Supporting information for the manuscript

Synergistic effect in an Au-Ag alloy nanocatalyst: CO oxidation

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The following figures give data that are not printed in the main paper. But they are mentioned in the text of the paper.

1. Textural properties of Au-Ag@MCM catalysts

Table S1 lists the textural properties of Au-Ag@MCM catalysts

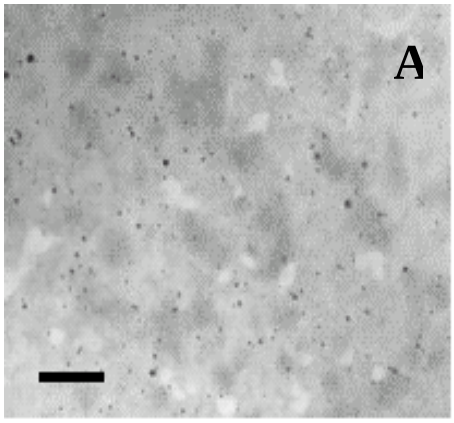
Au/Ag (molar ratio)	Au/Ag by EDX (molar ratio)	Au/Ag by XPS (molar ratio)	Pore size (nm)	Pore volume (cm^3/g)	BET surface area (cm^3/g)	Particle size (nm)[a]	Particle size (nm)[b]
1:0	1:0	1:0	2.38	1.61	836	7.0	6.7
5:1	5.28:1	-	2.39	1.85	812	19.7	32.3
3:1	3.19:1	0.75:1	2.35	1.70	844	21.5	33.7
1:1	1.38:1	0.43:1	2.38	1.96	862	26.0	52.3
0:1	0:1	0:1	2.33	2.00	901	-	-

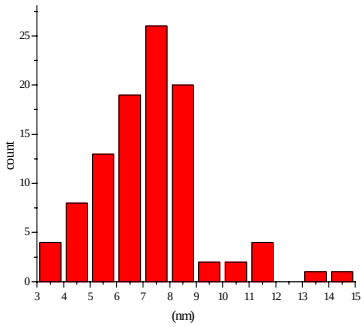
[a] Estimated by XRD according to Scherrer's equation

[b]Obtained from TEM

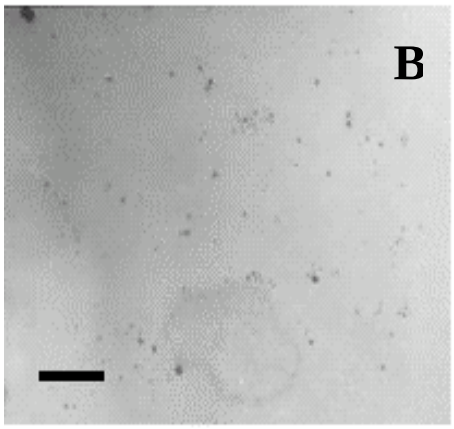
2. TEM of Au-Ag nanoparticles in colloid solution

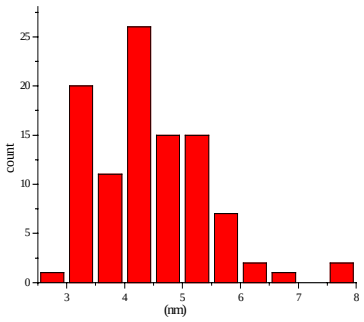
The particle size and size distribution of Au-Ag nanoparticles in colloid solution were determined by TEM, as illustrated in Figure S1. The average particle size are all below 10nm.



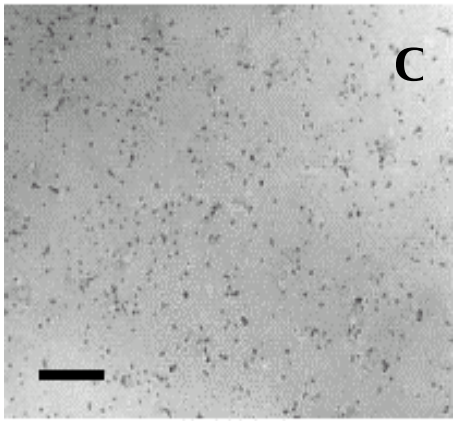


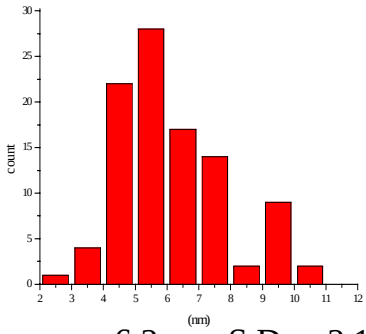
average = 7.2 nm, S.D. = 2.1





average = 4.5 nm, S.D. = 1.0 nm





average = 6.2 nm, S.D. = 2.1 nm

Figure S1. TEM images and corresponding size distribution of colloid (A) pure gold, (B) Au-Ag alloy with molar ratio of 1:1, (C) pure silver. Scale bar = 100 nm.

3. UV-vis spectra of Au-Ag@MCM with different Au/Ag molar ratios after calcination and reduction

Figure S2 shows the UV-vis spectra of the samples after calcination and reduction. All the spectra of bimetallic catalysts have only one absorption band between pure gold and pure silver catalyst, confirming the Au-Ag alloy formation.

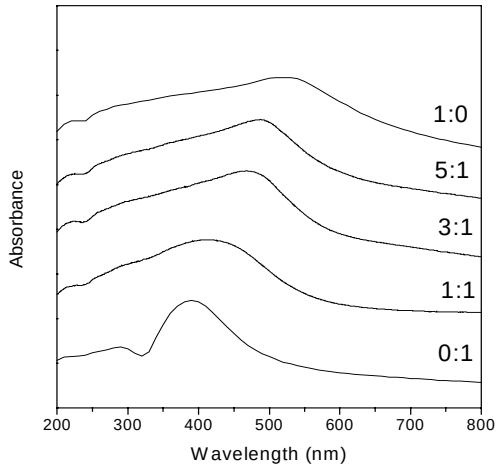


Figure S2. UV-Vis spectra of the Au-Ag@MCM after calcination and then reduction treatment.

4. XPS results

Table S2 shows the XPS results of the reduced catalysts with different Au/Ag ratios. It is clear that both Au and Ag are in metallic state. Moreover, Au_{4f} binding energies shifted to higher values compared to pure Au@MCM, whereas Ag_{3d} binding energies shifted to lower values compared to pure Ag@MCM, implying that there is charge transfer between Au, Ag and the support. In addition, no traces of bromine was found on all the samples by XPS, indicating that after reduction by H_2, Br was completely removed and Au-Ag alloy was formed again.

Table S2 Binding energies and surface compositions of reduced catalysts

Nominal Au/Ag (molar)	$Au4f_{7/2}$ (eV)	$Au4f_{5/2}$ (eV)	$Ag3d_{5/2}$ (eV)	$Ag3d_{3/2}$ (eV)	Surface composition (molar)		
					Au/Si	Ag/Si	Au/Ag
1/0	83.4	87.2			0.0274	0	∞
1/1	83.8	87.5	368.2	374.2	0.0111	0.0255	0.43
3/1	83.6	87.3	368.0	374.0	0.0165	0.0221	0.75
0/1			368.5	374.5	0	0.0500	0