Supporting Information

Superior electrochemical performances of double-shelled CuO yolk-shell powders formed from spherical copper nitrate-polyvinylpyrrolidone composite

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This file includes:

- XRD patterns of the precursor and post-treated powders.
- Thermogravimetric curve of the copper nitrate-PVP composite powders coated with $Cu_2(OH)_3NO_3$-carbon layer.
- EDX spectra of the precursor and post-treated powders at 200°C.
- Long-term cycling performance of the CuO yolk-shell powders at a current density of 1000 mA g^{-1}.
- Nitrogen adsorption-desorption isotherms and pore size distributions of (a) the commercial CuO nanopowders and (b) the CuO yolk-shell powders.
- Morphologies and elemental mapping images of the CuO yolk-shell powders obtainbed after after 50 cycles at a current density of 500 mA g^{-1}.

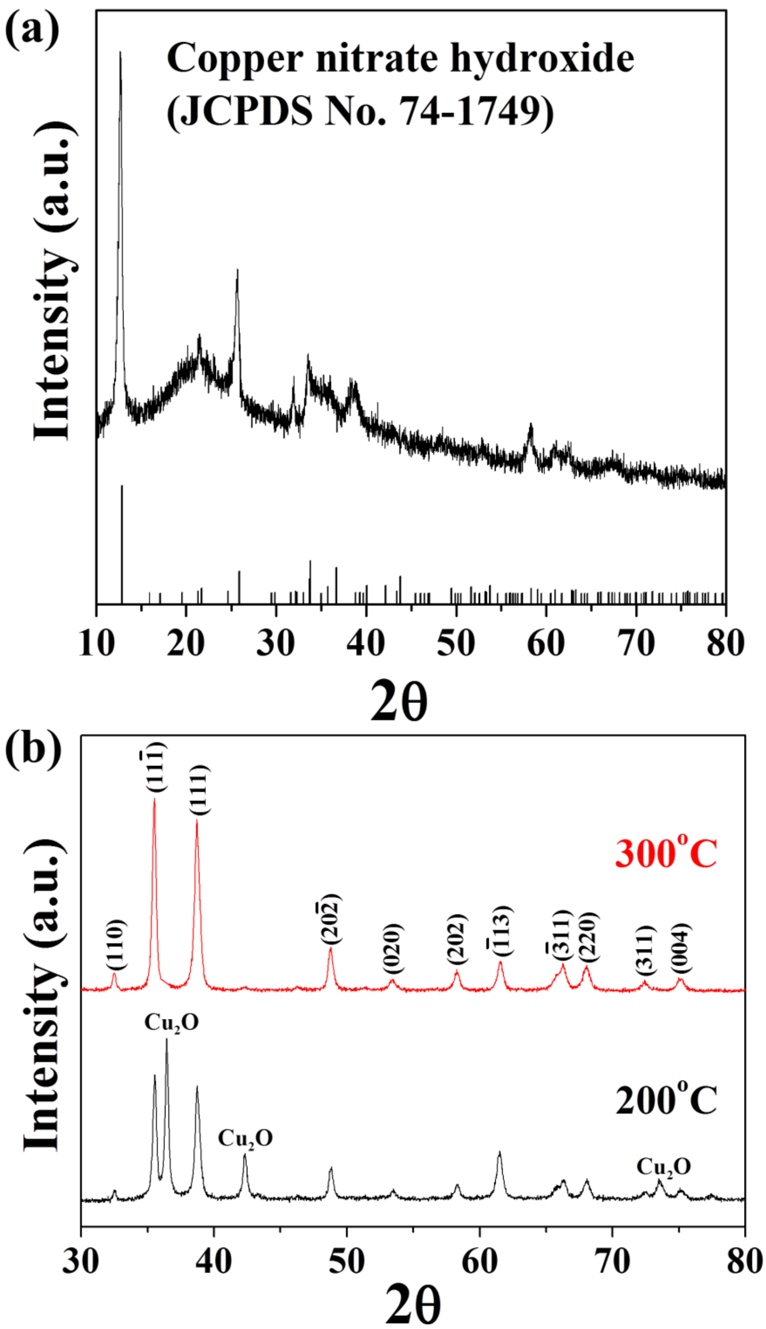

Fig. S1 XRD patterns of the (a) precursor and (b) post-treated powders.

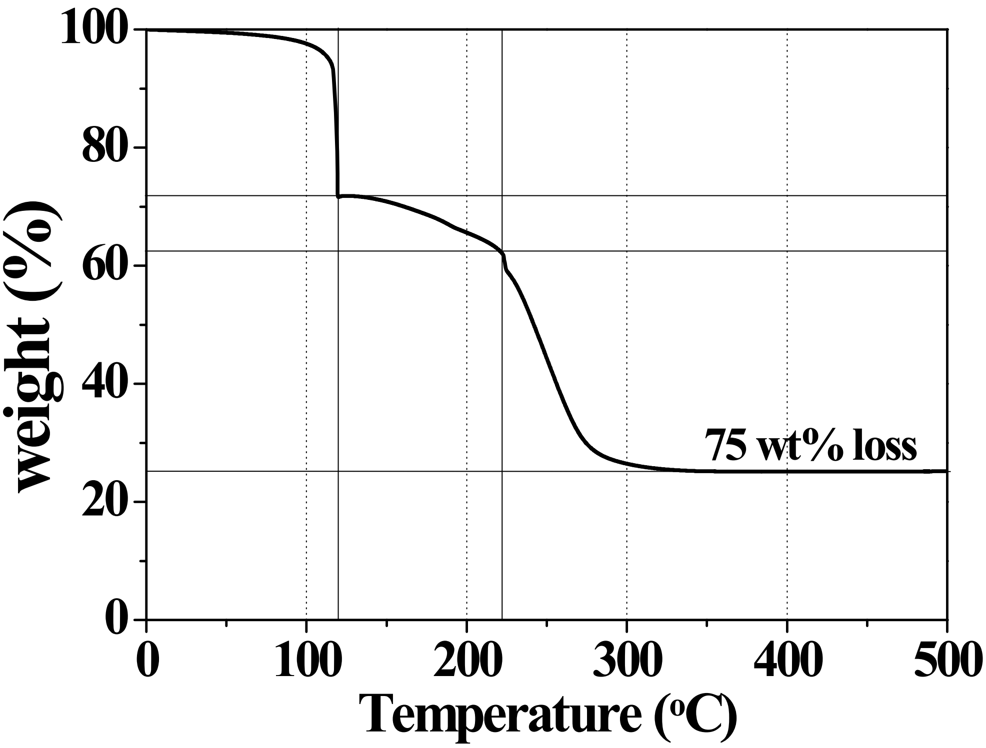

Fig. S2 Thermogravimetric curve of the copper nitrate-PVP composite powders coated with $Cu_2(OH)_3NO_3$-carbon layer.

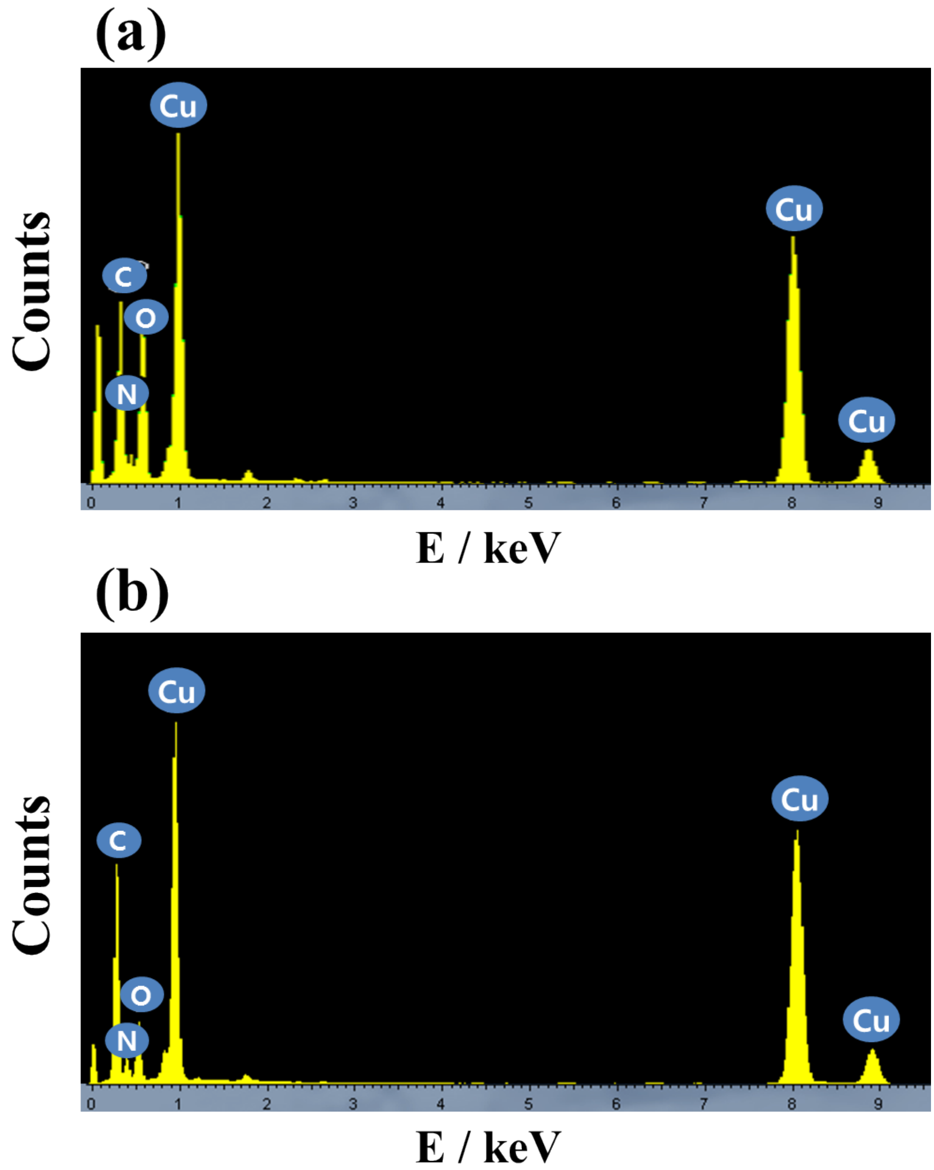

Fig. S3. EDX spectra of the (a) precursor and (b) post-treated powders at 200^{o}C.

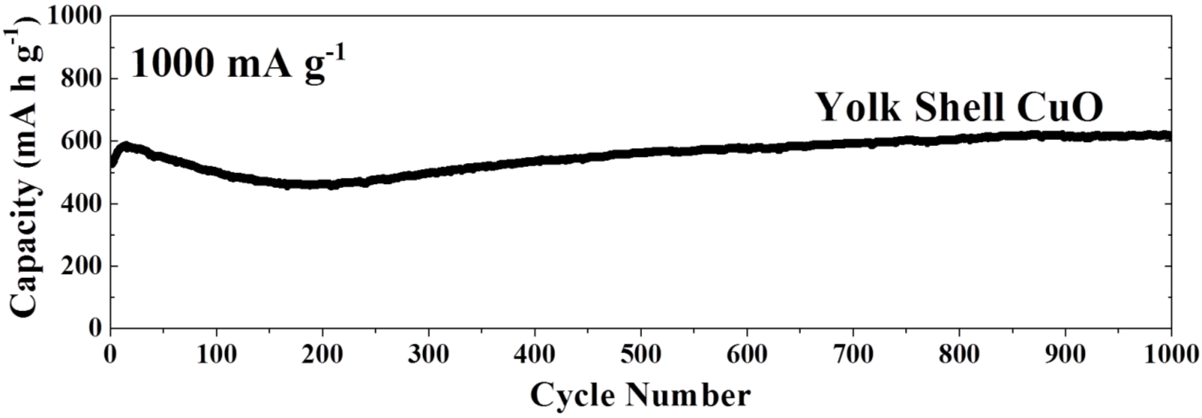

Fig. S4. Long-term cycling performance of the CuO yolk-shell powders at a current density of 1000 mA g^{-1}.

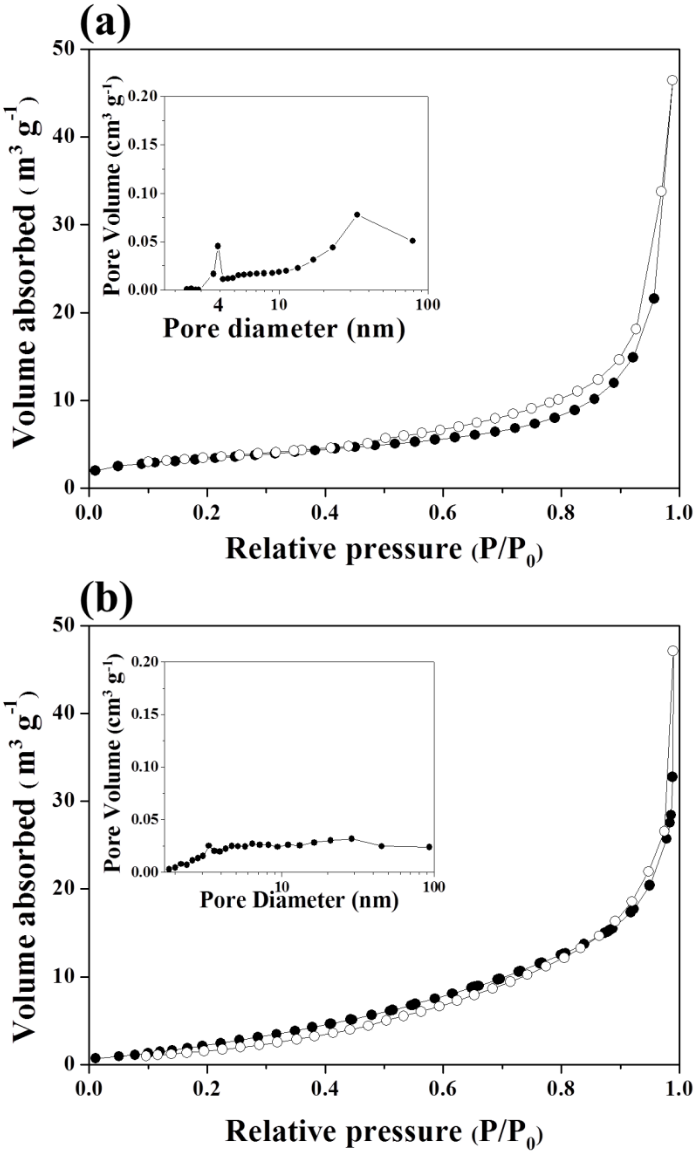

Fig. S5. Nitrogen adsorption-desorption isotherms and pore size distributions of (a) the commercial CuO nanopowders and (b) the CuO yolk-shell powders.

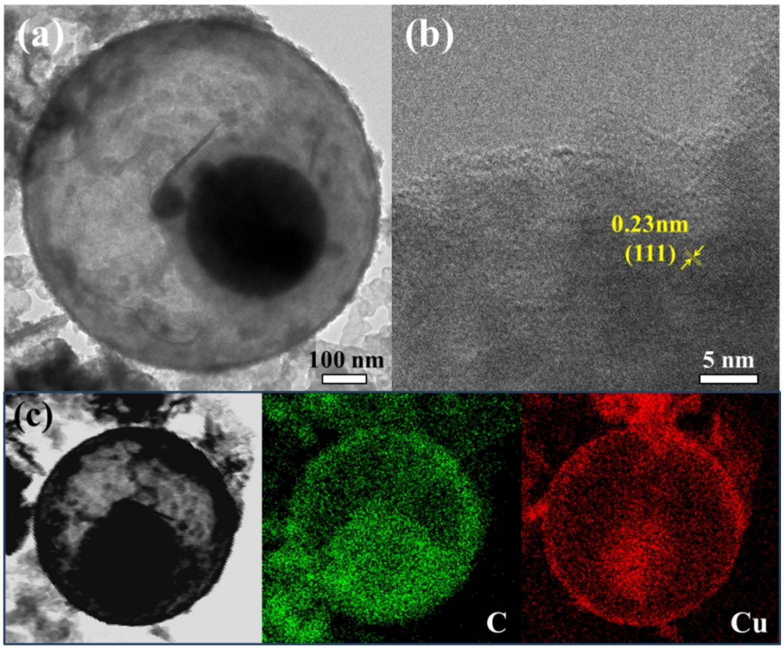

Fig. S6. Morphologies and dot-mapping images of the CuO yolk-shell powders obtainbed after after 50 cycles at a current density of 500 mA g^{-1}.

Table S1. Electrochemical properties of nanostructured CuO materials with different morphologies prepared by various preparation methods.

Material [preparation method]	Voltage range [V]	Current density [mA g^{-1}]	Initial C_{dis}/C_{cha} [mA h g^{-1}]	Discharge capacity [mA h g^{-1}]	Cycle number	Ref.
complex hollow CuO sphere [precipitation method]	0.001 – 3	150	1167 / -	~400	50	[16]
CuO urchin-like particles [precipitation method]	0.001 – 3	150	967 / 614	560 (charge)	50	[17]
CuO/graphene nanocomposite flower [simple liquid method]	0.01 – 3	65	~600 / ~900	600	100	[18]
leaf-like CuO nanostructures [hydrothermal]	0.01 – 3	-	1028 / 580	440	30	[20]
leaf-like CuO mesocrystal [electrochemical synthesis]	0.01 – 3	-	1063 / 674	500	30	[21]
single crystalline CuO anorods and 3D CuO nanostructures [one-step thermal]	0.01 – 3	100	1143 / 670	516	100	[22]
porous CuO hollow octahedra [metal organic framework templates]	0.05 – 3	100	1242 / 775	470	100	[23]
hierarchical CuO hollow microspheres [hydrothermal]	0.01 – 3	67	971 / 606	598	30	[24]
highly porous CuO nanorods [precipitation method]	0.001 – 3	300	703 / -	654	200	[25]
CuO nanowalnuts [precipitation method]	0.02-3.0	67	867 / -	407	30	[26]
sponge-like architectured cupric oxides [sintering of Cu NPs]	0.001-3.0	130	- / 662	667	50	[27]
bundle-like CuO structures [precipitation method]	0.001-3.0	200	1179 / -	666	50	[28]
CuO nanofibers [electrospinning]	0.005-3.0	100	1071 / 619	452	100	[29]
carbon-coated CuO hollow spheres [spray pyrolysis]	0 – 3.0	670	1003 / 551	750	300	[31]
double-shelled CuO yolk-shell powders [spray pyrolysis]	0.01 – 3.0	1000	1237 / 538	615	1000	This work