Electrodeposition of Ultrathin Nanosheets of Nickel-Cobalt Double Hydroxides with Layered Structure for Improved Supercapacitor Performance

Ao Ju², Ruidong Xu^{1,2,*}, Ying Zhang², Suyang Feng^{1,2}, Chen Chen², Jiang Liao^{1,2}

¹ State Key Laboratory of Complex Nonferrous Metal Resources Clean Utilization, Kunming University of Science and Technology, Kunming 650093, China

² Faculty of Metallurgical and Energy Engineering, Kunming University of Science and Technology, Kunming 650093, China

*E-mail: rdxupaper@aliyun.com

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Ultrathin nanosheet structures of tremella-like nickel-cobalt layered double hydroxide (LDH) grown on nickel foam were successfully prepared by a simple procedure involving the electrodeposition method. The obtained nickel foam supported tremella-like nickel-cobalt LDH nanosheet material can be directly used as a supercapacitor electrode. FE-SEM, Raman spectroscopy, XRD, and XPS were used to examine the microstructure, molecular bond energy structure, phase structure, and valence state of the material, and its electrochemical properties were tested by CV, GCD, and EIS. By adjusting the $\text{NiCl}_2/\text{Co}(\text{NO}_3)_2$ mole ratios in the electrodeposition electrolyte, the sample morphology and electrochemical properties can be controlled. When the Ni/Co molar ratio was 2/1 under the optimal deposition conditions, the sample demonstrated high specific capacitances of $2065 \text{ F}\cdot\text{g}^{-1}$ and $2357.5 \text{ F}\cdot\text{g}^{-1}$ at current densities of $10 \text{ A}\cdot\text{g}^{-1}$ and $1 \text{ A}\cdot\text{g}^{-1}$, indicating good rate capability. After charging and discharging for 3000 cycles at $10 \text{ A}\cdot\text{g}^{-1}$ in 2 M KOH, the capacitance remains 81.8%, exhibiting superior recycling stability. The outstanding electrochemical performance of the electrode is mainly attributed to the ultrathin nanosheets, the excellent redox reversibility, and the synergistic effects between $\text{Ni}(\text{OH})_2$ and $\text{Co}(\text{OH})_2$. Therefore, this remarkable new electrode material has promising applications in electrochemical energy storage.

Keywords: Ni-Co layered double hydroxides, electrodeposition, specific capacity, cyclic stability, supercapacitors

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