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RESEARCH ARTICLE

Synthesis and characterization of CuO micro-flowers/PPy nanowires nanocomposites as high-capacity anode material for lithium-ion batteries

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Abstract

A novel set of CuO/PPy nanocomposites (NCs) with varying PPy weight ratios was synthesized via microwave irradiation and oxidative chemical polymerization. The resulting NCs and CuO micro-flowers were characterized by X-ray diffraction, Fourier transform infrared spectroscopy, thermogravimetric analysis, Brunauer–Emmett–Teller analysis, field-emission scanning electron microscopy, energy-dispersive X-ray spectroscopy line, and dot mapping techniques. The formation mechanism of CuO micro-flowers and PPy nanowires were discussed in detail. The electrochemical lithium-ion storage properties of all samples, used as anode materials in Li-ion batteries, were measured. Our results indicate that PPy nanowires with various weight ratios play a critical role in the lithium storage properties of the hybrid CuO/PPy NCs. An increase in the nanowire mass ratio enhances the cyclic durability and charge/discharge capacities of the PPy/CuO NCs. Specifically, NCs containing 3.5-, 5-, 6.2-, and 8.8-wt% PPy nanowires exhibit reversible capacities of 128, 231, 371, and 200 mAh g^{-1}, respectively. The superior performance of the hybrid CuO/PPy NCs is attributed to the PPy nanowires. The CuO/PPy NCs benefit from the nanowire morphology and composite structural features that can accommodate the dramatic volume expansion of CuO during discharge/charge steps and enhance electrical conductivity. Our study demonstrates that tuning the PPy nanowire mass ratio in hybrid Metal Oxide/Polymer NCs is an effective method to enhance the electrode performance of an energy storage device.

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