

Electronic Supplementary Information (ESI) for

Hollow Silica Nanostructures with Small Sizes of Au Nanoparticles for Catalytic Applications

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Materials and Methods

All materials were used without further purification. Tetrachloroauric(III) acid($\text{HAuCl}_4 \cdot x\text{H}_2\text{O}$), Sodium borohydride(NaBH_4), 1,3,5-trimethylbenzene (TMB, 98%), (3-aminopropyl) trimethoxysilane (APTMS), tetraethyl orthosilicate (TEOS), and hexadecyltrimethylammonium bromide (CTAB, 99%) were purchased from Sigma Aldrich. Copper specimen grids (300 meshes) with formvar/carbon purchased from Beijing XXBR Technology Co.. Deionized (DI) water (resistance $> 18.2 \text{ M}\Omega\cdot\text{cm}^{-1}$) was used in all of our experiments.

Transmission electron microscopy (TEM) images were taken from a JEM-1400 transmission electron microscopy (JEOL) operated at 100 kV.

The synthesis of hollow silica nanostructure with small size of Au NPs: 4 mg of CTAB was dissolved in 2 mL DI water and 14 μL of NaOH (2M) was added to the solution. It was stirred at 80°C . After 1min, 200 μL TMB was added to the solution in one shot. Followed by 20 μL TEOS and 20 μL APTMS were added to the solution at the same time in 1 minute. 50 μL HAuCl_4 (100 mg/ mL) was added in 5 minutes and 100 μL NaBH_4 (2.5 mg) was added in 30 minutes. The solution was stirred at 80°C for 2 hours.

The catalytic reduction of 4-nitrophenol: NaBH_4 (50 μL , 0.3M) aqueous solution was added to the solution of 4-nitrophenol (450 μL , 0.96 mM), and the solution was degassed. Then, the above solution was transferred in a 0.5 mL quartz cuvette containing Au nanoparticles ($1.676 \times 10^{-6} \text{ mmol}$). At room temperature, the process of the catalytic reaction was monitored by UV-vis spectroscopy recording a spectrum every 2 min.

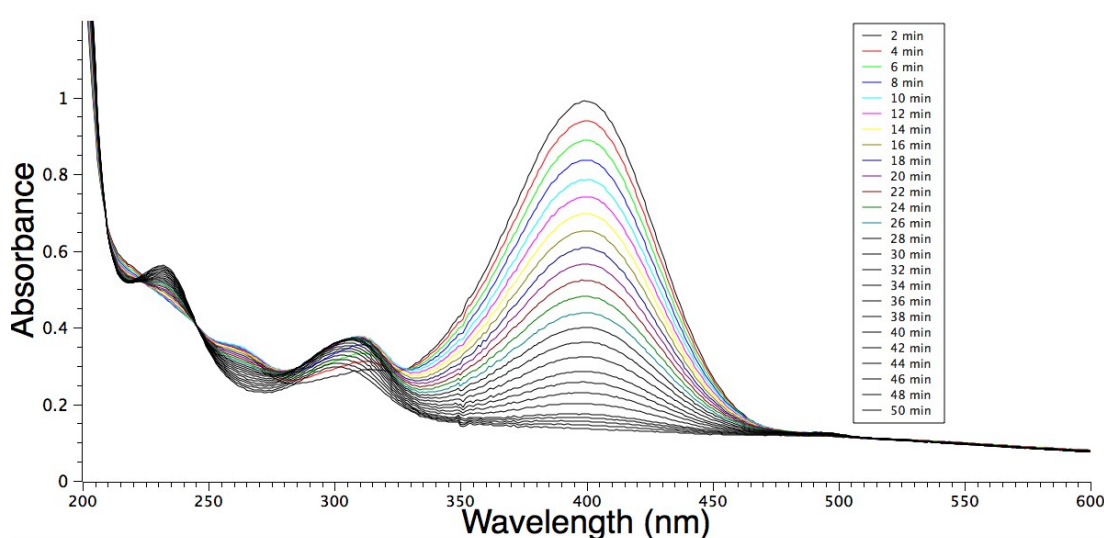


Figure S-1. The UV spectrum of the reduction reaction of 4-nitrophenol to 4-aminophenol by using Au / solid silica nanostructures as a catalyst.

Table S-1 The table of the turnover frequency (TOF) in the reduction of 4-nitrophenol as reported in the literature

	This work (Hollow)	This work (Au/Solid silica)	Chem.Comm . 2012, 1108	Angew. Chem. Int. Ed. 2008, 8924.	Inorg. Chem. 2011, 50, 8038	J. Phys. Chem. C 2007, 111, 4596	Adv. Mater. 2014, 26, 4151
TOF(/s)	0.09	0.03	0.03	0.02	0.07	0.02	0.09

The TOF is defined as the number of moles of reduced 4-nitrophenol per mole Au nanoparticles per second. It was based on the total amount of Au in the system, not the amount of surface atoms.

Reference:

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