

ZnO-CoO Nanopowders for Asymmetric Supercapacitors

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Zn_{1-x}Co_xO nanopowders were obtained by chemical bath deposition followed by thermal annealing. The structure and morphology of the samples were studied by X-ray diffraction analysis and scanning electron microscopy. Raman spectra were studied at room temperature using a Solver Spectrum (NT-MDT) spectrometer with laser excitation at 473 nm. Depending on the synthesis conditions, nanopowders with an average size of 1-2 nm were obtained.

It was shown that while chemical precipitation from a solution of zinc nitrate allows to obtain zinc oxide, and chemical precipitation from a solution of cobalt nitrate results in cobalt hydroxocarbonate, the presence of zinc and cobalt in equal molar concentrations inhibits the growth of both zinc oxide and cobalt hydroxocarbonate. The growth mechanism in the case of equal molar concentrations of zinc and cobalt in the growth solution changes dramatically. The resulting material is transformed by annealing in air into ZnCo₂O₄ oxide. However, it can be easily transformed by annealing at 350 °C in hydrogen atmosphere into a ZnO-CoO solid solution having a ZnO-type hexagonal lattice. The obtained fine powder of ZnO-CoO solid solution has an average crystallite size of 1-2 nm, depending on the conditions of preparation, and optical absorption spectra indicate the presence of doubly charged cobalt Co²⁺, which is in a tetrahedral environment. XRD and Raman results show that a single-phase Zn_{0.5}Co_{0.5}O solid solution is obtained, which consists of a hexagonal phase of the ZnO type. Electrodes from the obtained material showed a high specific capacity.

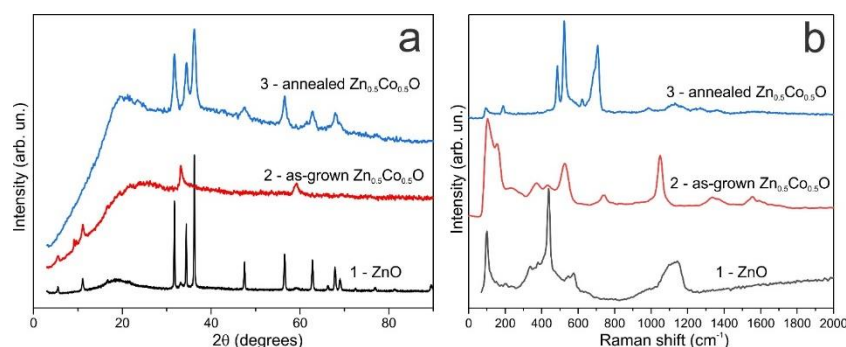


Figure 1. XRD patterns (a) and Raman spectra (b) of the samples: 1 - ZnO, 2 - Zn_{0.5}Co_{0.5}O immediately after synthesis, and 3 - Zn_{0.5}Co_{0.5}O after annealing in a hydrogen atmosphere at 350 °C/3 hours.

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