catalysts

MDPI

Supplementary Materials

Efficient Synthesis of Methyl Methacrylate by One Step Oxidative Esterification over Zn-Al-Mixed Oxides Supported Gold Nanocatalysts

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This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Table S1. Summarization of catalytic performances of supported gold catalysts for one-step oxidative esterification from MAL and methanol in recent years.

Entry	Catalysts	Au (mol%)	T (K)	P_{O2} (atm)	CH_3OH /MAL	t (h)	Conv. (%)	Sel. (%)	Ref.
1	$AuNiO_x/SiO_2{-}Al_2O_3$	0.1	333	2	16	2	63	97	[1]
2	Au/MgO	0.1	343	2	40	2	98	99	[2]
3	Au/N-HAP	0.2	343	1	20	2	87	99	[3]
4	Au/ZnO	0.2	343	2	30	2	99	86	[4]
5	$Au/Ce_{0.6}Zr_{0.4}O_2$	0.1	353	3	25	2	99	74	[5]
6	Au/La_2O_3	0.08	343	3	8	2	89	98	[6]
7	$Au/MnCeO_x$	0.1	353	3	20	2	99	90	[7]
8	Au/PNCM-12	-	353	3	10	2	98	82	[8]
9	$AuCeO_2/\gamma\text{-}Al_2O_3$	0.1	343	2	20	2	97	90	[9]
10	$Au_{25}/Zn_2Al\text{-}400$	0.1	353	3	23	2	93	95	This work

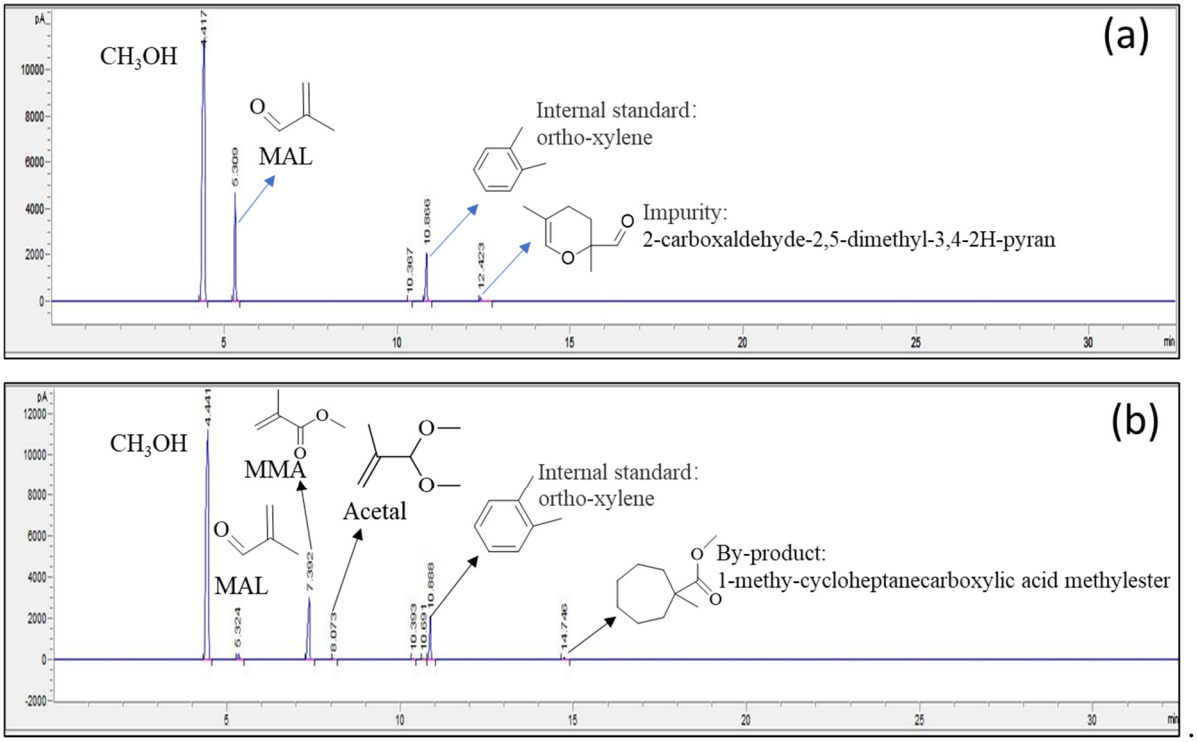

Figure S1. Chromatogram analysis of liquid product (**a**) before and (**b**) after oxidative esterification between MAL and CH_3OH (CH_3OH was also the solvent), with ortho-xylene as the internal standard.

Table S2. Element contents of supported gold catalysts with various Zn/Al molar ratios.

Entry	Catalyst	Content (wt%)			Theoretical molar ratio of Zn/Al	Actual molar ratio of Zn/Al
		Zn	Al	Au		
1	Au_{25}/Zn_3Al-400	26.6	3.3	1.3	3	3.3
2	Au_{25}/Zn_2Al-400	32.2	5.6	1.2	2	2.4
3	Au_{25}/Zn_1Al-400	21.0	7.4	1.3	1	1.2

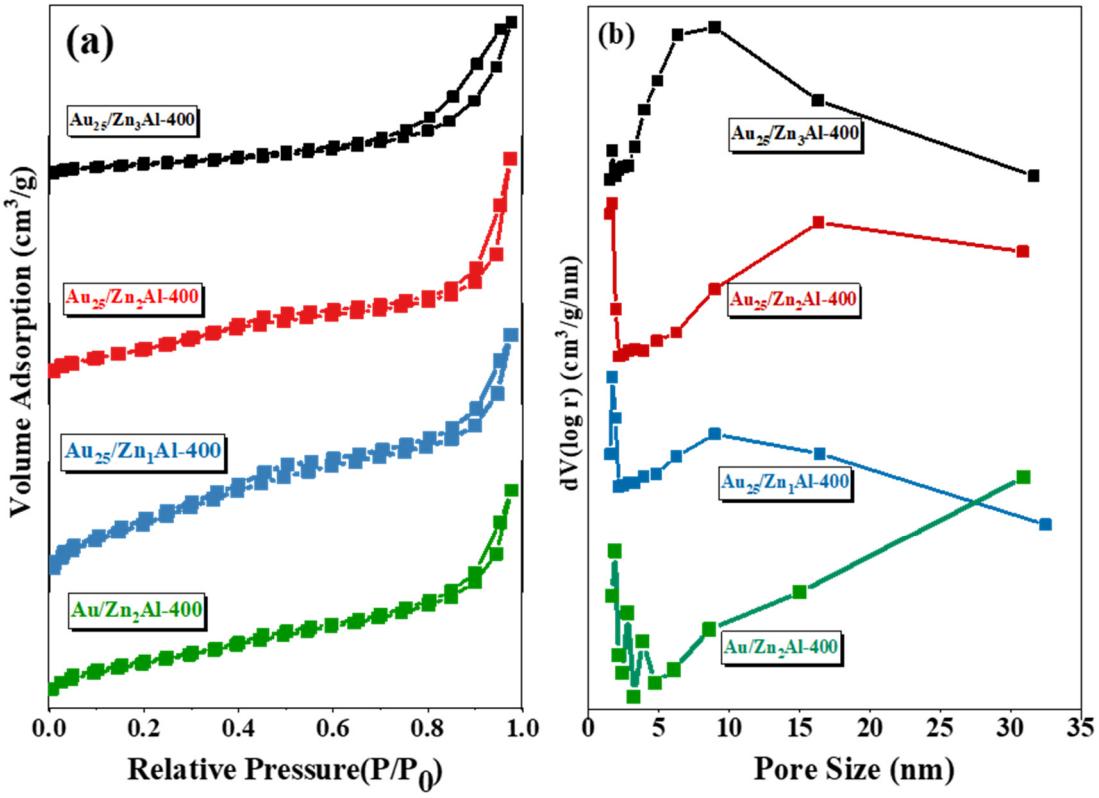

Figure S2. (**a**) N_2 adsorption–desorption isotherms and (**b**) BJH pore size distributions of the supported gold catalysts.

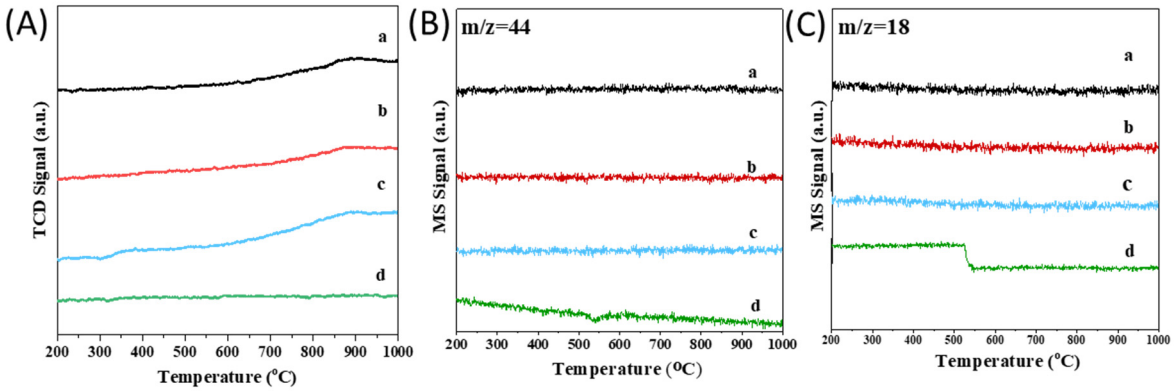

Figure S3. TPD profiles of supported gold catalysts without adsorption of CO_2: a. Au_{25}/Zn_3Al-400; b. Au_{25}/Zn_2Al-400; c. Au_{25}/Zn_1Al-400; d. Au/Zn_2Al-400, with (**A**) TCD signal and MS signal of (**B**) CO_2 and (**C**) H_2O.

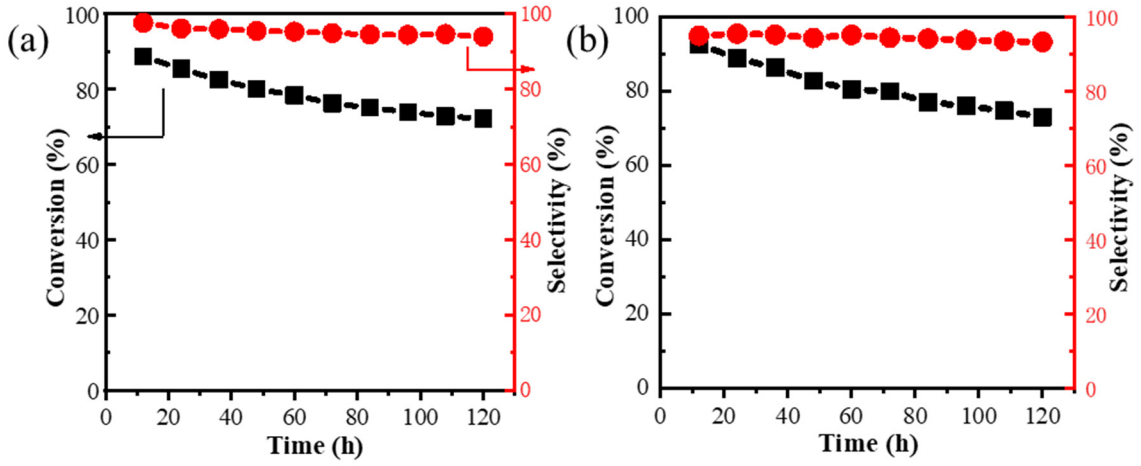

Figure S4. Stabilities of supported gold catalysts with various Zn/Al ratios for synthesis of MMA from MAL and MeOH: (**a**) Au_{25}/Zn_3Al-400; (**b**) Au_{25}/Zn_1Al-400. Reaction conditions: V(MAL)/V(MeOH) = 5/100, catalyst 0.5 g, T = 353 K, P = 30 atm (7%O_2/93%N_2), GHSV: 300 h^{-1}, LHSV:10 h^{-1}.

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