Electronic supplementary information for

CoO octahedral nanocages for high-performance lithium ion batteries

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Experimental

Synthesis of porous CoO octahedral nanocages: In a typical synthesis, 1 g of cobalt acetate tetrahydrate ($Co(AC)_2 \cdot 4H_2O$) were dispersed into 70 mL ethanol and the above solution was transformed into a 100 mL Teflon-lined stainless steel autoclave. The autoclave was sealed and maintained at 160-170 ˚C for 24 h and then cooled down to room temperature. And then 0.01-0.3 g of urea was added into above reaction system, followed by heating 60˚C for 24 h. The final products were centrifuged, rinsed with distilled water and ethanol several times to remove any impurities that remained in the final products.

Characterization. X-ray powder diffraction (XRD) patterns were recorded on a Philips X΄Pert PRO MPD X-ray diffractometer operated at 35 kV and 45 mA with Cu Kα radiation. Transmission electron microscopy (TEM) images were obtained on a JEOL JEM-3000F transmission electron microscope with an accelerating voltage of 300 kV. FE-SEM analysis was carried out with a field-emission microscope (JEOL S4800) operated at an acceleration voltage of 10 kV.

Electrochemical Characterization: Electrochemical experiments were performed using coin cells. The working electrodes prepared by mixing the CoO samples, acetylene black, and poly (vinyl difluoride) (PVDF) at a weight ratio of 70:20:10, were pasted on pure Cu foil. Glass fibber (GF/D) from Whatman was used as a separator. Lithium foil was used as the counter electrode. The electrolyte consisted of a solution of 1 M $LiPF_6$ in ethylene carbonate (EC)/dimethyl carbonate (DMC)/diethyl carbonate (DEC) (1:1:1, in wt %). Galvanostatic discharge/charge measurements were performed in a potential range of 3 V-0.05 V vs Li^+/Li.

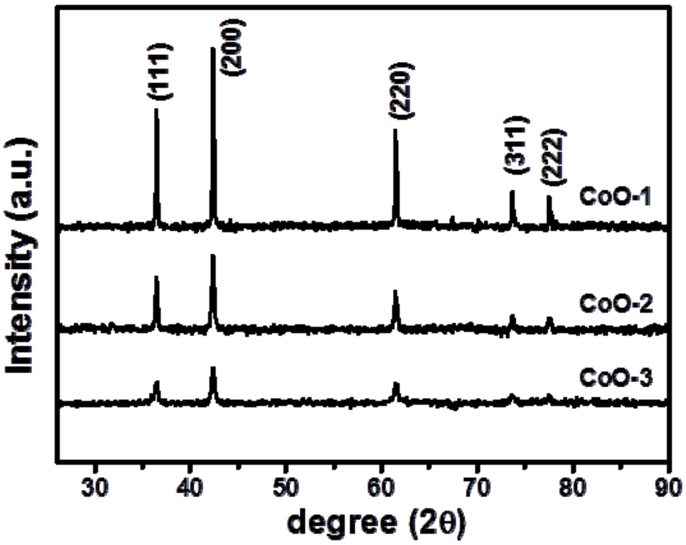

Fig. S1 XRD patterns of the three samples obtained by the addition of the different amounts of urea: CoO octahedrons (CoO-1, without addition of urea), octahedral CoO nanocages (CoO-2), CoO hollow microspheres (CoO-3).

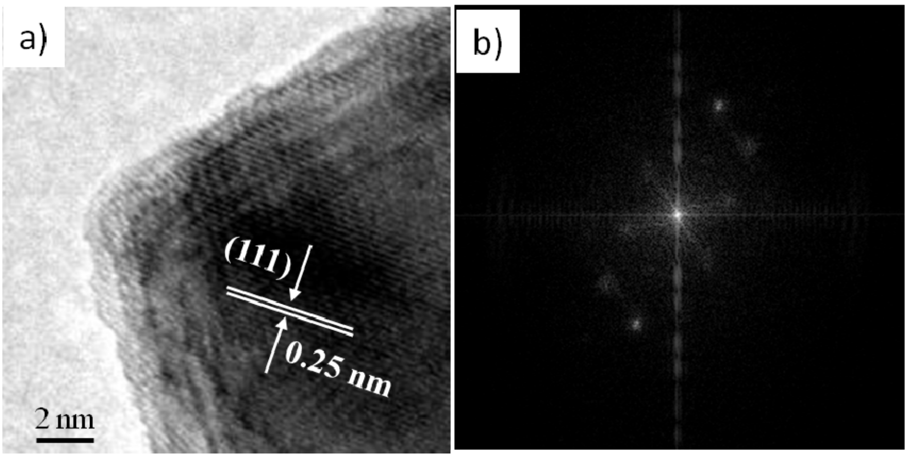

Fig. S2 Characterizations of CoO octahedrons (CoO-1): a) High resolution TEM image, b) Its corresponding fast Fourier transform pattern (FFT).

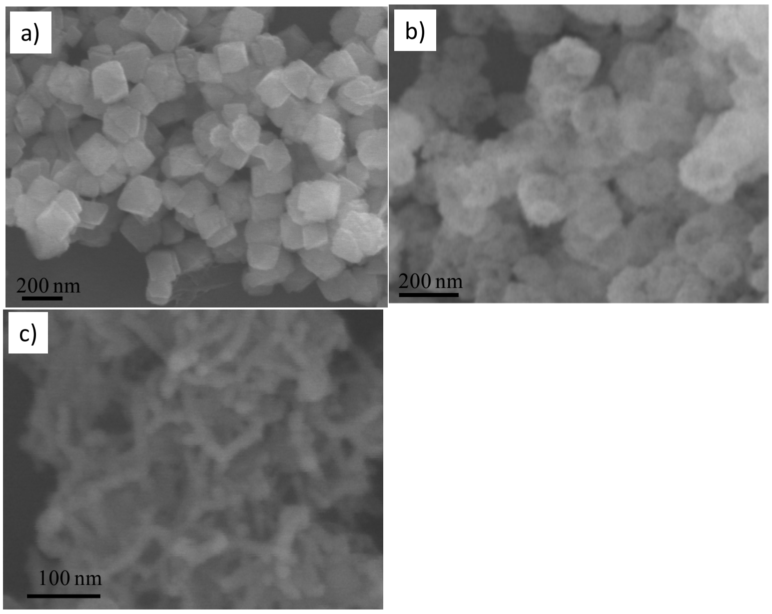

Fig. S3 SEM images of the products with different morphologies obtained with addition of urea at different reaction stages under the same condition of CoO-2: a) Solid CoO nanooctahedrons, 0 h, b) Hollow CoO nanocages, 36 h, c) CoO octahedral nanoframes, 48 h.

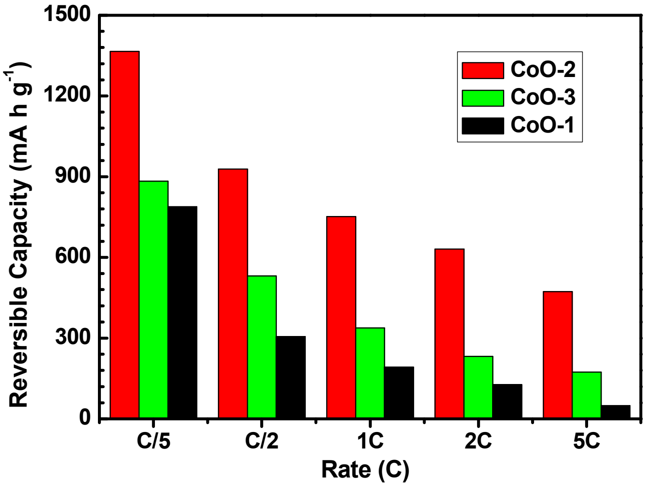

Fig. S4 The comparative rate capabilities of three CoO samples, respectively.