Supporting Information

Controllable Synthesis of Barnyardgrass-like CuO/Cu_2O Heterostructured Nanowires for Highly Sensitive Non-enzymatic Glucose Sensor

Qing-Qing Zhou,[a] Ming-Peng Zhuo,[b] Rui Chen,[a] Shao-Zhen Wang,[a] Zuo-Shan Wang,*[a] Min Zheng,*[c] and Liang-Sheng Liao[b,d]

[a] College of Chemistry, Chemical Engineering and Materials Science, Soochow University, Suzhou, Jiangsu 215123, China

[b] Jiangsu Key Laboratory for Carbon-Based Functional Materials & Devices, Institute of Functional Nano & Soft Materials (FUNSOM), Soochow University, Suzhou, Jiangsu 215123, China

[c] College of Textile and Clothing Engineering, Soochow University, Suzhou, Jiangsu 215123, China

[d] Institute of Organic Optoelectronics, Jiangsu industrial Technology Research Institute (JITRI), Wujiang, Suzhou, Jiangsu 215211, China

*E-mail: zuoshanwang@suda.edu.cn (Z.-S. Wang) or zhengmin@suda.edu.cn (M. Zheng)

Experimental details

Materials

Cupric acetate monohydrate ($Cu(Ac)_2 \cdot H_2O$), sodium hydroxide (NaOH), polyethylene glycol 200 (PEG200) were purchased from Sinopharm Chemical Reagent Co., Ltd. All the reagents used here were analytically pure except for PEG200 which was of chemical grade. They were used as received without any further purification and deionized water was used throughout the whole course.

Synthesis of porous $Cu(OH)_2$ nanorods

$Cu(OH)_2$ nanowires were fabricated by a simple precipitation method. Briefly, 0.3 mol L^{-1} $Cu(Ac)_2$ and 3 mol L^{-1} NaOH aqueous solutions were respectively prepared in the same volume and stirred for several minutes. Then under rapid magnetic stirring, $Cu(Ac)_2$ solution was added dropwise to NaOH solution at room temperature. Immediately after reaction, the product was centrifuged and washed by deionized water and ethanol and dried at 60 ℃ for 12 h.

Synthesis of self-assembly barnyardgrass-like CuO, Cu_2O and CuO/Cu_2O nanowires

Self-assembly CuO nanowires were synthesized by a microwave method. First, 0.04 g $Cu(OH)_2$ nanorod powders were evenly dispersed in 100 mL PEG200 by an ultrasonic treatment. After stirring for 10 min, the reaction system was transferred to a 250 mL three-necked flask and treated in Microwave Chemical Reactor (XH-100B, Beijing Xianghu Technology Development Co. Ltd) under 180 ℃ with the power of 700 w for 10 min and 20 min respectively to prepare barnyardgrass-like CuO and CuO/Cu_2O nanowires. As the microwave time elongates to 3 h, the CuO/Cu_2O nanowires completely convert to Cu_2O nanowires. After cooling to room temperature, the final products ware washed and collected, and then dried at 60 ℃ for 12 h.

Characterization

The crystalline phase of the synthesized samples was ascertained through powder X-ray diffraction (XRD) on a Rigaku D/max-Ⅲ C X-ray diffractometer with Cu-$K\alpha$ radiation (k = 0.154 nm), scanning from 10° to 80° with a scanning voltage of 40 kV, a

scanning current of 100 mA. The elemental composition and valence state can be confirmed through X-ray photoelectron spectroscope (XPS, ESCALAB 250). The morphology of the samples was observed by transmission electron microscopy (TEM, FEI Tecnai G20), high-resolution transmission electron microscopy (HRTEM, Hitachi H600A-G) and Selected Area Electron Diffraction (SAED) patterns that captured by the testing machine. Surface area and pore size distribution analysis can be conducted by Brunauer-Emmett-Teller (BET) method in Micromeritics Tristar 3020. Electrochemical experiments were conducted on a CHI-6611D electrochemical workstation, involving a three-electrode system, which includes a working electrode, a counter electrode (platinum wire) and a reference electrode (saturated calomel electrode).

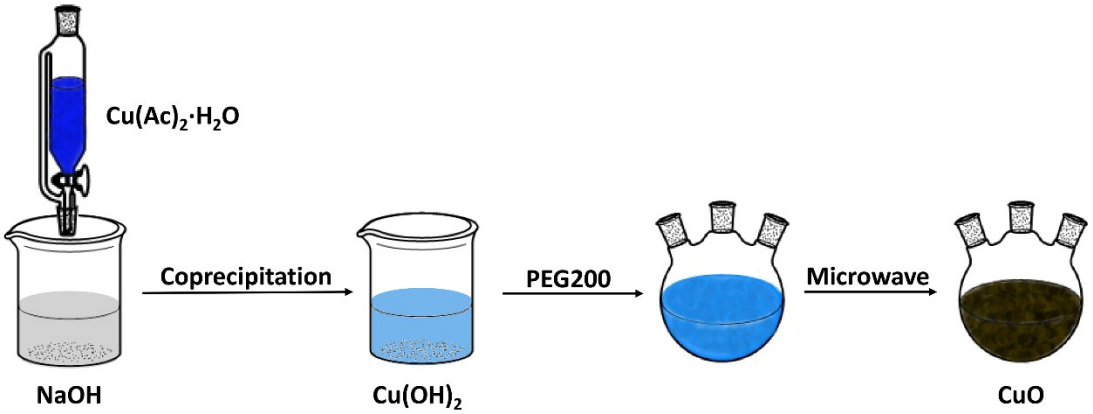

Fig. S1. The flow chart of the preparation of porous $Cu(OH)_2$ nanorods and barnyardgrass-like CuO nanowires.

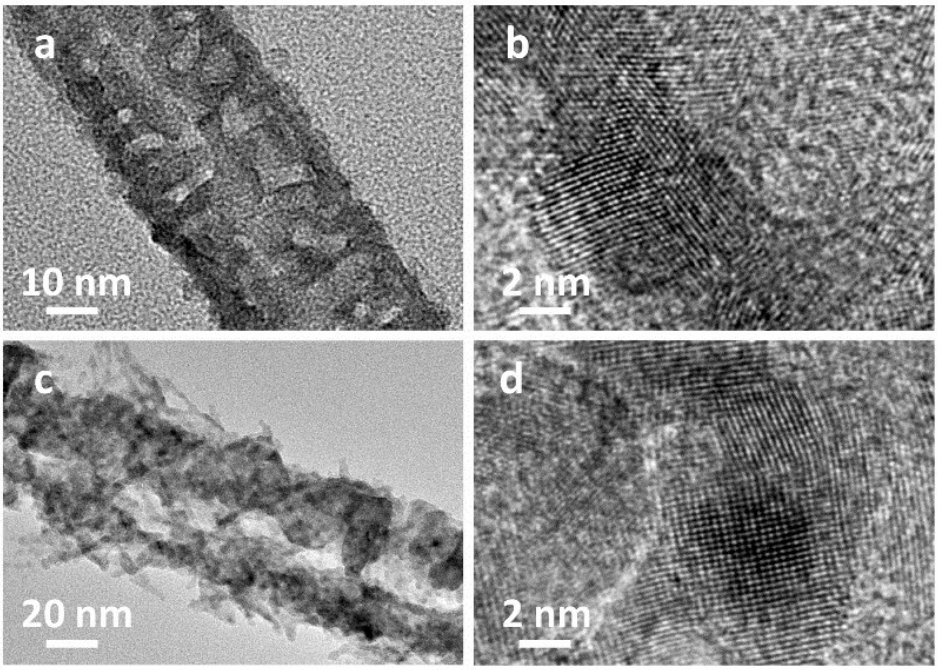

Fig. S2. (a-b) HRTEM images of porous $Cu(OH)_2$ nanorods, scale bars are 10 nm and 2 nm for (a) and (b), respectively. (c-d) HRTEM images of barnyardgrass-like CuO nanowires, scale bars are 20 nm and 2 nm for (c) and (d), respectively.

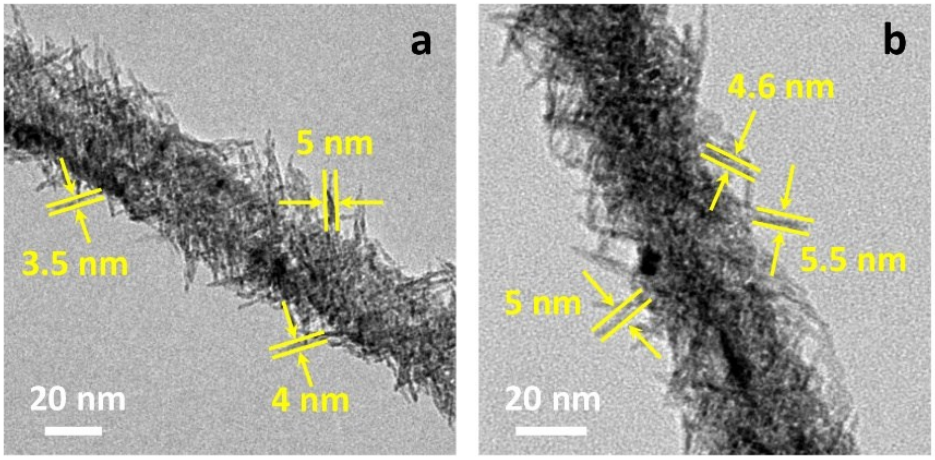

Fig. S3. TEM images of barnyardgrass-like (a) CuO and (b) CuO/Cu_2O heterostructured nanowires.

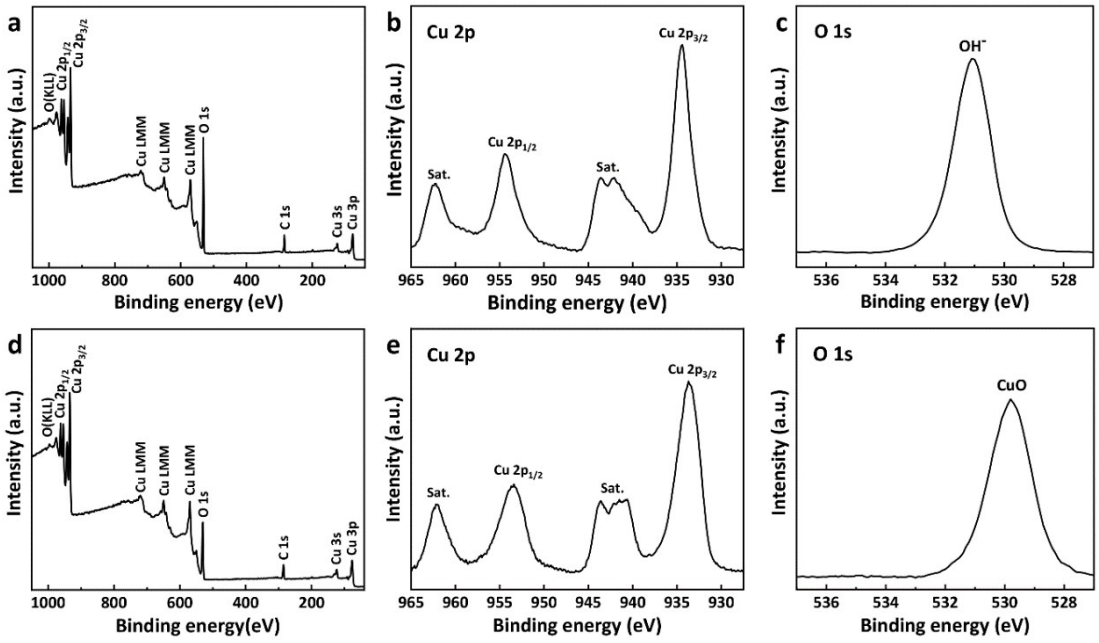

Fig. S4. (a) XPS survey spectrum of porous $Cu(OH)_2$ nanorods. (b-c) XPS spectra in the (b) Cu 2p and (c) O 1s regions of $Cu(OH)_2$. (d) XPS survey spectrum of barnyardgrass-like CuO nanowires. (e-f) XPS spectra in the (e) Cu 2p and (f) O 1s regions of CuO.

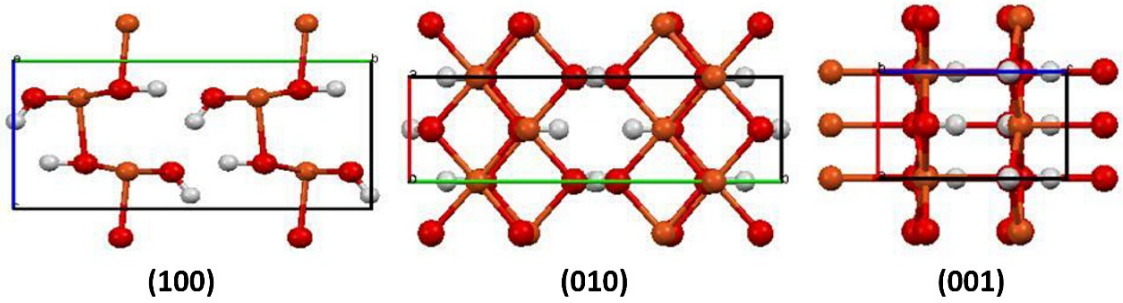

Fig. S5. The single-crystal structures of $Cu(OH)_2$.

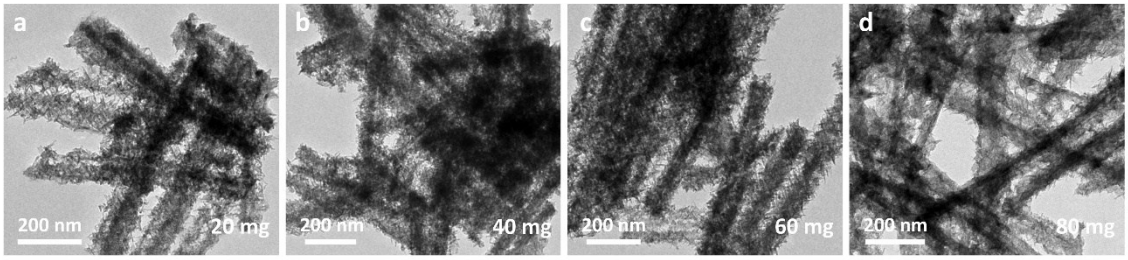

Fig. S6. TEM images of samples reacted in 100 mL PEG200 with the $Cu(OH)_2$ content of (a) 20 mg, (b) 40 mg, (c)60 mg, (d) 80 mg, respectively, scale bars: 200 nm.

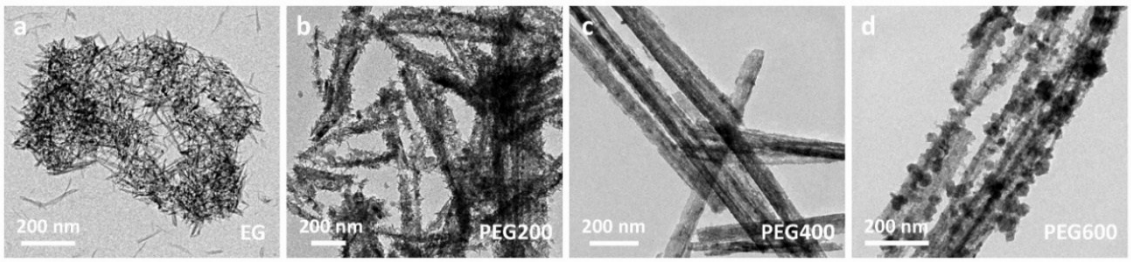

Fig. S7. TEM images of samples reacted in the solvent of (a) EG, (b) PEG200, (c) PEG400, (d) PEG600, respectively, scale bars: 200 nm.

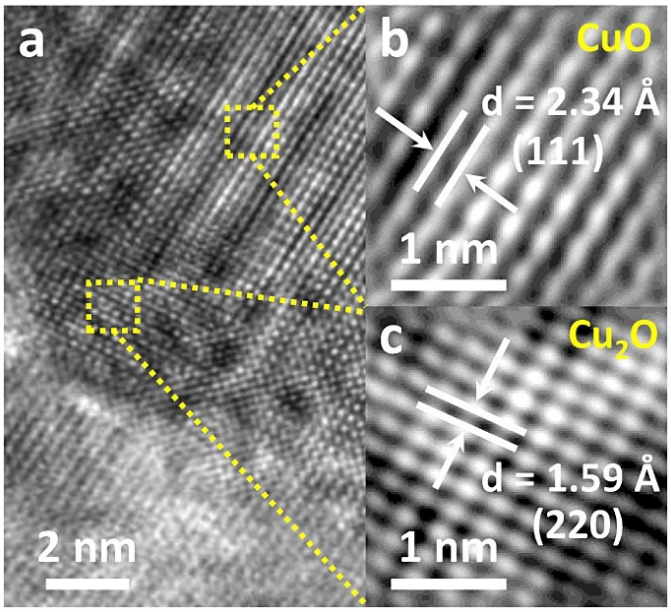

Fig. S8. (a) HRTEM image of barnyardgrass-like CuO/Cu_2O nanowire, scale bar: 2 nm. (b-c) HRTEM images corresponding to the two marked areas belonging to CuO and Cu_2O, respectively, scale bars: 1 nm.

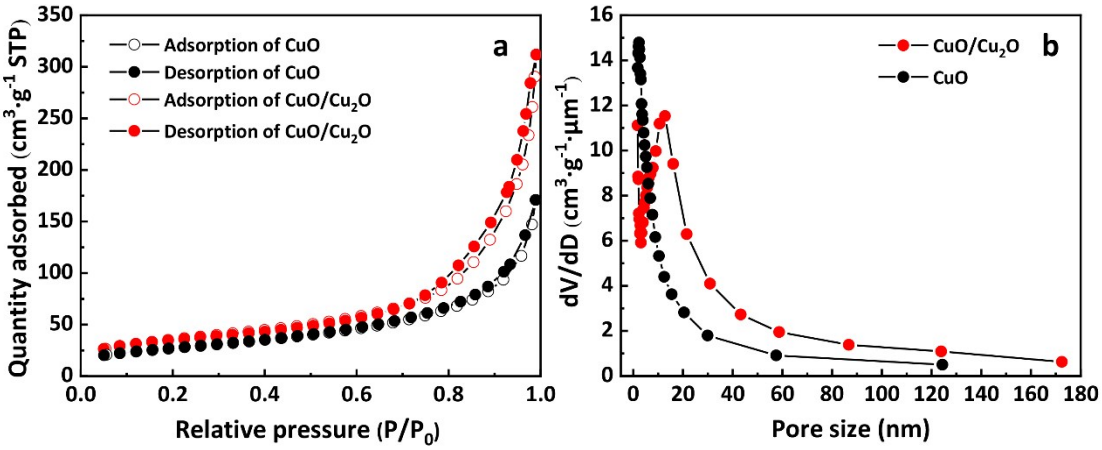

Fig. S9. (a) Nitrogen adsorption-desorption isotherms and (b) corresponding pore size distribution curves of barnyardgrass-like CuO and CuO/Cu_2O nanowires.

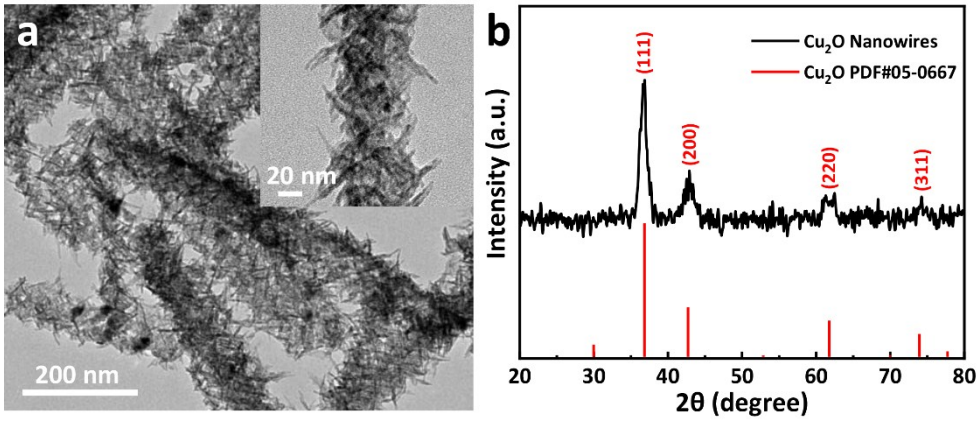

Fig. S10. (a) TEM image of barnyardgrass-like Cu_2O heterostructured nanowires with scale bar of 200 nm. Inset: TEM image of individual Cu_2O with scale bar of 20 nm. (b) XRD pattern of barnyardgrass-like Cu_2O heterostructured nanowires after the microwave treatment for as long as three hours.

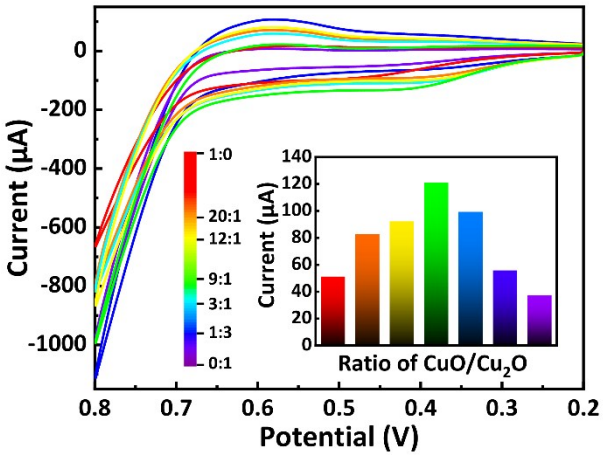

Fig. S11. CV curves of electrodes based on barnyardgrass-like CuO/Cu_2O nanowires with different ratios in 75 mM NaOH solution with 1 mM glucose. Inset shows the corresponding the respond peak current of each ratio.