OP-D8

A facile approach of MnO_2 based cathode materials for Zn- Ion battery

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A simple and versatile reverse micelle process was used to prepare MnO_2 and MnO_2@Ag cathode material. The prepared cathode materials were characterized by different spectroscopic techniques. Fourier Transform Infrared (FT-IR) spectroscopic data shows an intense peak at 529 cm^{-}, confirming the presence of stretching vibrations of the Mn-O bond in MnO_2. The surface morphology of uncoated and coated MnO_2 was characterized by FE-SEM, where the surface was rough having particles of different shapes and sizes. Presence of Mn, O, Ag was detected by Energy Dispersive X-ray Spectroscopy (EDX). X-ray Diffractometry (XRD) indicated the formation of the tetragonal crystal system α-MnO_2. UV-visible spectroscopic techniques showed the band gap 3.19 and 2.79 for uncoated and coated MnO_2 respectively, which proves the characteristics of semiconductors. Cyclic Voltammetry (CV) data directed the existence of redox phenomena in the prepared CR-2032 coin cell battery. Potentio Electrochemical Impedance Spectroscopy (PEIS) analysis indicated that the battery having coated MnO_2 had lower resistance than uncoated MnO_2. Electrochemical cycling tests were performed in the voltage range of -2.5 V to +2.5 V at a constant applied current of 1 mA. This study proved that Ag enhances the intercalation and deintercalation of Zn^{2+} ions in the cathode material. Battery charge discharge (BCD) curve showed the charging and discharging capacity for uncoated battery was 126 mAh, 178 mAh and that for Ag coated battery was 140 mAh, 203 mAh, respectively. Eventually the capacity was almost 100% even after 20 cycles.

OP-D9

In situ preparation of CuO cathode materials in cellulose matrix for aqueous rechargeable zinc-ion batteries

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Whatman filter paper, a readily available cellulosic paper, used as a scaffold for the solid state conversion of copper acetate to copper oxide. Aqueous solutions of the raw materials copper acetate were absorbed in cellulose fiber at the initial phase of the reaction. CuO nanoparticles were then created by calcining cellulose matrix grafted with copper ions at 700°C. Afterward, X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectroscopy (EDS), and Fourier transform infrared spectroscopy (FTIR) were used to analyze the created CuO nanoparticles. The XRD diffraction peaks showed that pure crystalline monoclinic CuO nanoparticles were formed. According to FESEM image analysis, the synthesized CuO nanoparticles have a spike-containing polyhedral form. Using the synthesized CuO nanoparticles, an aqueous rechargeable zinc-ion coin cell (CR-2032), consisting of Zn (anode) and CuO (cathode), was built. The constructed CR-2032 coin cell's electrochemical evaluation was performed using the biological sp-300 workstation. The built-in CuO/Zn aqueous battery shows a significant degree of cycling durability for the prepared CuO material.