Supporting Information

Influence of Morphology on the Optical Properties of Self-Grown Nanowire Arrays

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Experimental details

(1) The synthesis of Cu_2S nanowire arrays

Solid-gas reaction was used to prepare Cu_2S nanowire arrays, Copper foil (99.9% purity) was carefully polished with number 0-6 abrasive paper, and then washed with

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deionized water. The foil was cleaned sequentially in an ultrasonic bath containing 3%

sulfuric acid, then absolute ethanol, and finally deionized water three times. The

solid–gas reaction was performed in an airtight ceramic pipe (Figure S1). Pure O_2 with

a flow of 800 sccm was introduced into the pipe for 5 min, and then switched to the

mixed gas of H_2S (3000 sccm) and O_2 (240 sccm) for about 3 min, at last, the pipe was

sealed and kept at a fixed temperature of 18, 20, 25, 28 or 30 °C for 15 h. By the way,

the excess H_2S was absorbed by NaOH solution，the O_2 was first flow through the water

before mixing with H_2S to increase the humidity of the reaction. The area of each sample

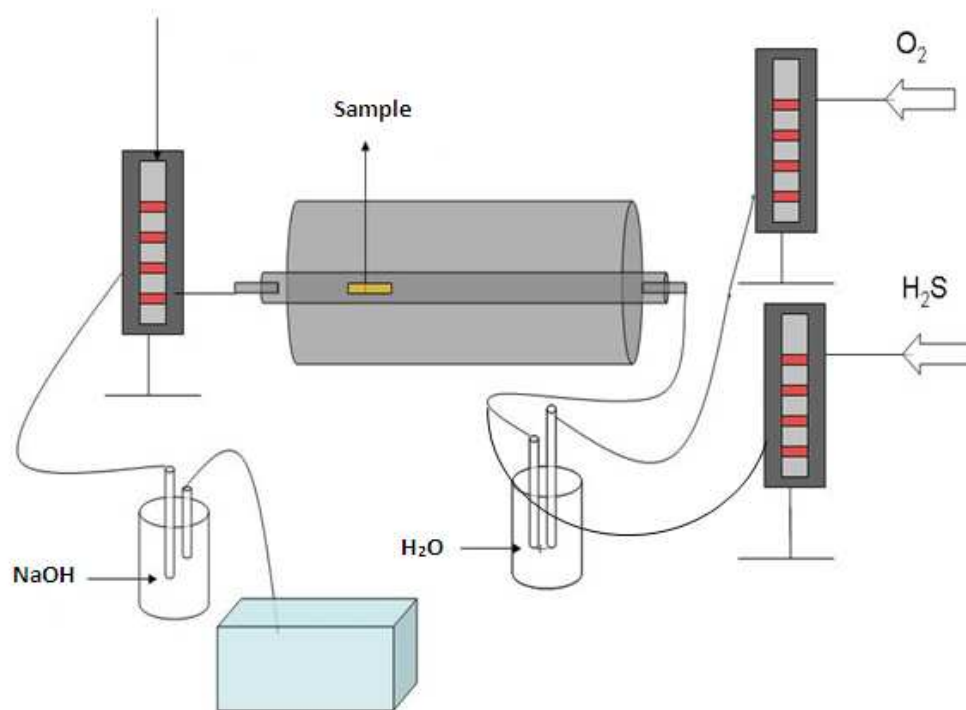was about 15×25 mm. The temperature was controlled by thermostatic water bath.

Figure S1. The reaction device that was used for the growth of Cu_2S nanowires.

(2) The characterization of Cu_2S nanowire arrays

Scanning electron microscopy (SEM) and X-ray diffraction (XRD) was used to observe the

morphology and make sure the phase of Cu_2S nanowire arrays; Transmission electron

microscopy (TEM) was performed on an electron microscope (JEOL JEM-2010HR) equipped with an energy-dispersive X-ray spectrometer (EDS, Oxford, UK) to characterize the growth direction and the component elements of the nanowire; X-ray photoelectron spectroscopy (XPS) and Raman spectrum were used to analyze the surface component of the nanowire; Photoluminescence (PL) spectra were measured to characterize the band gap of the nanowire; Diffused reflectance spectra (DRS) were used to measure the light absorption properties of Cu_2S nanowires of different morphologies.
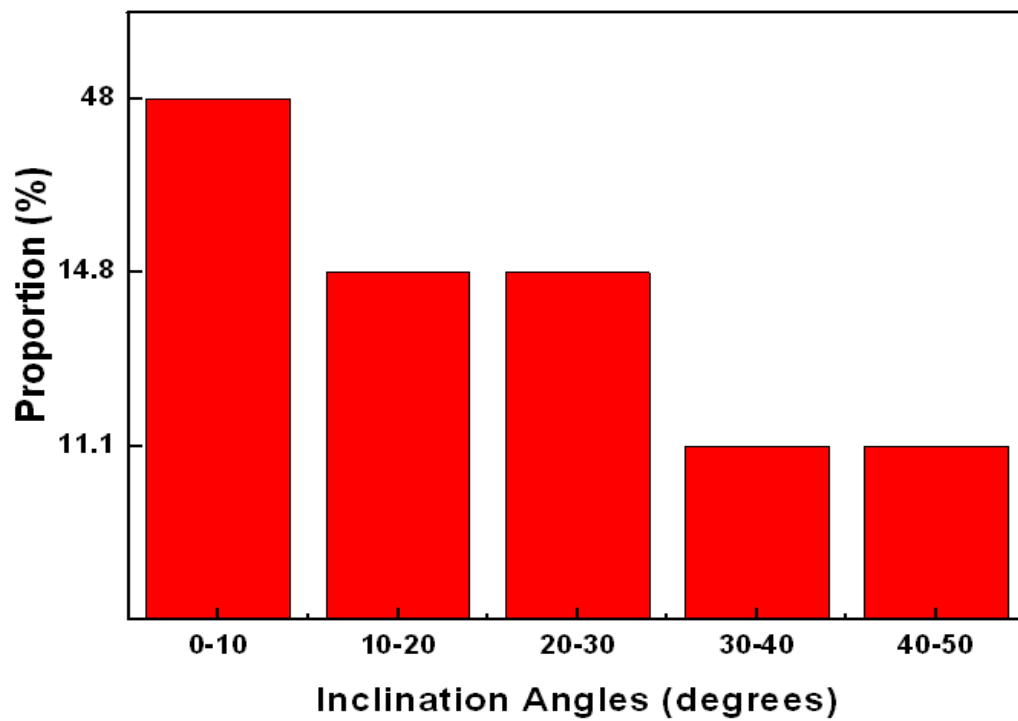
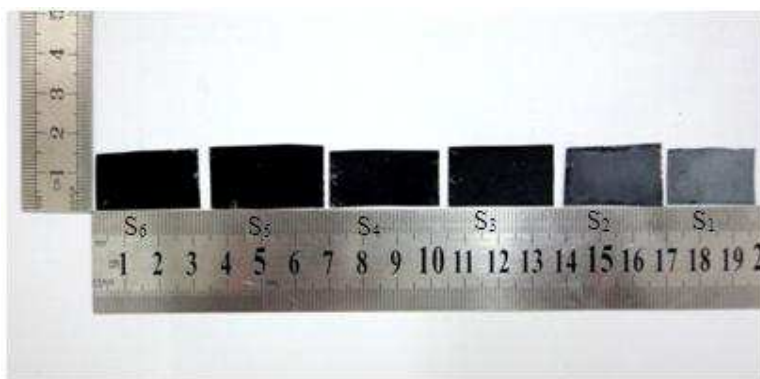**Figure S2.**The proportion of Cu$_2$S nanowire with different inclination angles.

Figure S3. Digital camera images, S_1-S_6 Corresponding to the Cu_2S nanowire arrays demonstrated in figure 1 (S_1)- (S_6). The minimum scale of the ruler is mm.
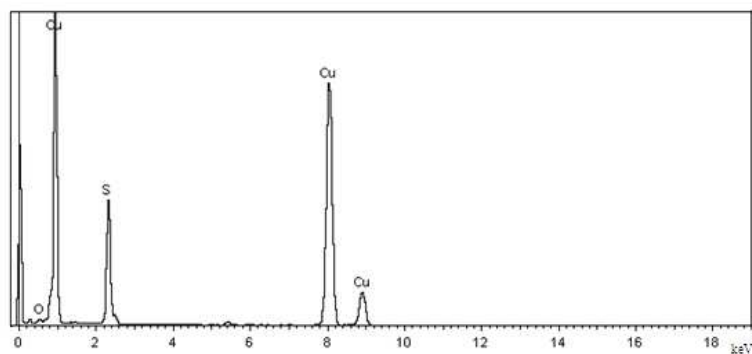
Figure S4. EDS of Cu_2S nanowire arrays, which shows the composition of the nanowire is Cu, S and O, indicating there is a certain amount of O^{2-} in the nanowire and part of O^{2-} will combined with Cu^{x+} and formed CuxO (x=1, 2).

Table S1. The content ratio of the ions (O ion, Cu ion and S ion) with different valences. (a) Corresponding to the Cu_2S nanowire arrays prepared at 18°C with a reaction time of 15 h, (b) corresponding to the Cu_2S film prepared at 18°C with a reaction time of 2 h. following the Cu_2S film becomes Cu_2S nanowire arrays, the relative amount of both the Cu_xO and Cu_2S become bigger.

Samples corresponding to figure 5	Peak area of O^{2-}:peak area of O	Peak area of Cu^{+1}/Cu: peak area of Cu^{2+}	Peak area of S^{2-}:peak area of S
a	0.281	0.579	1.56
b	0.176	0.457	1.41