Electronic Supplementary Information (ESI) for

Architecture yolk-shell structured mesoporous silica nanospheres for catalytic applications

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Experimental

Synthesis of PMO or Au nanoparticles

The periodic mesoporous organosilica (PMO) or Au nanoparticles were prepared according to the reported method.^{1, 2}

In a typical synthesis of PMO nanoparticles: 0.21 g of CTAB, 97.4 ml of water and 2.6 ml of ammonia (27 wt%, aqueous solution) were mixed and stirred for 10 min to form a clear solution at room temperature. This solution was heated in an oil bath to 50 °C, and 0.32 g of bis(triethoxysilyl)ethane was added under stirring. The product was collected by centrifugation.

For Au nanoparticles: 70.8 mL of water and 8.3 mL of 2.54×10^{-3} M HAuCl₄ solution were mixed, and vigorously stirred under reflux. The solution was stirred until boiling point was reached again. Then, 4.16 mL of 10 mg mL⁻¹ sodium citrate solution was added and the system was refluxed for 30 min. Finally, the resultant colloid was cooled to room temperature. Then, the solution was centrifuged (15,000 rpm; 20 min) and the supernatant was removed.

The prepared PMO nanoparticles were redispersed with 5 ml ethanol solution and Au nanoparticles were redispersed with 2 ml water.



Figure S1. The SEM and TEM images of (a), (b) and (c) PMO nanoparticles; (d) Au nanoparticles.



Figure S2. Powder XRD pattern of Au@SiO₂ nanoparticles.



Figure S3. Hydrodynamic diameters of hybrid Au/SiO₂ nanospheres and Au@SiO₂ nanoparticles.



Figure S4. Time-dependent UV-vis absorption spectral changes of the reaction mixture for (a) 4nitrophenol and (b) nitrobenzene reduced by sodium borohydride using Au@SiO₂ nanoparticles as catalysts.

Table S1. Comparison of the catalytic activity of $Au@SiO_2$ nanoparticles with reported Au-based catalysts for the reduction of 4-nitrophenol.

Catalysts	Annarent rate	References
Catalysts	Apparent late	Kererences
Au@SiO ₂	0.52 min ⁻¹	This work
Au@SiO ₂ -0.6-c	0.144 min ⁻¹ ($2.4 \times 10^{-3} \text{ s}^{-1}$)	J. Mater. Sci., 2018, 53, 8086-8097
AuNPs/SNTs	0.638 min ⁻¹ (10.64×10 ⁻³ s ⁻¹)	Chem. Commun., 2011, 47, 3906-3908
YS-Au@Ph-PMOs	$0.3 \min^{-1} (5 \times 10^{-3} \text{ s}^{-1})$	J. Mater. Chem. A, 2014, 2, 12403-12412
Au@SiO ₂	0.2696 min ⁻¹	ACS Catal., 2017, 7, 5391-5398
Fe ₃ O ₄ @SiO ₂ -	0.35 min ⁻¹	J. Am. Chem. Soc., 2010, 132, 8466-8473
Au@mSiO ₂		
Au@SiO ₂	$0.234 \text{ min}^{-1} (3.9 \times 10^{-3} \text{ s}^{-1})$	Adv. Mater., 2008, 20, 1523-1528
Au-Fe ₃ O ₄	0.78 min ⁻¹	Appl. Catal. A Gen., 2014, 486, 32-41
AuNPs/uTiO ₂	0.6326 min ⁻¹	Mater. Design, 2017, 121 , 167-175



Figure S5. The SEM and TEM images of (a) and (b) PMO-NH₂@SiO₂-SO₃H nanoparticles.



Figure S6. Hydrodynamic diameters of PMO-NH₂@SiO₂-SO₃H nanoparticles.



Figure S7. SXRD pattern of PMO-NH₂@SiO₂-SO₃H nanoparticles.

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