode has been successfully prepared using nickel cobalt manganese hydroxide as precursor via simple and low temperature stirring process. The nanograin and meso-porous structure provide the as-synthesized NiCoMnO2 electrode with high diffusion rate of electrons and ions in the matrix of the material resulting in the enhanced electrochemical performance. The as-synthesized NiCoMnO2 electrode exhibits a high specific capacitance/capacity (1203 Fg-1/132.1 mAhg-1), good cycle stability as well as good rate capability. After 1000 cycles, the efficiency of the electrode is observed to only decrease by 6.8 % of the initial capacity showing improved electrochemical stability. Electrodes with desired thickness, good uniformity, enhanced electrochemical properties and high throughput could be prepared through this simple and cost effective process. The as-synthesized NiCoMnO2 electrode material is a promising candidate for applications in energy storage devices.

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Yes

Level for award
 (Hons, MSc,
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PhD

Main supervisor (name and email)
and his / her institution

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