

Supporting Information for

Facile fabrication of pompon-like hierarchical CuO hollow microspheres for high-performance lithium-ion batteries

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Experimental details

Materials Synthesis

CuO nanomaterials were synthesized by a simple solvothermal method. In a typical procedure, solid urea (0.03 mol) was directly added to a mixed solution of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (Cu(II), 0.01 mol) and glutamine (GLN, 0.01 mol) in distilled water (50 ml). The mixture was vigorously stirred for 15 min and then sealed into a Teflon-lined autoclave. The autoclave was heated to 140 °C and maintained for 12 h, and then cooled to room temperature naturally. The resulting precipitate was separated by centrifugation, washed with distilled water several times, and dried at 60 °C for 12 h. The obtained samples were further calcined in air at 400 °C for 2 h. In addition, the effects of the reaction parameters such as the concentration of glutamine and reaction time on the morphologies of CuO were investigated.

Materials Characterizations

The crystal phases of the as-synthesized and calcined samples were characterized using X-ray powder diffraction (XRD, Rigaku. D/Max Φ) with a graphite monochromatic Cu K α radiation ($\lambda=0.15418$ nm) at a scanning rate of 4°/min. X-ray photoelectron spectroscopy (XPS) measurements were performed on a Kratos

Axis Ultra DLD spectrometer employing a monochromated Al-K α X-ray source ($h\nu = 1486.6$ eV). The size and morphology of the samples were examined by scanning electron microscopy (SEM, HITACHI S-4800) and transmission electron microscopy (TEM, JEM-2100F). TGA-DSC analysis was conducted by an integrated thermal analyzer (SDT Q600) with a heating speed of 10 °C /min in air. The Brunauer-Emmett-teller (BET) surface area of CuO microsphere sample was tested by Quantachrome NOVA 2000e sorption analyzer.

Electrochemical Measurements

Electrochemical measurements were carried out using CuO as working electrode and lithium metal as counter/reference electrode. The working electrode was prepared by mixing 80 wt% active material (CuO products), 15 wt% conductive agent (acetylene black) and 5 wt% polymer binder (PVDF) together in N-methyl-pyrrolidinone (NMP) solvent to form homogeneous slurry, and then coated onto copper foil, dried at 80 °C for overnight in vacuum oven. The electrolyte solution was obtained by dissolving 1 M LiPF₆ into the mixture of ethylene carbonate (EC) + dimethyl carbonate (DMC) + ethyl methyl carbonate (EMC) (1:1:1, volume ratio) and separator was Celgard 2300 membrane. The testing cells were assembled in an argon-filled glove box with moisture and oxygen contents maintained below 5 ppm. The discharge/charge tests were run on a Land CT2001 automatic battery tester at the potential range of 0.01-3 V vs. Li/Li⁺. The capacity was calculated on the basis of the weight of active materials (CuO products) without counting the weight of the conducting agent and the binder. Cyclic voltammograms (CV) test was performed on

a Zahner-Elektrik electrochemical work station at a scan rate of 0.1 mV s^{-1} with the voltage ranging from 0 V to 3 V. All the tests were performed at room temperature.

Supplementary Figures

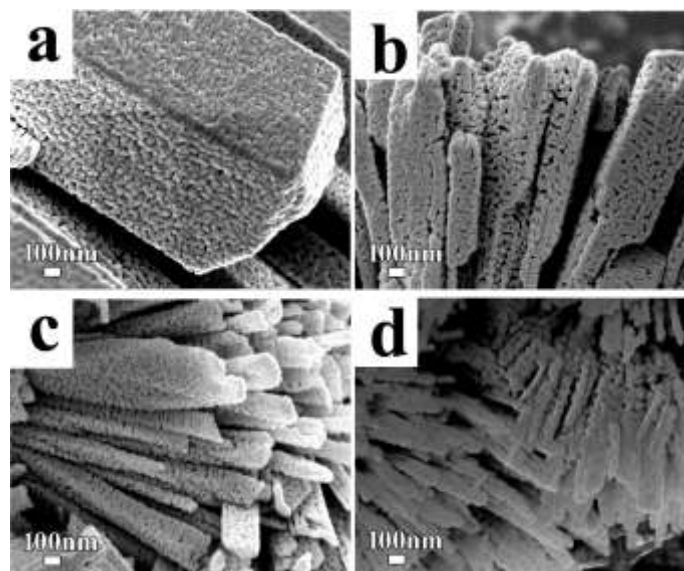


Fig. S1 High magnification SEM images of the calcined samples prepared with different ratios of GLN/Cu(II). (a) 0:1, (b) 0.5:1, (c) 1:1 and (d) 1.5:1.

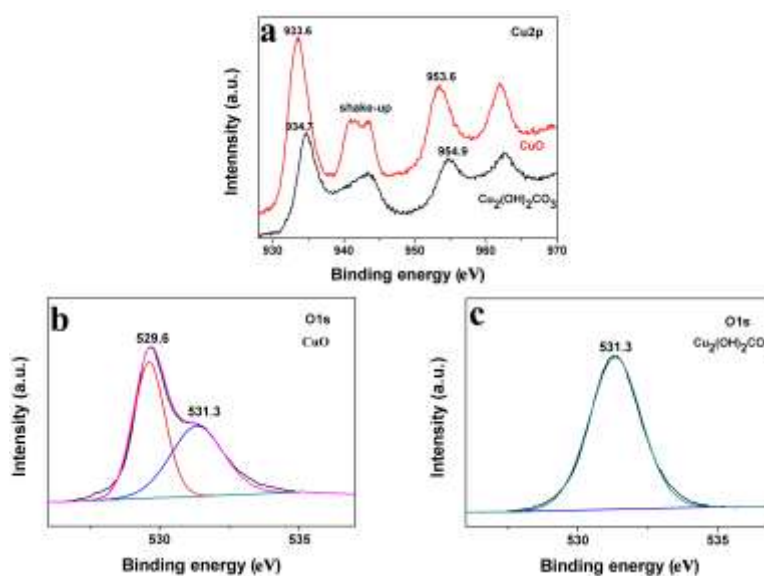


Fig. S2 XPS spectra of Cu2p (a) O1s (b, c) for CuO and Cu₂(OH)₂CO₃ precursor.