The study of ternary transition metal layered double hydroxides as the supercapacitor electrode materials

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Abstract

Two different kinds of ternary transition metal layer double hydroxides (LDHs), NiCoMn-LDH and NiCoFe-LDH, have been synthesized in this study. To understand the valance change during charging-discharging process, the in-situ X-ray absorption spectroscopy (XAS) have been done in this study.

NiCoFe-LDHs with different ratios of transition metal ions have been synthesized by the simple electrodeposition method on graphite paper. The microstructure of NiCoFe-hydroxide was examined by the X-ray diffraction and scanning electron microscopy. The electrochemical impedance spectra of NiCoFe-LDHs were also tested and analyzed. NiCoFe-LDH could provide the specific capacitance of 1052 F g^{-1} at 2 mV s^{-1} and high rate retention ability (~ 50% at 500 mV s^{-1}) which shows the great potential of high-power device application. The NiCoFe-LDH electrodes have also been used to fabricate the all solid-state supercapacitor with commercial activated carbon electrodes and PVA-KOH gel electrolyte.

SWCNTs-NiCoMn-LDH was synthesized by a facile hydrothermal method. SWCNT-NiCoMn-LDH can provide high specific capacitance of 1520 F g^{-1} at 1 A g^{-1}. The charge transfer mechanism of the Ni-Co-Mn LDHs during charge/discharge is investigated through in-situ XAS. Nanohybrid//SWCNTs asymmetric supercapacitors are also tested in pouch cell configuration, and their performances under folded condition are also evaluated, revealing great potential for flexible supercapacitor applications.

Keywords – ternary transition metal hydroxide, in-situ XAS, solid state supercapacitor.