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Supplementary Information

A Novel Method to Enhance the Conductance of Transitional Metal Oxide Electrodes

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Experimental Methods

Synthesis of the ultralong Cu nanowires and CuO nanotubes: The method to synthesize ultralong copper nanowires was reported in our previous work.[17] Typically, 8 g n-hexadecylamine (HDA) was melted at 180 ^{o}C, and 0.5 g hexadecyltrimethy ammonium bromide (CTAB) was dissolved into it. Then, 0.2 g copper acetylacetonate was added and stirred until homogeneous blue solution formed. After that, the solution was transferred to a Teflon autoclave, and a 0.5 cm^2 silicon wafer sputtered with platinum was put in. Then the autoclave was put in a 180 ^{o}C oven and held for 10 h. After reaction, the autoclave cooled down to room temperature in air, and the

products were rinsed with toluene thoroughly. Finally, thread-like reddish product was obtained and kept in toluene. After anealed at 300 ^{o}C in air for 30 min, CuO nanotubes were obtained. X-ray diffraction measurements were taken on a Panalytical X'Pert Pro X-ray powder diffractometer using Cu-Ka radiation (λ =1.54Å). SEM experiments were conducted on a Jeol JSM-6700 FE-SEM instrument. TEM experiments were conducted on a Philips CM120 instrument operated at 120 kV.

Electrode fabrication and electrochemical measurement: To prepare working electrodes, CuO naotubes or a mixture of CuO nanotubes and MWNTs at a weight ratio of 7:1 was pasted on a titanium sheet, and dried at 100 ^{o}C under vacuum for 12 h. The electrodes were put on a hot plate of 250 ^{o}C and treated with atmospheric pressure H_2 plasma generated by Atomflow^{-TM} 400L from Surfx® Technologies LLC. To make 2032 type coin cells, glass fiber (GF/D) from Whatman was used as the separator. The electrolyte consisted of a solution of 1 M LiPF6 in ethylene carbonate (EC)/dimethyl carbonate (DMC) (1:1 v/v). Lithium foil was used as counter electrodes. The cells were assembled in a glove-box under an argon atmosphere. The charge and discharge measurements were carried out by LAND CT2000 (Wuhan Jinnuo Electronics, Ltd., Wuhan, China) in the voltage range of 0.005-3V (*vs.* Li^+/Li) under different current densities. The specific capacitance was calculated based on the total mass of anode materials. CV measurements and the electrochemical impedance spectroscopy (EIS) recorded on a Solartron 1860/1287 Electrochemical Interface.

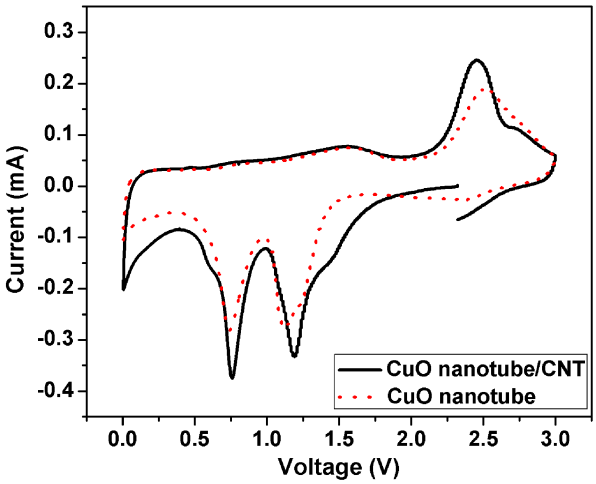

Figure S1 Cyclic voltammograms of the electrodes made of CuO nanotubes and CuO nanotube/CNT composites at a potential scan rate of 0.5 mV/s.

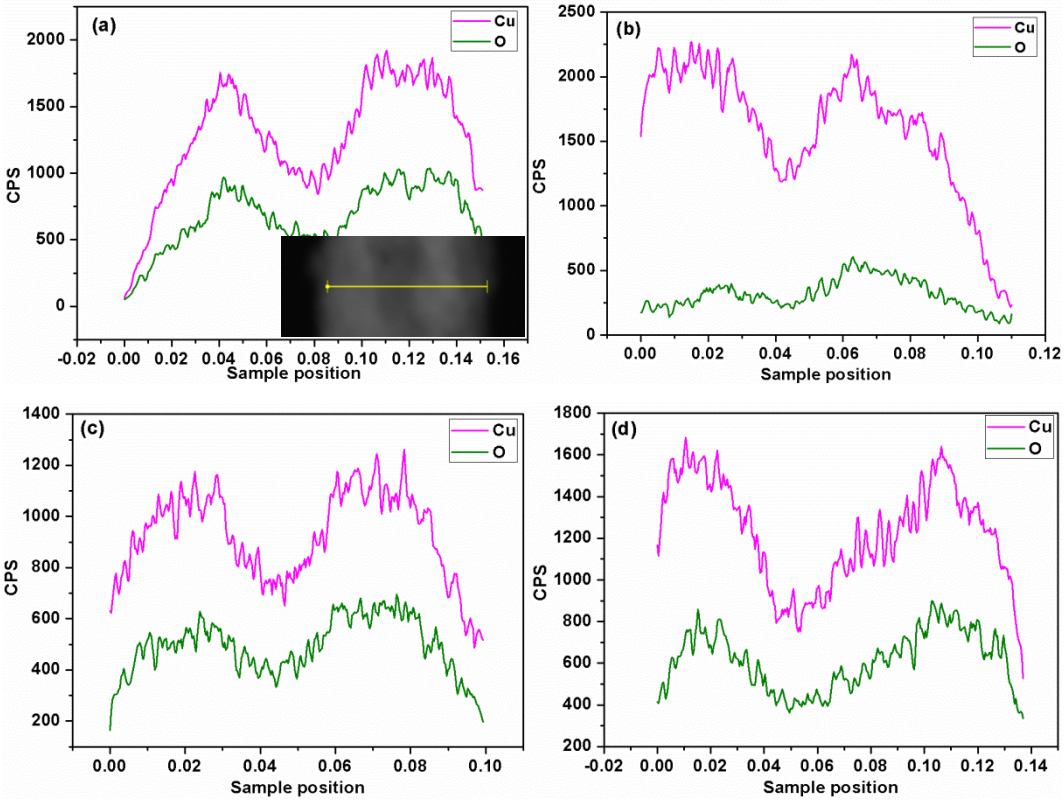

Figure S2 Elemental analysis of a single CuO nanotube before and after H_2 plasma treatment by STEM (a) a CuO nanotube, the inset is the transmitting electron image of a part of a CuO nanotube, and the elemental analysis was conducted by scanning across the nanotube; (b) a CuO nanotube after H_2 plasma treatment for 5 min; (c) a CuO nanotube covered with CNTs; (d) a CuO nanotube covered with CNTs after H_2 plasma treatment for 5 min. The valley in the center area is caused by the tube structure of CuO.

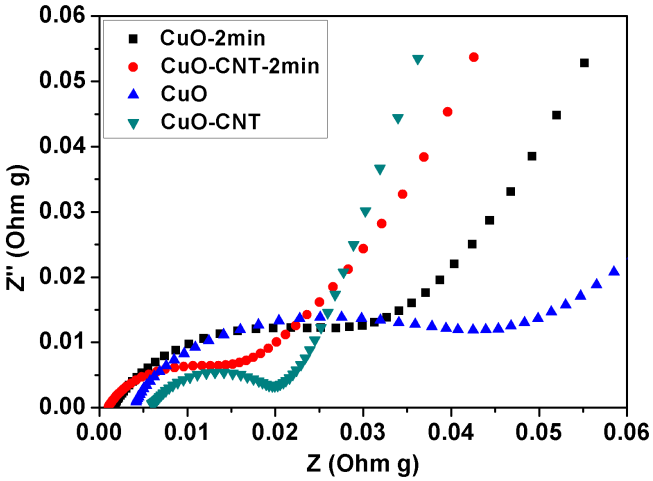

Figure S3 Impedance measurement of the electrode made of CuO nanotube, CuO nanotube-CNT composite, and their electrode treated with H_2 plasma for 2 min.

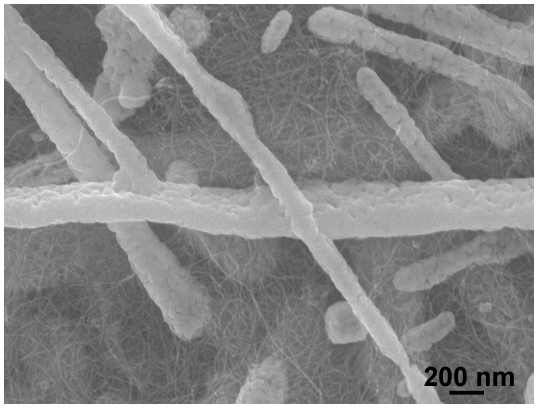

Figure S4 SEM image of CuO nanotube-CNT composite electrode treated with H_2 plasma for 5 min