Electronic Supplementary Information

One-pot synthesis of finely-dispersed Au nanoparticles on ZnO hexagonal sheet for base-free aerobic oxidation of vanillyl alcohol

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Table S1. Kinetic data of the base-free aerobic oxidation of vanillyl alcohol to vanillin over Au/ZnO catalysts

	Au/ZnO-MZ			Au/ZnO-Et_3N			Au/ZnO-NH_3			Au/ZnO-NaOH		
T (K)	383	393	403	383	393	403	383	393	403	383	393	403
Conv. (%)	15.8	31.5	56	3.5	9.9	24.6	0.9	3.1	7.6	0.3	1.4	3.9
k (s^{-1})	4.5E-05	1.1E-04	2.3E-04	9.9E-06	2.9E-05	7.8E-05	4.9E-06	1.6E-05	4.0E-05	1.0E-06	3.8E-06	1.1E-05
1000/T (K^{-1})	2.61	2.54	2.48	2.61	2.54	2.48	2.61	2.54	2.48	2.61	2.54	2.48
ln$k$	-10	-9.1	-8.4	-11.5	-10.4	-9.5	-12.2	-11.0	-10.1	-13.8	-12.5	-11.4

Reaction conditions: vanillyl alcohol, 1 mmol; catalysts, 50 mg; *p*-xylene, 10 mL; O_2, 5 bar; time, 1 h. The rate constant (k) was calculated by $\ln C_0/\ln C_t = kt$. The apparent activation energy (E_a) was calculated based on the arrangement of Arrhenius equation, $E_a = -R\mathrm{dln}k/\mathrm{dln}(1/K)$.

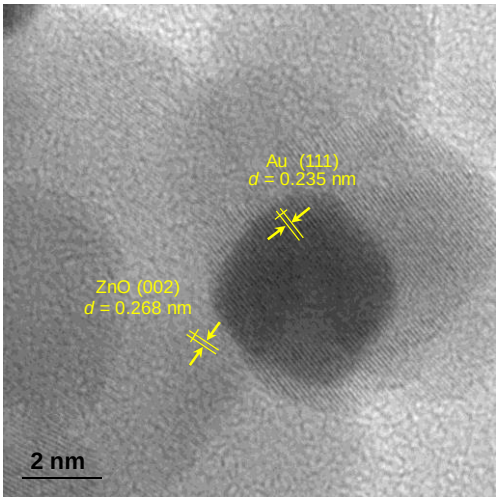

Fig. S1 High-resolution TEM image with marks of the lattice fringes for the Au/ZnO-MZ catalyst.

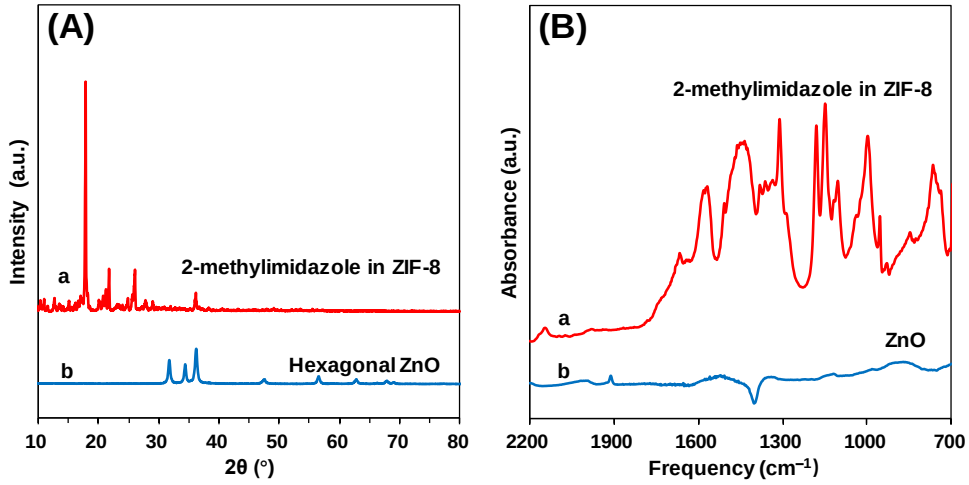

Fig. S2 (A) PXRD patterns and (B) FT-IR spectra of (a) the Au/ZnO-MZ precursor and (b) the Au/ZnO-MZ catalyst.

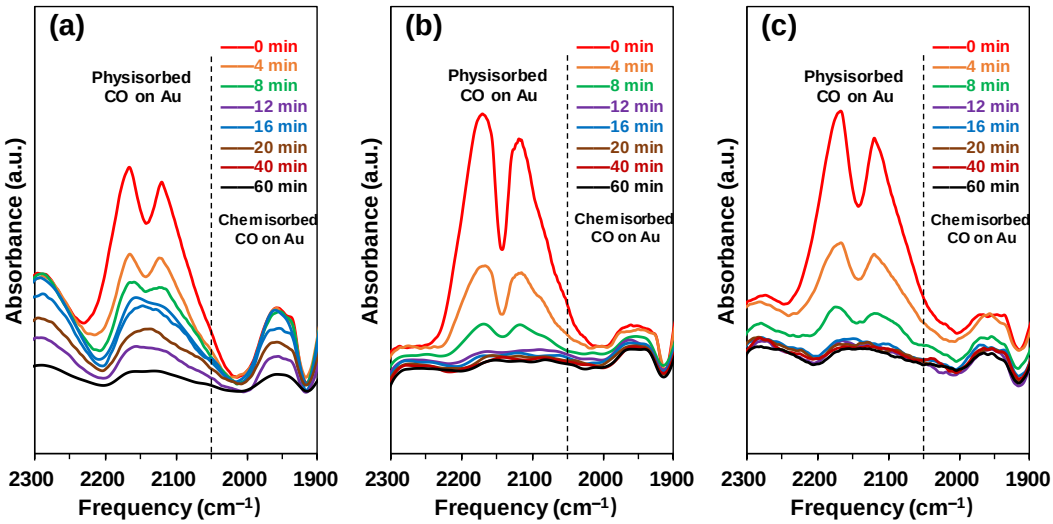

Fig. S3 Time-resolved DRIFT-IR spectra of CO adsorption for the (a) Au/ZnO-NaOH, (b) Au/ZnO-Et_3N, and (c) Au/ZnO-NH_3 catalysts.

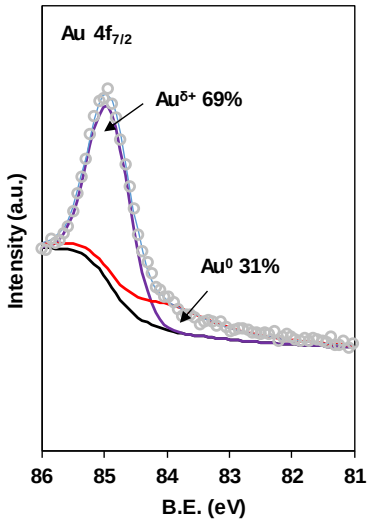

Fig. S4 Deconvoluted XPS spectrum of Au $4f_{7/2}$ core level for the Au/ZnO-MZ catalyst after O_2 treatment at 300 °C for 0.5 h.

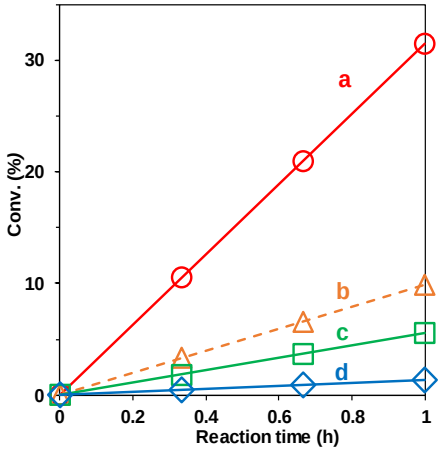

Fig. S5 Conversion of vanillyl alcohol during the initial stage of the base-free aerobic oxidation over the (a) Au/ZnO-NaOH, (b) Au/ZnO-Et_3N, (c) Au/ZnO-NH_3, and (d) Au/ZnO-MZ catalysts. Reaction conditions: vanillyl alcohol, 1 mmol; catalyst, 50 mg; *p*-xylene, 10 mL; O_2, 5 bar; temperature, 120 °C.

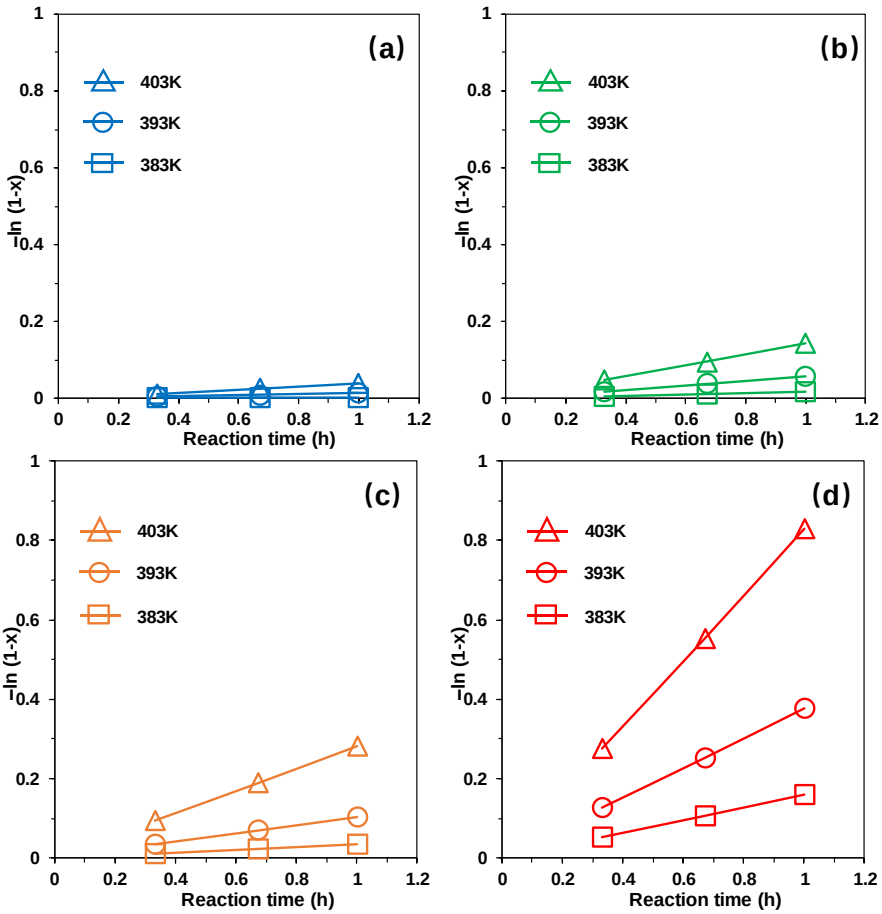

Fig. S6 Kinetic profiles of the (a) Au/ZnO-NaOH, (b) Au/ZnO-Et_3N, (c) Au/ZnO-NH_3, and (d) Au/ZnO-MZ catalysts during the base-free aerobic oxidation of vanillyl alcohol. Reaction conditions: vanillyl alcohol, 1 mmol; catalyst, 50 mg; *p*-xylene, 10 mL; O_2, 5 bar.

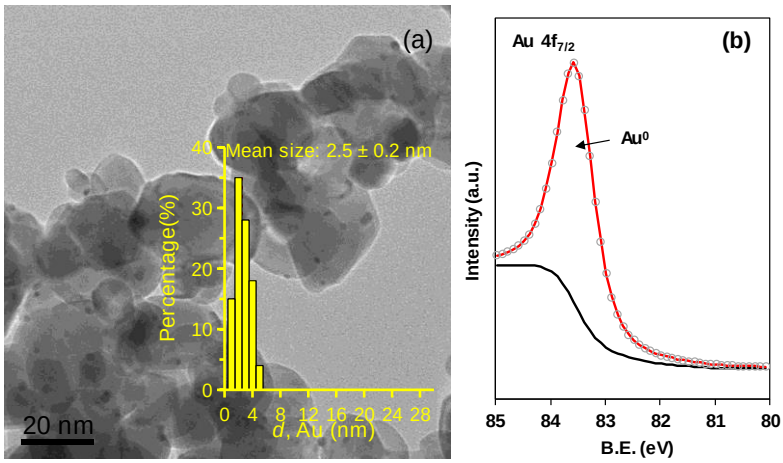

Fig. S7 (a) TEM image with insertion of size distribution of Au nanoparticles and (b) XPS spectrum of Au $4f_{7/2}$ core level for the used Au/ZnO-MZ catalyst.