Electronic Supplementary Information

In situ assembly of well-dispersed gold nanoparticles on electrospun silica nanotubes for catalytic reduction of 4-nitrophenol

Zhenyi Zhang,[a] Changlu Shao,*[a] Peng Zou,[a] Peng Zhang,[a] Mingyi Zhang,[a] Jingbo Mu,[ab] Zengcai Guo,[ab] Xinghua Li,[a] Changhua Wang,[a] and Yichun Liu[a]

[a]Center for Advanced Optoelectronic Functional Materials Research, and Key Laboratory of UV Light-Emitting Materials and Technology of Ministry of Education, Northeast Normal University, 5268 Renmin Street, Changchun 130024, People's Republic of China.

[b]Department of Chemistry, Northeast Normal University. People' s Republic of China.

*Corresponding author: Changlu Shao

Center for Advanced Optoelectronic Functional Materials Research, and Key Laboratory of UV Light-Emitting Materials and Technology of Ministry of Education, Northeast Normal University, 5268 Renmin Street, Changchun 130024, People's Republic of China.

E-mail: clshao@nenu.edu.cn; Tel. 8643185098803.

Experimental details

Preperation of silica nanotubes (SNTs):

1.6 g of polyvinylpyrrolidone (PVP) powder (*Mn*= 900 000) was dissolved in 20 ml of ethanol. Then, 3.2 ml of tetraethyl orthosilicate (TEOS) was slowly dropped into above PVP solution to obtain the precursor. After that, the precursor was transferred into a plastic syringe for electrospinning under the voltage of 10 kV. The products were collected at a distance about 10-12 cm to the syringe tip. Afterward, the above composite NTs of PVP/TEOS were calcined at a rate of 25 deg/h and remained for 2 h at 550 ^{o}C. Thus, the catalyst support of SNTs was obtained.

Assembly of well-dispersed gold nanoparticles (AuNPs) on electrospun SNTs:

0.01 g of $SnCl_2$ was dissolved in 20 mL of 5 mM HCl solution. Then, 0.01 g of as-electrospun SNTs was added to above solution and stirred for 6 h at room temperature. After this, the precipitate was recovered by centrifugation, followed by washing with distilled water five times. Thus, the activated SNTs were obtained. Afterward, the activated SNTs were added to 20 mL of 0.05 mM tetrachloroauric acid ($HAuCl_4$) solution under vigorous stirring for about 2 h at room temperature. The color of precipitate changed from white to pink, which implied that the AuNPs/SNTs nanocomposite was formed.

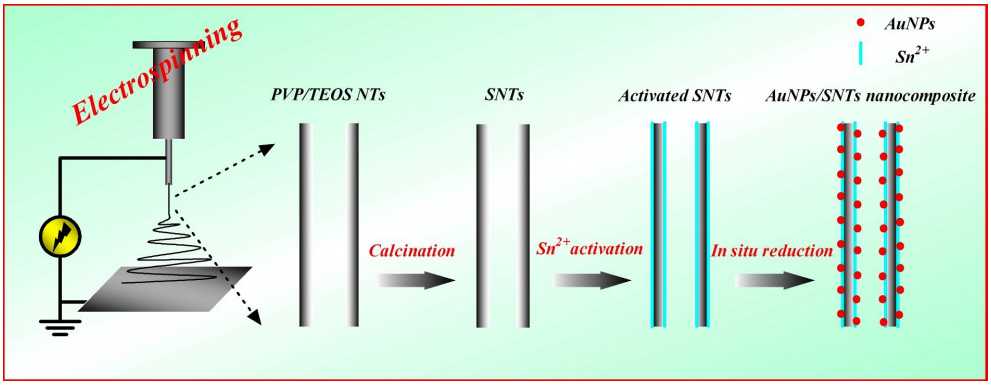
Catalytic reduction of 4-nitrophenol (4-NP):

8 mg of AuNPs/SNTs nanocomposite was added to 30 ml of aqueous 4-NP solution (0.12 mM). Subsequently, the above solution was mixed with 30 ml fresh $NaBH_4$ solution (5 mM). The molar ratios of Au: 4-NP: BH_4^- in the catalytic reaction

was about 1 : 3.6 : 150. The reaction was carried out at room temperature with continuous stirring. Parts of the mixture were taken out after every 70 s and centrifugated for the determination with UV-vis absorption spectra.

Characterization:

UV-Vis absorption spectra were measured at room temperature with a Lambda 900 UV-vis spectrophotometer (Perkin-Elmer). Scanning electron microscopy (SEM; XL-30 ESEM FEG, Micro FEI Philips) and high-resolution transmission electron microscopy (HRTEM; JEOL JEM-2100) were used to characterize the morphologies of the products. X-ray diffraction (XRD) measurements were carried out using a D/max 2500 XRD spectrometer (Rigaku) with a Cu KR line of 0.1541 nm.



Scheme 1. Schematic diagram of the fabrication of AuNPs/SNTs nanocomposite.

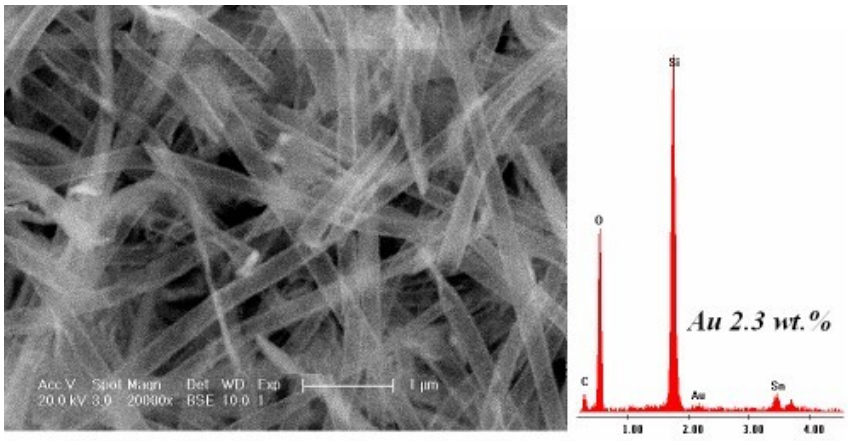


Fig. S1. SEM image of AuNPs/SNTs nanocomposite with well-dispersed distribution of small AuNPs using Backscattered electron (BSE) mode, and the corresponding EDX spectrum.

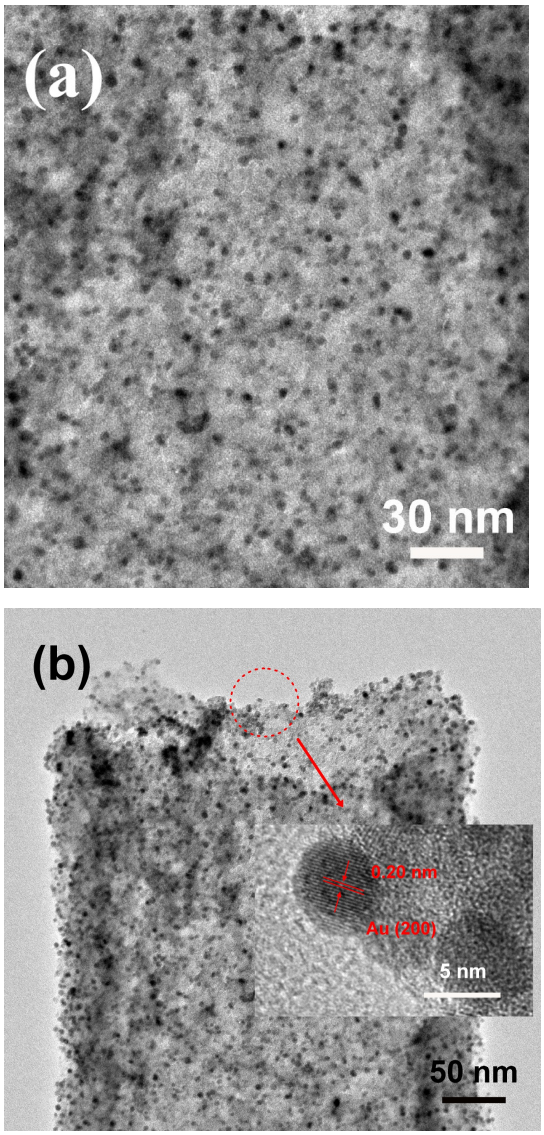


Fig. S2. (a) TEM image of well-dispersed AuNPs with the size of 3-5 nm on the surface of electrospun STs. (b) TEM image of AuNPs/SNTs nanocomposite; the insert was the HRTEM image of AuNP on the inside surface of electrospun SNTs.

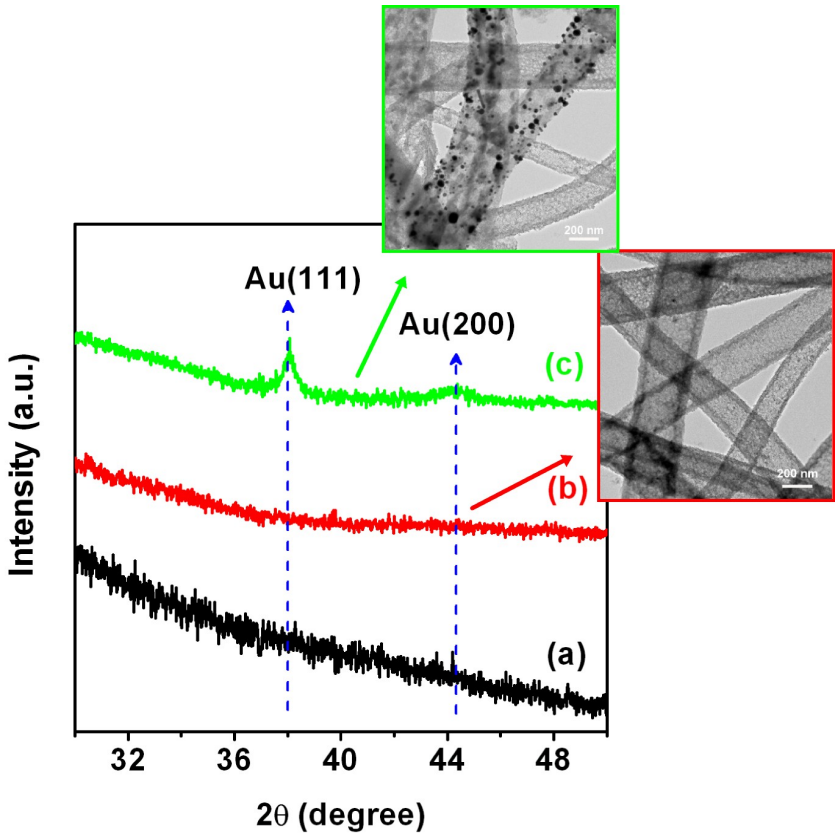


Fig. S3. XRD patterns and the corresponding TEM images of as-prepared products: (a) SNTs; (b) AuNPs/SNTs nanocomposite prepared by low concentration of $HAuCl_4$; (c) AuNPs/SNTs nanocomposite prepared by high concentration of $HAuCl_4$.

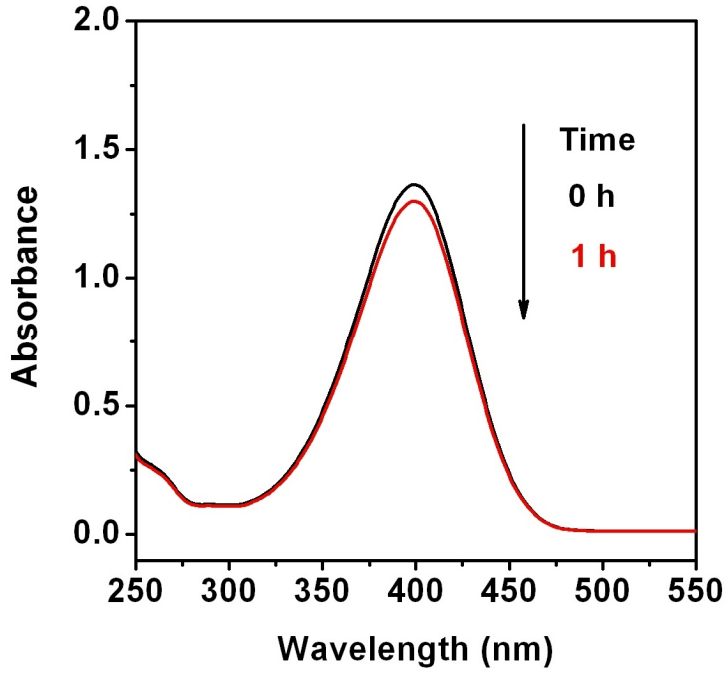


Fig. S4. UV-Vis absorption spectra of 4-NP in the presence of Sn^{2+} activated SNTs and $NaBH_4$ for 1h.