Electronic Supplementary Information (ESI)

Interparticle coupling effect of gold nanoparticles in confined ordered mesopores enhances high temperature catalytic oxidation

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Synthesis of silica supports:

For the synthesis of EP-FDU-12, 0.50 g of Pluronic F127, 0.60 g of 1,3,5-trimethylbenzene (TMB) and 1.25 g of KCl were dissolved in 30 ml of 2 M HCl at 14 ± 0.1^{o}C. After 1 h stirring, 2.08 g of TEOS was added to this solution. The synthesis composition (in molar ratio) F127/KCl/TEOS/TMB/HCl/H_2O was 0.00256/1.083/0.645/0.323/3.87/100. After stirring for 24 h at 14 ^{o}C, the mixture was transferred into an autoclave and heated at 100 ^{o}C for 24 h. Then the products was obtained by filtration and dried at room temperature in air. The organic templates were removed by microwave digestion.

Synthesis of AuNPs and AuNPs/EP-FDU-12:

In a typical synthesis, 100 mg of $AuPPh_3Cl$ was mixed with 400 µL of dodecanethiol in 20 mL of benzene to form a clear solution, to which 84 mg of $NaBH_4$ was then added in one portion. The mixture was heated with stirring at 55 ^{o}C for 7 h before the reaction system was cooled to room temperature. AuNPs were precipitated out from the reaction mixture as black solid powders by addition of 20 mL of ethanol. The precipitate was separated by centrifuge, washed with ethanol. Finally, the precipitate was dried naturally. AuNPs was loaded into EP-FDU-12 by a colloid deposition method. Desired amount of AuNPs were dissolved in 25 ml of chloroform. To this solution, desired amount of EP-FDU-12 was added. After 30 min stirring, the solid product was centrifuged and dried in air. The AuNPs/EP-FDU-12 was calcined at 350 ^{o}C~650 ^{o}C for 5 h (in air) to evaluate their anti-sintering properties and catalytic performances.

Measurement and Characterization:

Transmission electron microscopy (TEM) images were recorded on a JEOL JEM-1230 operated at 100 kV. The sample was embedded in epoxy resin, and then microtomed into sub-100-nm ultra thin film at room temperature. These thin film samples floated on water or other solvents were collected by copper mesh with polymer micro grid for TEM imaging. SERS spectra were collected by Renishaw inVia Raman microscope at room temperature through 50X objective of a Leica DM13000M microscope. We used a wavelength of 633 nm HeNe laser as excitation. The output power supplied to 4-MBA on AuNPs/EP-FDU-12 was 0.95 mW. The exposure time is 5 s and the number of acquisition is 1. Raman mapping was carried on Renishaw inVia Raman microscope at room temperature through 50X objective of a Leica DMLM microscope, which 0.6 mW of output power was supplied to the samples with a wavelength of 633 nm HeNe laser as excitation. The exposure time is 5 s and the number of acquisition is 1.

Catalytic oxidation of CO:

30 mg of catalyst was packed into a quartz tube (i.d. = 4 mm) sealed by quartz wool, a gas stream of 1% CO (balance air,) flowed through the catalyst at a rate of 10 mL/min, and the exiting stream was analyzed by a gas chromatograph equipped with a dual molecular sieve/porous polymer column and a thermal conductivity detector.

The reaction temperature was varied using a furnace.

Catalytic oxidation of cyclohexanol:

The oxidation of cyclohexanol was carried out in a fixed bed vertical glass reactor (h = 250 mm, d = 12 mm), fitted with a glass frit carrying the catalyst mixed with quartz sand and provided with an electronically controlled furnace. The oxygen stream (8 mL/min) was controlled by a mass flow instrument and the liquid reagent (0.9 mL/h) was supplied through a syringe pump. Liquid vaporization occurred on the reactor wall prior to the catalytic bed. The products were analyzed by GC. The selectivity was calculated as mol of produced cyclohexanone per mol of reacted cyclohexanol and the carbon mass balance > 99 % in the case of selectivity > 99.5%.

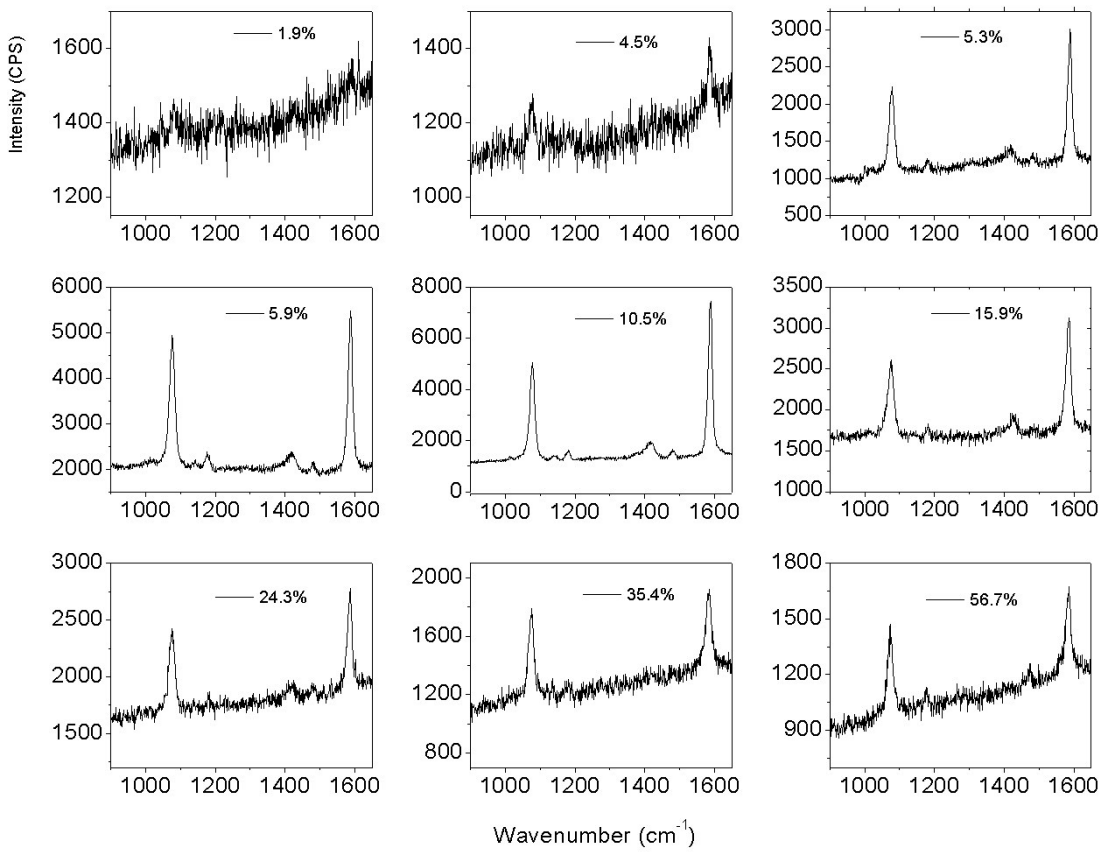

Fig. S1 Raman spectra of 4-MBA on 10.5 wt% AuNPs/EP-FDU-12 with different gold loading.