

Supporting Information

Simple fabrication and electrochemical performance of porous and double-shelled macroporous CuO nanomaterials with a thin carbon layer

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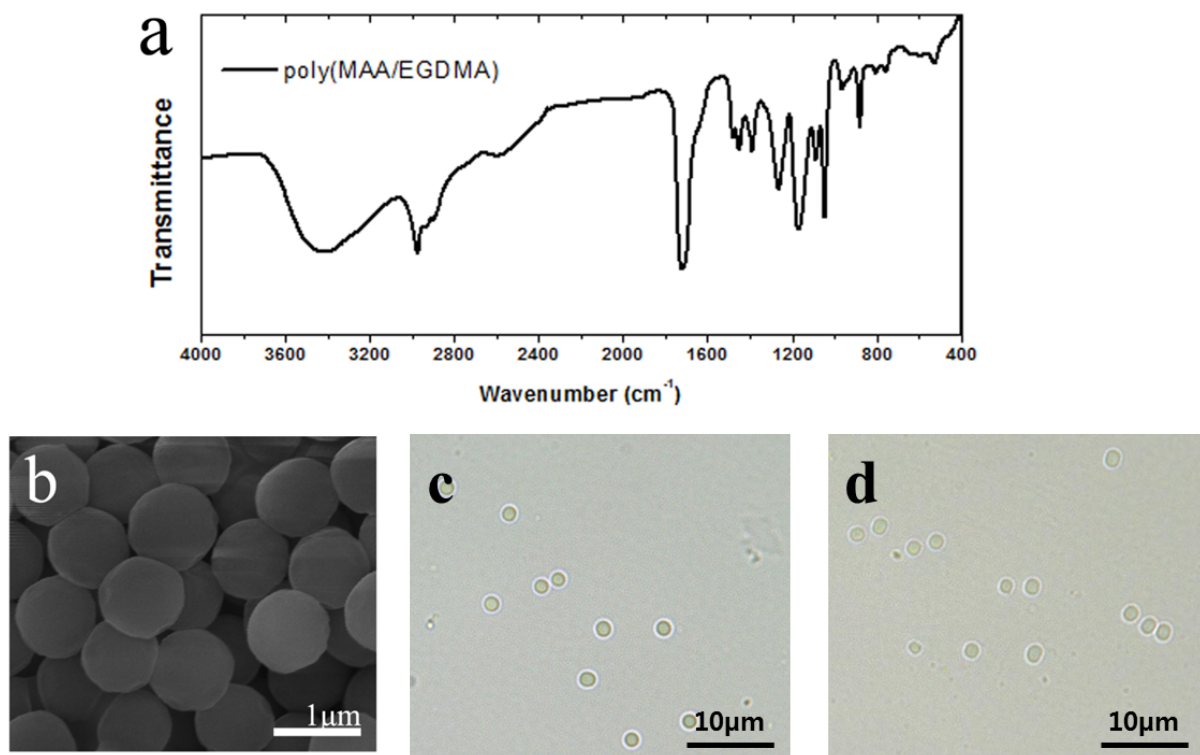
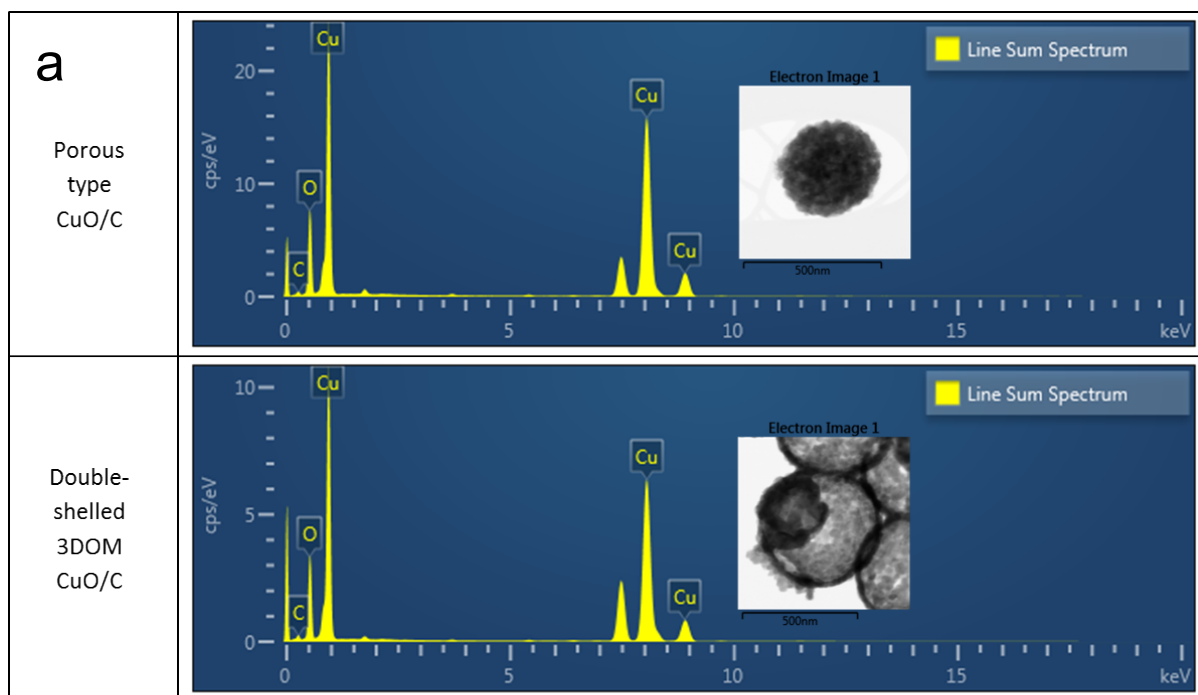


Figure S1. (a) FT-IR spectrum, (b) SEM image of poly(MAA/EGDMA) microspheres and OM images of poly(MAA/EGDMA) microspheres dispersed in aqueous solutions pHs of (c) 6.44 and (d) 9.05.



b

Element	Line Type	Porous type CuO		Double-shelled 3DOM CuO/C	
		Wt%	Atomic %	Wt%	Atomic %
C	K series	4.57	10.33	5.50	12.25
O	K series	38.54	65.37	38.28	64.06
Cu	K series	56.89	24.30	56.22	23.69
Total		100.00	100.00	100.00	100.00

Figure S2. (a) EDX profiles of porous CuO/C and double-shelled 3DOM CuO/C and (b) element contents of C, O and Cu in two types of CuO/C samples.

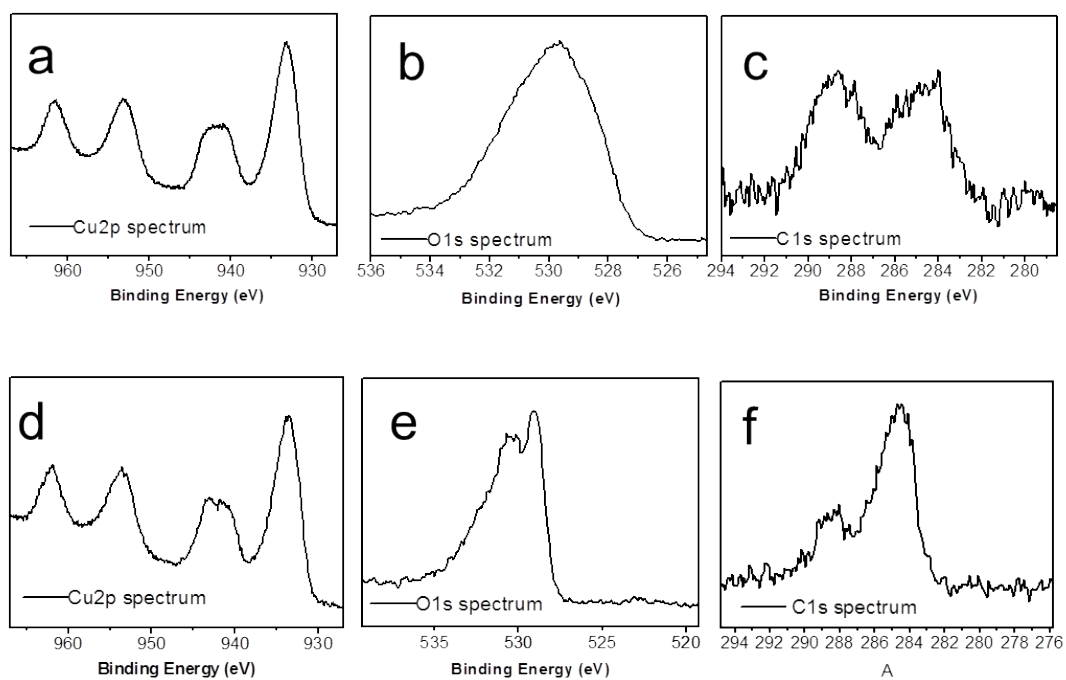


Figure S3. XPS spectra of (a, b and c) porous CuO/C submicron spheres and (d, e and f) double-shelled 3DOM CuO/C: (a and d) Cu2p, (b and e), O1s and (c and f) C1s.

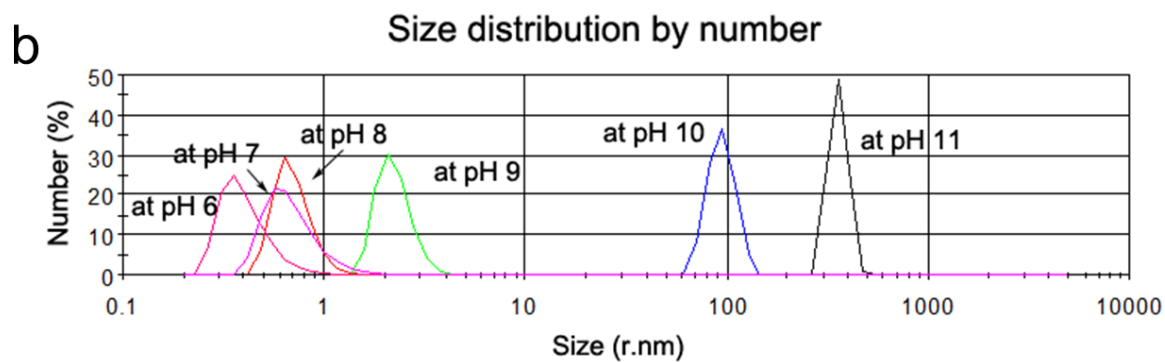
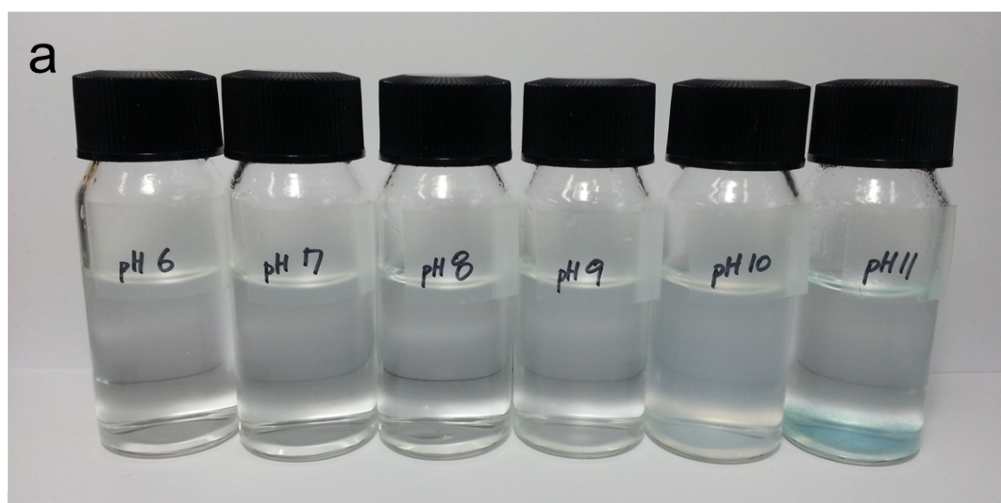


Figure S4. (a) Digital photograph of vials containing Cu aqueous solutions with different pHs (pH6~11) after adding CuSO_4 solution. (b) Size distribution of Cu precursors formed in aqueous solutions with different pHs.

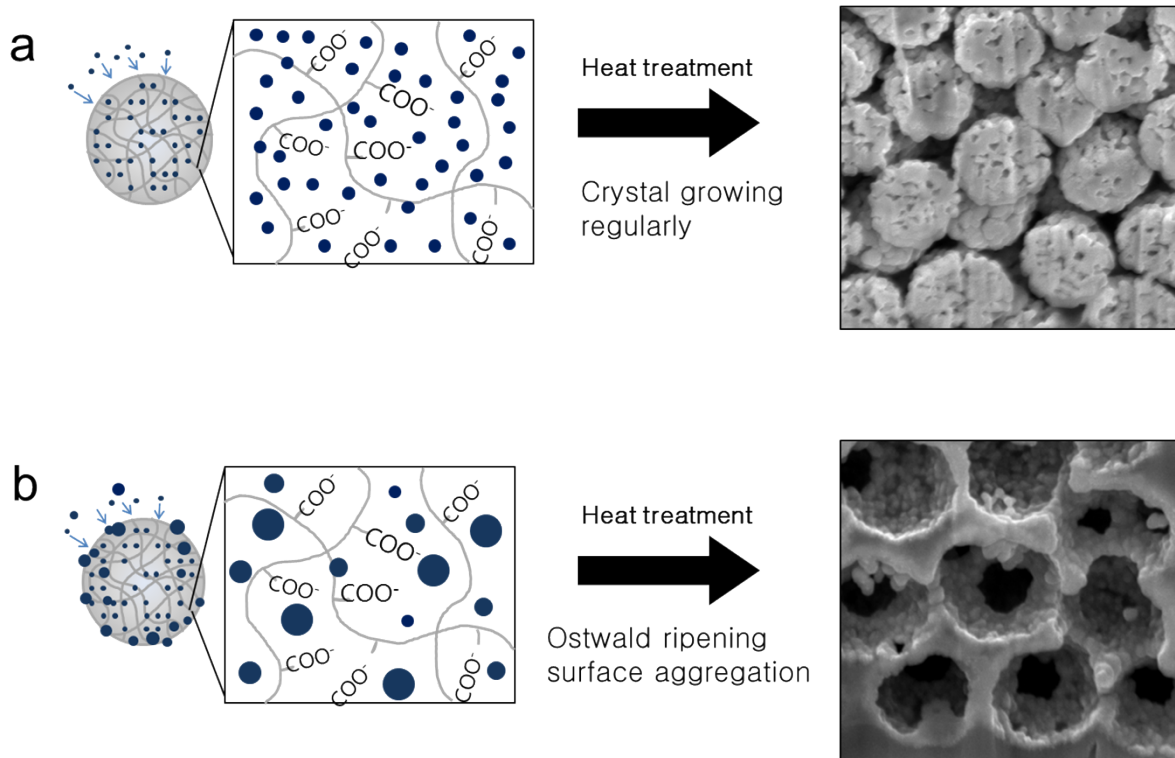


Figure S5. Schematic illustration of polymer networks with Cu precursors in Cu precursors/poly(MAA/EGDMA) composite microspheres prepared under different pH conditions and FIB-SEM images of (a) porous CuO/C submicron spheres and (b) macroporous 3DOM CuO/C after heat treatment.

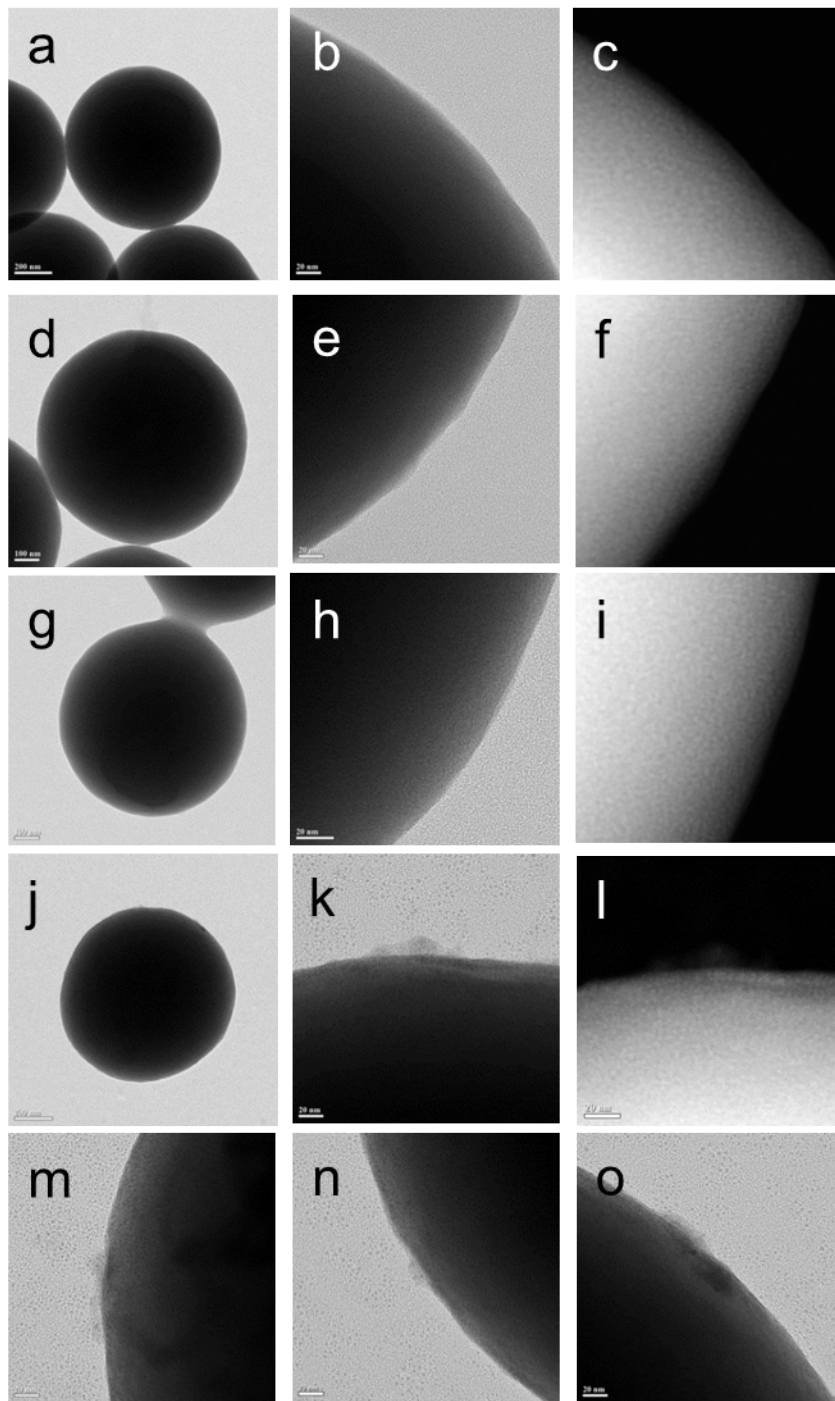


Figure S6. HR-TEM images at (a, d, g and j) low and (b, e, h, k, m, n and o) high magnifications and (c, f, i, and l) STEM images of Cu precursors/poly(MAA/EGDMA) composite microspheres prepared under different pH conditions: (pH 6.55: a, b and c), (pH 7.44: d, e and f), (pH 9.05: g, h and i), (pH 10.05: j, k and l) and (pH 11.21: m, n and o).

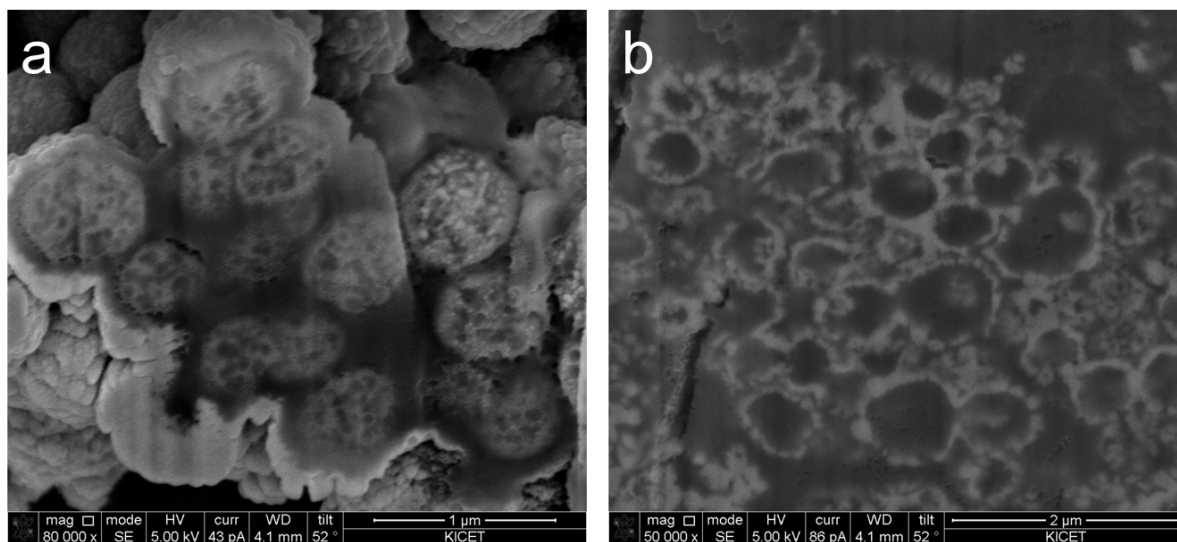


Figure S7. Cross-sectional(FIB-SEM) images of composite electrodes containing (a) porous Cu/O submicron spheres and (b) double-shelled 3DOM CuO/C after 100 cycles.

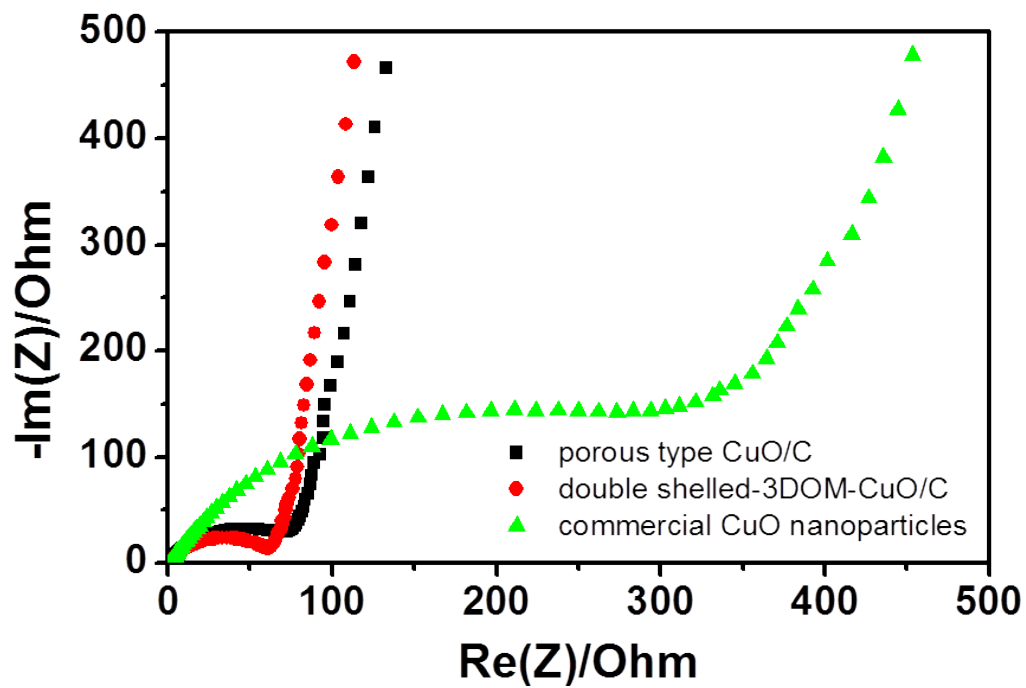


Figure S8. Electrochemical impedance spectroscopy (EIS) of the fresh cells containing (black square) porous CuO/C submicron spheres, (red circle) double-shelled 3DOM-CuO/C and (green triangle) commercial CuO nanoparticles.