Electronic Supplementary Material (ESI) for Catalysis Science & Technology

Supporting Information

CuO@Ag as A Highly Active catalyst for Oxidation of *trans*-Stilbene and Alcohols

Zhengmao Ye,[a] Lei Hu,[a] Jiang Jiang,[b] Jianxin Tang,[c] Xueqin Cao,*[a,d] Hongwei Gu*[a]

Synthesis of Ag *NWs:*

In a typical synthesis, 3mL ethylene glycol solution of $AgNO_3$ and 3 mL ethylene glycol solution of poly(vinyl pyrrolidone) (Aldrich, Mw≈55,000) were added dropwise (simultaneously) to the hot solution over 6 min, and the reaction continued at 160 ^{o}C for another 60 min. To purify the product, the final dispersion was separated by adding acetone (20ml), and centrifugation (2000rmp, 20min). The NWs were washed three times by ethanol (10mL) and acetone (20ml) and dispersed in ethanol.

Synthesis of CuO@Ag *NWs:*

In this case, the Ag NWs were re-dispersed in 20 mL of EG with magnetic stirring and 20mg cupric acetate was added. After the cupric acetate dissolved, the temperature was then raised to 180 ^{o}C and keep at this temperature for 30 min. Subsequently, the reaction mixture was cooled to room temperature naturally, the products were precipitated by adding EtOH, and finally the products were retrieved by centrifugation, and washed with ethanol several times. The nanowires were disperisible in water or EtOH.

General procedure for Catalytic epoxidation of stilbene over CuO@Ag NWs:

Catalyst testing was carried out in a sealed tube. 100μL CuO@Ag NWs (0.5mg) in EtOH, 0.2mmol trans-stilbene and a certain solvent (2 mL) were added. The reactions were took place at a certain temperature under air. Resulting product mixtures were analysed by GC-MS (VARIAN 450-GC & VARIAN 240-GC) equipped with a CP8944 capillary column (30 m × 0.25 mm) and a FID detector. All catalytic tests were repeated three times.

General procedure for Catalytic oxidation of alcohols over CuO@Ag NWs:

Catalyst testing was carried out in a sealed tube. 100μL CuO@Ag NWs (0.5mg) in EtOH, alcohols (1 mmol), TBHP (2.5 mmol) and a certain solvent (2 mL) were added into the glass reactor. The reactions were took place at a certain temperature under oxygen atmosphere. Resulting product mixtures were analysed by GC-MS (VARIAN 450-GC & VARIAN 240-GC) equipped with a CP8944 capillary column (30 m × 0.25 mm) and a FID detector. All catalytic tests were repeated three times.

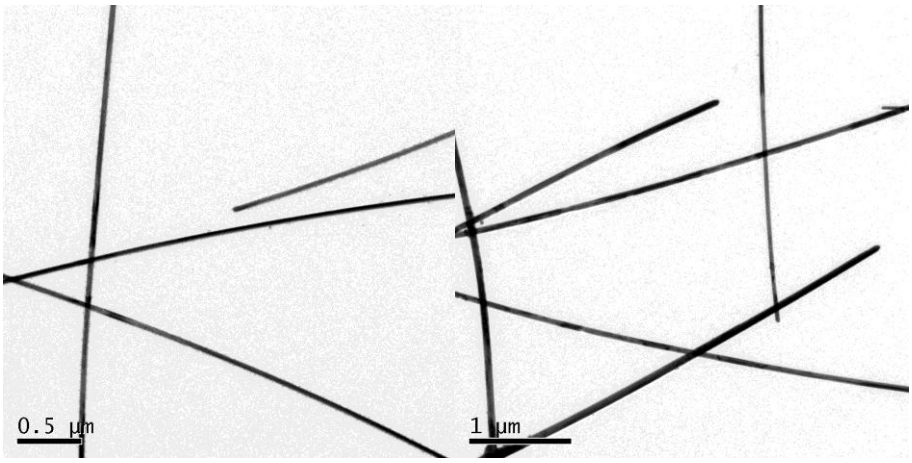


Figure S1 TEM images of Ag Nanowires.

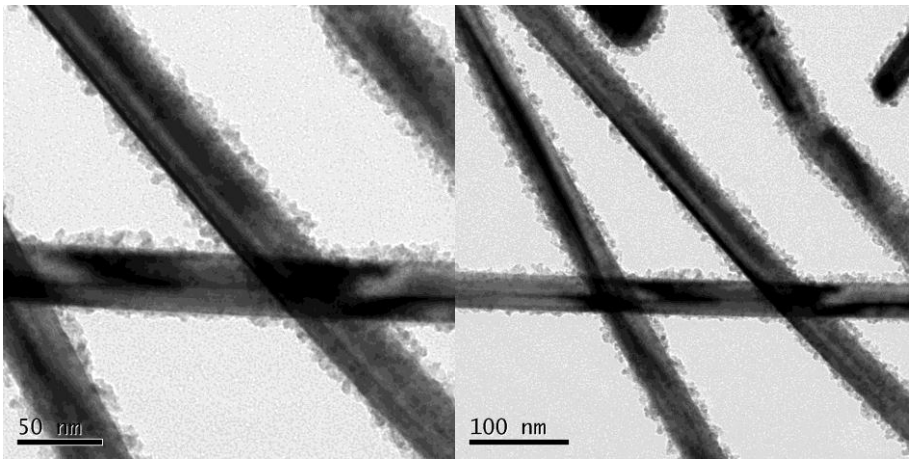


Figure S2 TEM images of CuO@Ag Nanowires.

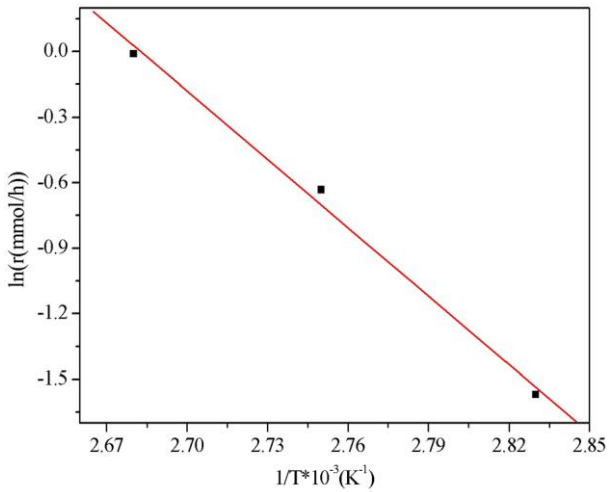


Figure S3 Arrhenius plot of the CuO@Ag NWs under different reaction temperatures.

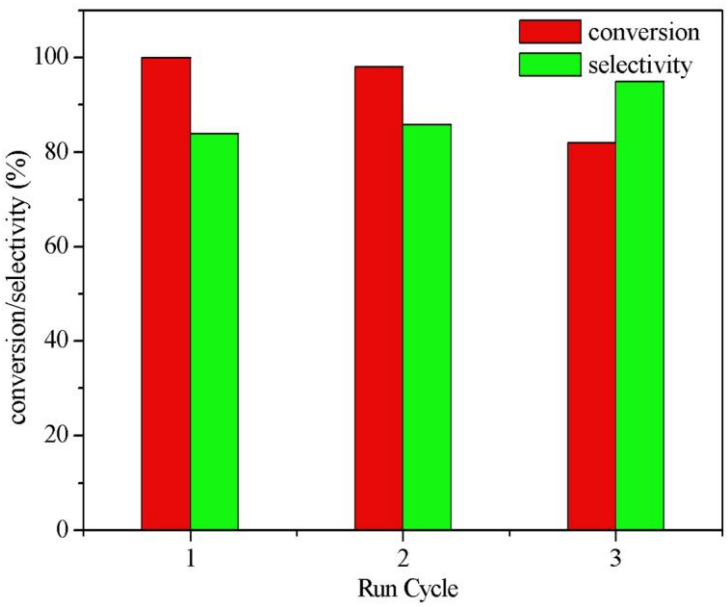


Figure S4 Recovery and reusability of the CuO@Ag NWs for trans-stilbene epoxidation.

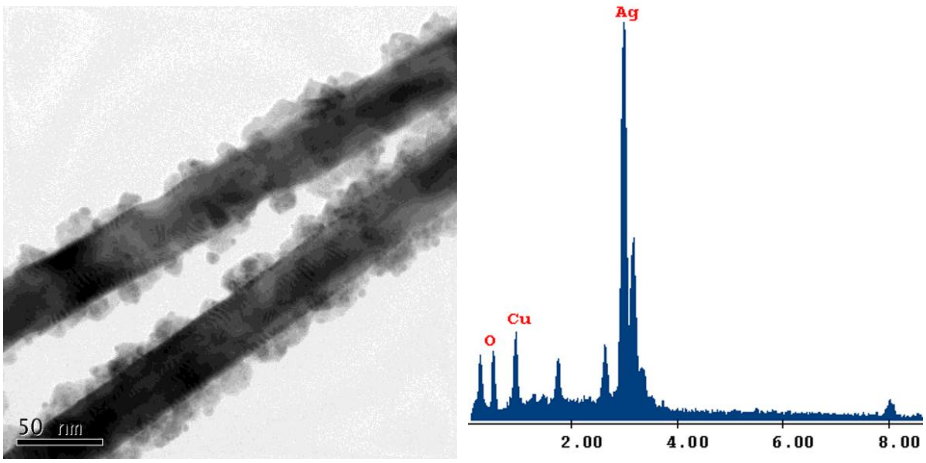


Figure S5. TEM image and EDS of the catalyst separated after 3 cycles of the catalytic reaction.

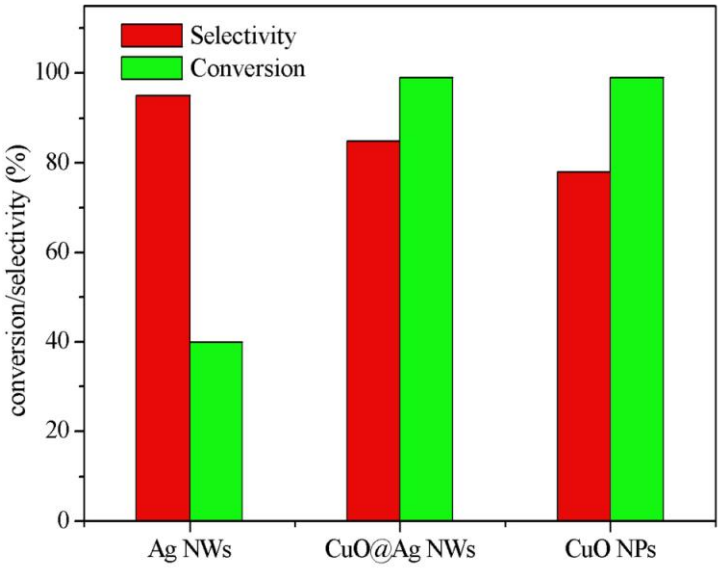


Figure S6. Compared the oxidation activity of CuO@Ag NWs with other catalysts. 1. Ag NWs; 2. CuO@Ag NWs; 3. CuO NPs.

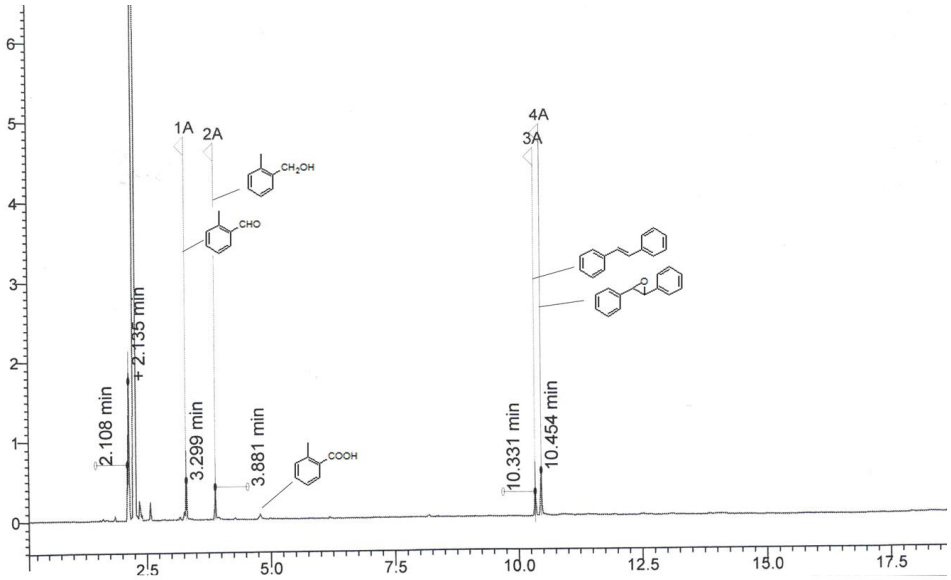
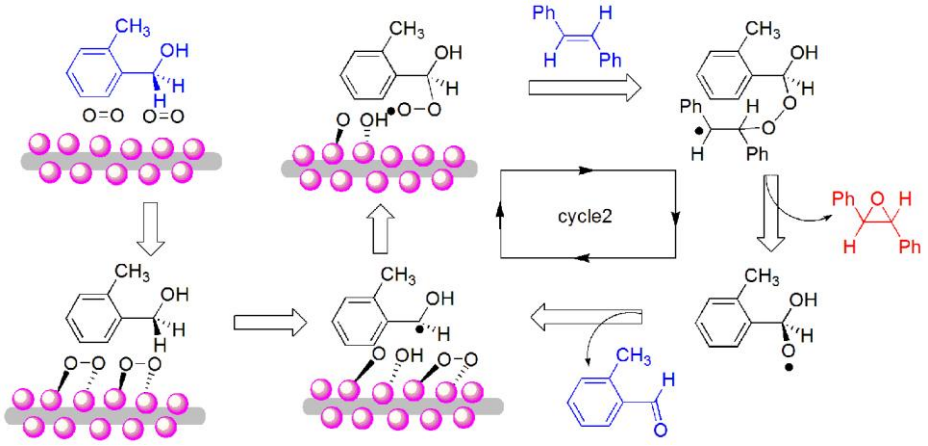
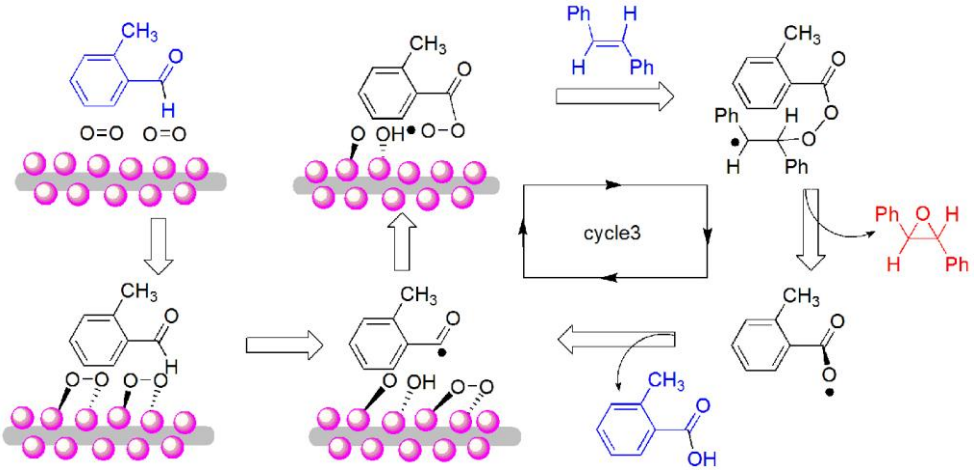


Figure S7. GC analysis of the oxidation of *o*-xylene (A) and *trans*-stilbene (B).



Cycle 2



Cycle 3

Scheme S1 The proposed reaction mechanism

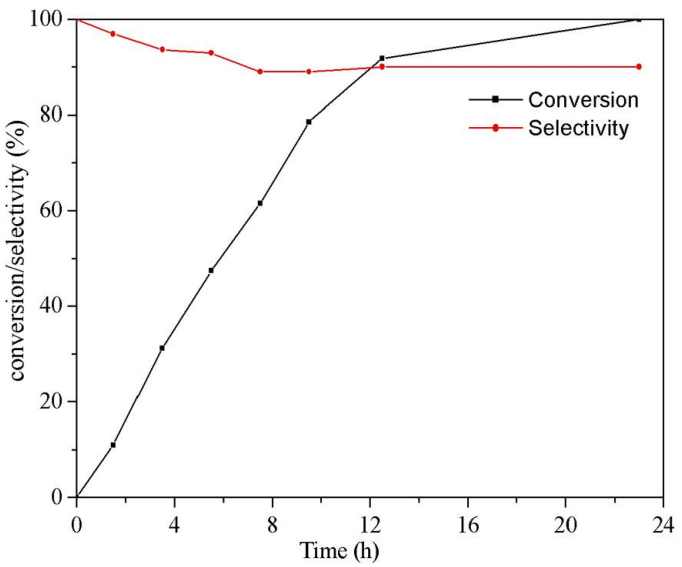
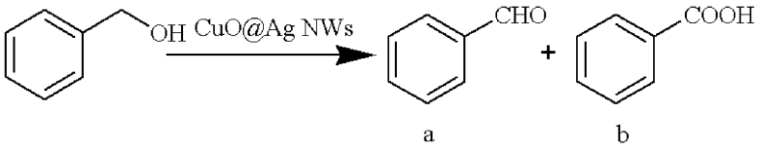


Figure S8. Reaction profile of CuO@Ag NWs catalyzed oxidation

Table S1 Oxidation of benzyl alcohol in different solvents[a]



Entry	Solvent	Conv.(%)[b]	Select.(%)[b]	
			a	b
1	CH_3CN	100	1.6	98.4
2	DMF	45.7	100	0
3	DMSO	35.2	100	0
4	toluene	57.2	90	10

[a] All reactions were carried out with 0.5 mg CuO@Ag NW catalyst, 1.0 mmol alcohol, 2.5 mmol TBHP and 2 mL solvent for 24 h in air. [b] GC yield.

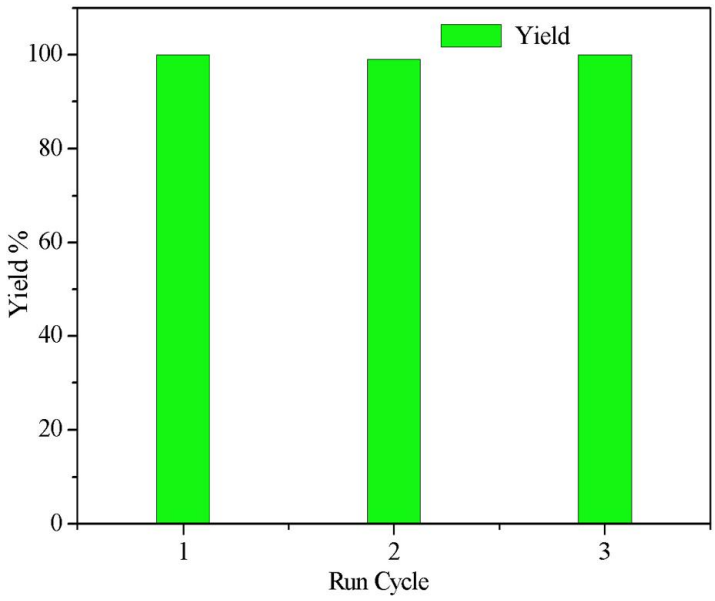


Figure S9 Recovery and reusability of the CuO@Ag NWs for benzyl alcohol oxidation.

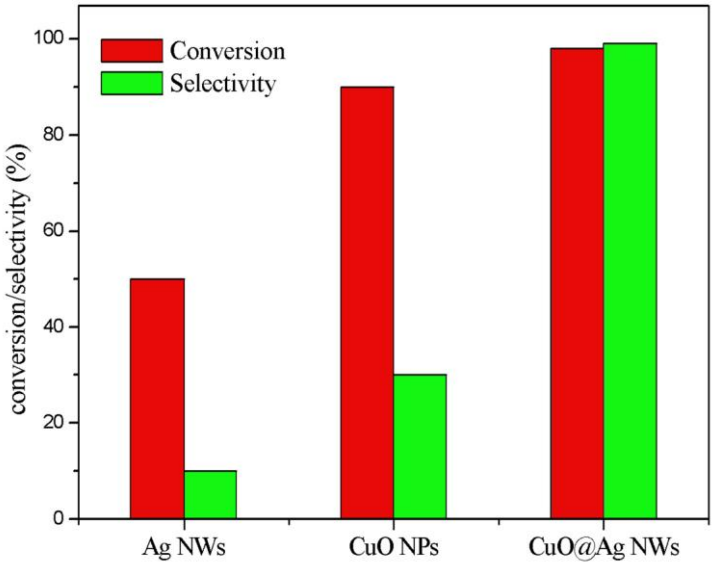


Figure S10. Activity of CuO@Ag NWs (the conversion of benzyl alcohol and the selectivity of benzoic acid) compared with other catalysts 1. Ag NWs; 2. CuO NPs; 3. CuO@Ag NWs