Supporting Information

Self-assembling of Mesoporous CuO Nanosheets/CNT 3D-Networks Composite for Lithium-ion Battery

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1. Experimental section

1.1 Chemicals

Copper nitrate ($Cu(NO_3)_2 \cdot 2.5H_2O$, 98%), aminoethanol ($NH_2CH_2CH_2OH$, 99%) were purchased from Sigma-Aldrich. Single-walled carbon nanotubes (SWCNT, 97%) produced by a high-pressure CO conversion method were purchased from Carbon Nanotechnologies. Ethanol and nitric acid were purchased from SINOPHARM. All chemicals were used as received. Polycarbonate (PC) membrane (Whatman) with a pore size of 200 nm and the effective diameter of 47 mm were used for forming the CuO-CNT freestanding film. Deionized water (18.2 MΩ) was produced by a Millipore Direct-Q3 System, and used in all of the experiments.

1.2 Synthesis of mesoporous CuO nanosheets

In a typical synthesis, a certain volume of 2 mmol $Cu(NO_3)_2$ aqueous solution was mixed with an equal volume of 1.6 mmol AE aqueous solution with stirring for 1 minute at the temperature of 25 ^oC. After 12 hours, the colloidal mesoporous CuO nanosheets solution was obtained. The detailed characterization is seen elsewhere.[1] In our experiments, 1.5L colloidal CuO solution can produce 80 mg CuO nanosheets.

1.3 Preparation of oxidated CNT

The protocol to prepare oxidated CNT is as following: a certain amount of single-walled nanotubes were heated in 6M nitric acid at 80 ^oC for 24 hours. The solution was subsequently washed with adequate deionized water and the precipitates were collected by centrifuge. The washing and centrifugation were repeated several times until the solution reached PH 6.5. The produced oxidated CNT were dispersed in water by sonification to give a concentration of 1 mg/ml.

1.4 Preparation of CuO/CNT 3D-networks composite

In a typical process, a certain amount of oxidate CNT aqueous solution (in our experiments, we take 10ml, 20 ml, 40 ml) was injected into 1.5L mesoporous CuO solution (80 mg CuO) with vigorous stirring at room temperature. Then the color of solution quickly turned from transparent brown to flocculent black. In ten minutes, the black CuO/CNT composite precipitates will be emerged at the bottom. After pouring the water above, the product can be collected. The composite film can be prepared by filtrating the above solution on PC membrane. In our experiments, three kinds of mass ratios of CuO to CNT are fabricated, including 8:1, 8:2 and 8:4. They are referred to 8 CuO-1CNT, 8 CuO-2CNT and 8 CuO-4CNT for convenience.

1.5 Assembly of coin-type cells

The coin-type cell was assembled with lithium foil as a counter electrode in an argon-filled glove box. The working electrode was prepared by mixing active materials (our prepared materials), the conductive materials (carbon black, super-P) and the binder (PVDF) at a weight ratio of 80:10:10. N-methylpyrrolidone (NMP) was used as a solvent. The mixed slurry was

pasted on foamed nickel base, which was as the current collector with the surface area of 1.33 cm^2, and dried at 120 ^oC under vacuum for 12 hours. The electrolyte employed in the cell was 1M $LiPF_6$ in a 50:50 (w/w) mixture of ethylene carbonate and diethyl carbonate. The galvanostatic charge-discharge performances of the cells were tested in the voltage range of 0.01-3.0 V under a constant current density of 67 mA/g by LAND battery-test system. The high rate capacities of the cells were measured under a constant charge current density of 67 mA/g with various discharge rates from 67-3350 mA/g.

2. Results

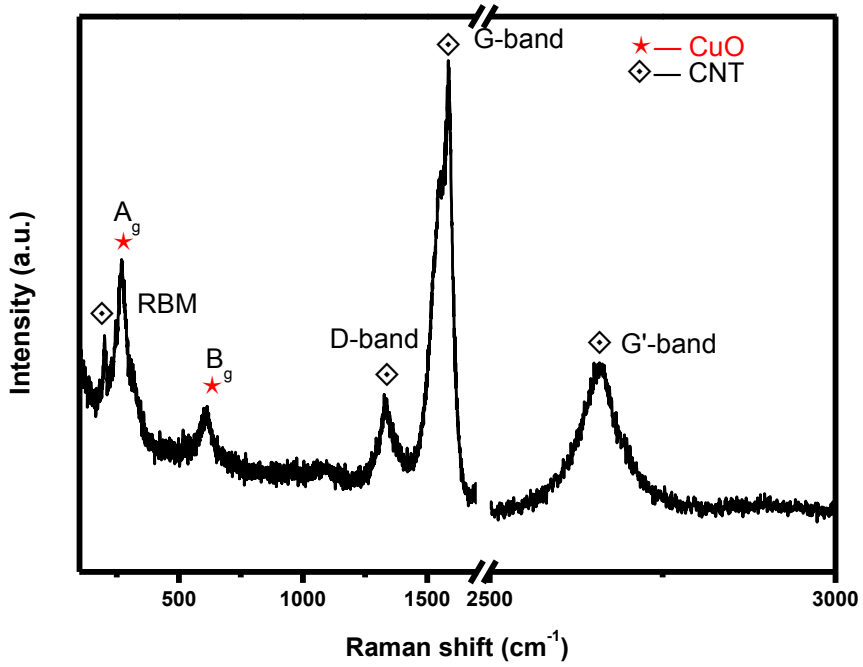

Figure S1. Raman spectrum of mesoporous CuO nanosheets-CNT composite. According to other republications, as marked by different stamps, the Ag and Bg modes are derived from CuO nanosheets, the RBM, D-bang, G-bang and G'-band modes are corresponding to CNT in composite.[2-5]

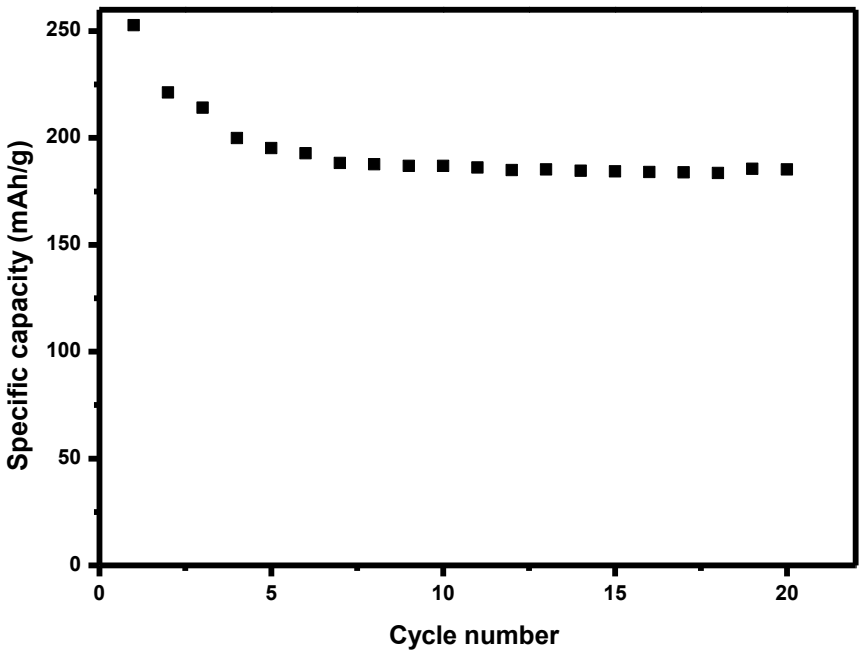

Figure S2. Cycling performance of SWCNT as anodes materials. After 20 cycles, the specific capacity of CNT anode still remains 183 mAh/g.

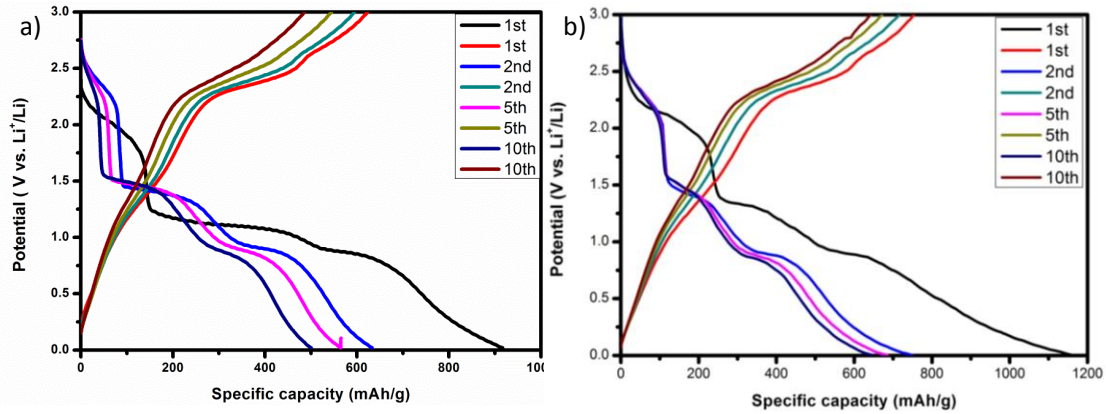

Figure S3. a) The charge/discharge profiles of mesoporous CuO nanosheets and b) 8 CuO-2CNT composite electrodes. The curves displayed the same characteristic for their electrochemical reaction, which reflected the same nature after adding CNT to form composite.

3. References

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