One-step Facile Synthesis of Hierarchically Porous Nitrogen-Doped SnO₂ Nanoparticles with Ultrahigh Surface Area for Enhanced Lithium Storage Performance

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In this work, one-step facile synthetic method was developed to obtain hierarchically porous nitrogen(N)-doped SnO₂ nanoparticles that exhibit enhanced lithium storage performance with a high discharge capacity of 590 mAh g⁻¹ after 50 times cycles. The investigation by X-ray diffraction (XRD) and transmission electron microscopy (TEM) show that the crystal size of N-doped SnO₂ nanoparticles was controlled to 2-3 nm. Moreover, the N₂ adsorption-desorption results suggest micropores (1.2 nm) and mesopores (< 5 nm) characters for N-doped SnO₂ nanoparticles with ultrahigh specific areas (212.7 m² g⁻¹). The doping concentration of N tested by elemental analyzer was found to be 2.7 at%. X-ray photoelectron spectroscopy (XPS) and Electron paramagnetic resonance (EPR) measurements further confirm that N doping results in the increase of the concentration of oxygen vacancy defects. The enhanced lithium storage performance of N-doped SnO₂ nanoparticles can be ascribed to ultrafine particle size, ultrahigh specific surface area, the high concentration of oxygen vacancy defects, as well as the unique hierarchically porous structure. All the results indicated that the N-doped SnO₂ nanoparticles have a great potential for application as anodes for lithium ion batteries.

Keywords: One-step synthesis; Nitrogen-doped SnO₂; Micro-mesoporous; Lithium-ion batteries

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