



Supplementary Materials

Metal-support synergy of supported gold nanoclusters in selective oxidation of alcohols

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Fig. S1. (a) N₂ adsorption/desorption isotherms and (b) pore size distributions of different supports: (1) ZnAl-300; (2) ZnO-300; (3) MgAl-300; (4) MgO-300; (5) Al₂O₃-300; (6) SiO₂-300.

Entry	Sample	Sbet (m²/g) ª	V _{micro} (cm ³ /g) ^a	D _{pore} (nm)	
1	MgAl-300	115.3	0.6	26.4	
2	ZnAl-300	108.	0.2	27.4	
3	MgO-300	5.2	0.01	26.4	
4	ZnO-300	3.8	0.01	26.4	
5	Al ₂ O ₃ -300	217.4	0.3	6.1	
6	SiO2-300	348.0	0.6	6.8	

Table S1. Physicochemical properties of different supports.

^a The specific surface area and pore structure were evaluated by N₂-physical adsorption-desorption test.



Fig. S2. XRD patterns of different supports; (a) MgAl-300; (b) MgO-300; (c) ZnAl-300; (d) ZnO-300; (e) Al₂O₃-300; (f) SiO₂-300.



Fig. S3. HRTEM images of different supported gold catalysts; (a) Au₂₅/MgAl-300; (b) Au₂₅/MgO-300; (c) Au₂₅/ZnAl-300; (d) Au₂₅/ZnO-300; (e) Au₂₅/Al₂O₃-300; (f) Au₂₅/SiO₂-300.



Fig. S4. XPS spectra of O 1s on different supported gold catalysts; (a) Au₂₅/ZnAl-300; (b) Au₂₅/ZnO-300; (c) Au₂₅/MgAl-300; (d) Au₂₅/MgO-300; (e) Au₂₅/Al₂O₃-300; (f) Au₂₅/SiO₂-300.

Table S2. The adsorption quantities of CO_2 , NH ₃ and O ₂ over different supported	i gold	l catalys	sts
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Entry	Sample	Total basicity	Total acidity	Total adsorption
		(µmol CO2/g _{cat}) ^a	(µmol NH3/g _{cat}) ^b	(µmol O2/g _{cat}) ^c
1	Au25/MgAl-300	1130	960	50
2	Au25/ZnAl-300	310	150	11
3	Au25/MgO-300	90	50	18
4	Au25/ZnO-300	10	100	15
5	Au25/Al2O3-300	460	1020	16
6	Au25/SiO2-300	20	250	11

^a The total basicity was calculated by CO₂ pulse adsorption test; ^b The total acidity was calculated by NH₃ pulse adsorption test; ^c The total adsorption of O₂ was measured by O₂ pulse adsorption test.



Fig. S5. TEM image and size distribution histogram of 1.1% Au₂₅/MgAl-300 catalyst.



Fig. S6. TEM images and size distribution histograms of gold catalysts with different preparation methods; (a) Au/MgAl-300-IMP; (b) Au/MgAl-300-DP.



Fig. S7. The reusability of $Au_{25}/MgAl-300$ catalyst in benzyl alcohol oxidation. BZ: benzaldehyde; BO: benzyl benzoate. The recycle experiments were conducted at the following reaction conditions: catalyst: 100 mg; substrate: 1 mmol; solvent: 10 mL of toluene; reaction temperature: 80 °C; O₂ pressure: 1 atm; flow rate: 30 mL/min; reaction time: 2 h. After each test, the catalysts were collected and separated from the products, and new reaction mixture were added to the reactor to proceed the next experiment run.



Fig. S8. The TEM images and size distributions of $Au_{25}/MgAl-300$ catalyst after reusing three times in benzyl alcohol oxidation.