

Electronic Supplementary Information

Gold nanobipyramid doped with Au/Pd alloyed nanoclusters for high efficiency ethanol electrooxidation

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Supplementary figures

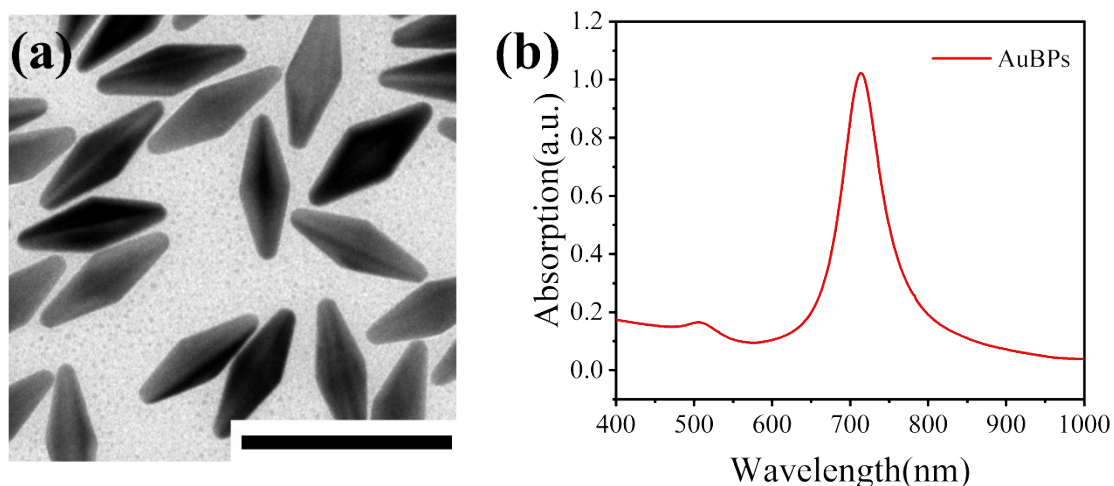


Fig. S1 (a) TEM image and (b) corresponding optical spectrum of the AuBPs (Scale bars: 100 nm)

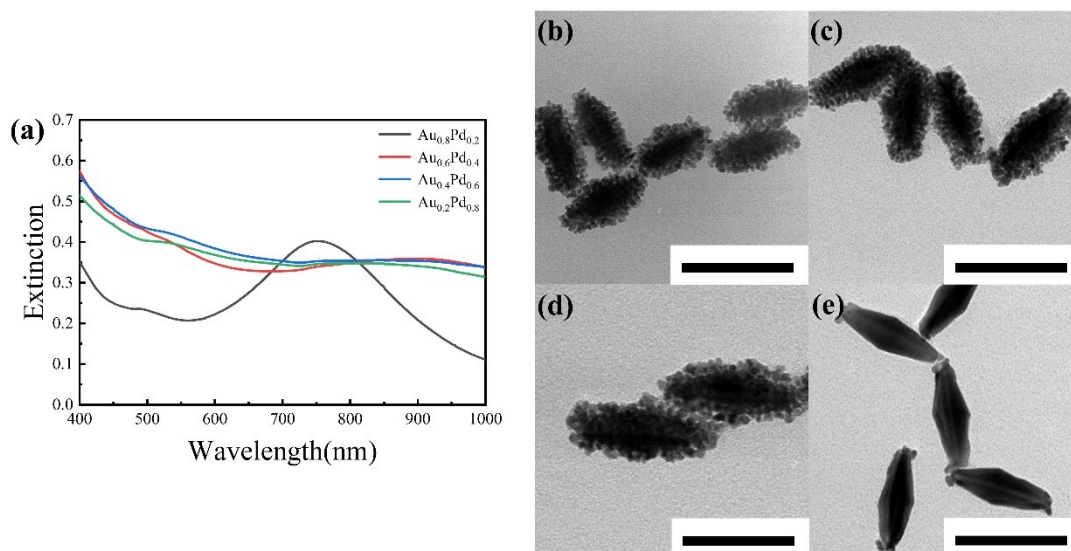


Fig. S2 (a) UV-vis-NIR absorption spectra of AuBPs@Au_xPd_{1-x} nanostructures with varying Au/Pd proportion in the alloy shell. TEM images of the nanostructures obtained under the addition of varying H₂PdCl₄ of 2mM (b), 1.5mM (c), 1mM (d) and 0.25mM (e) obtained at 65°C with respective addition of 0.2 mL HAuCl₄ and 0.2 mL H₂PdCl₄ (Scale bars: 100 nm).

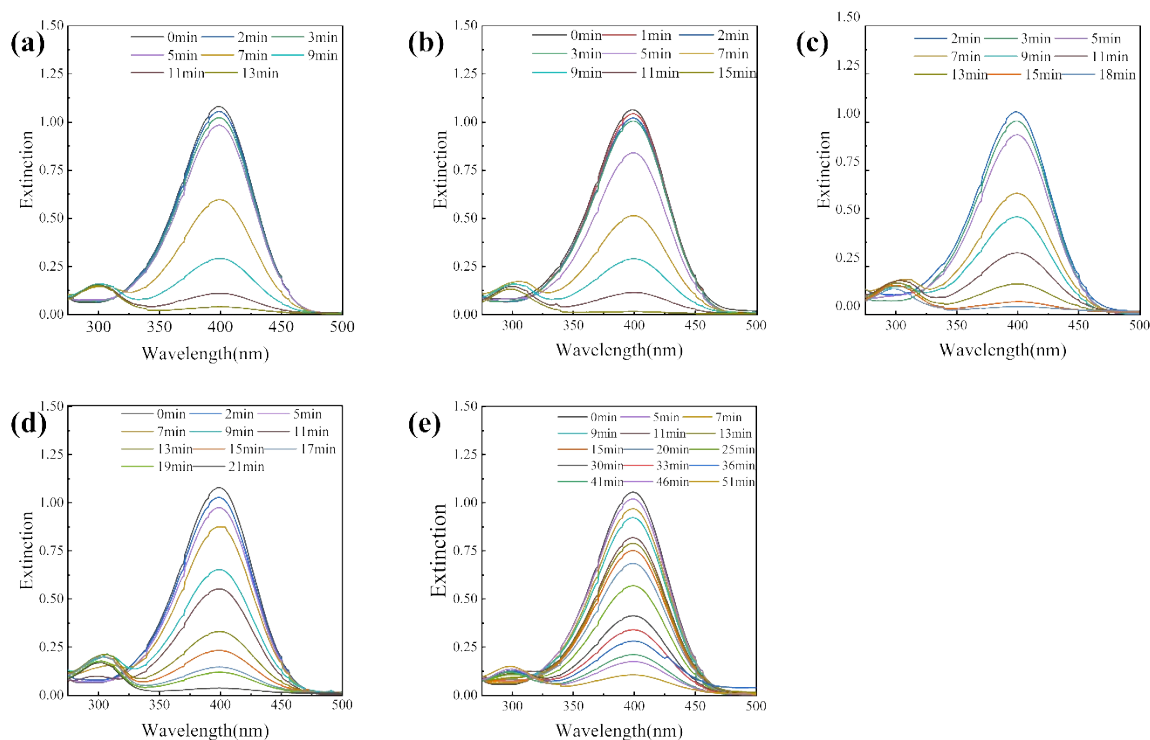


Fig. S3 Absorption spectra of 4-NP reduced by NaBH₄ in the presence of AuBPs@Au_xPd_{1-x}. (a) AuBPs@Au₀Pd₁, (b) AuBPs@Au_{0.2}Pd_{0.8}, (c) AuBPs@Au_{0.4}Pd_{0.6}, (d) AuBPs@Au_{0.6}Pd_{0.4}, (e) AuBPs@Au_{0.8}Pd_{0.2}.

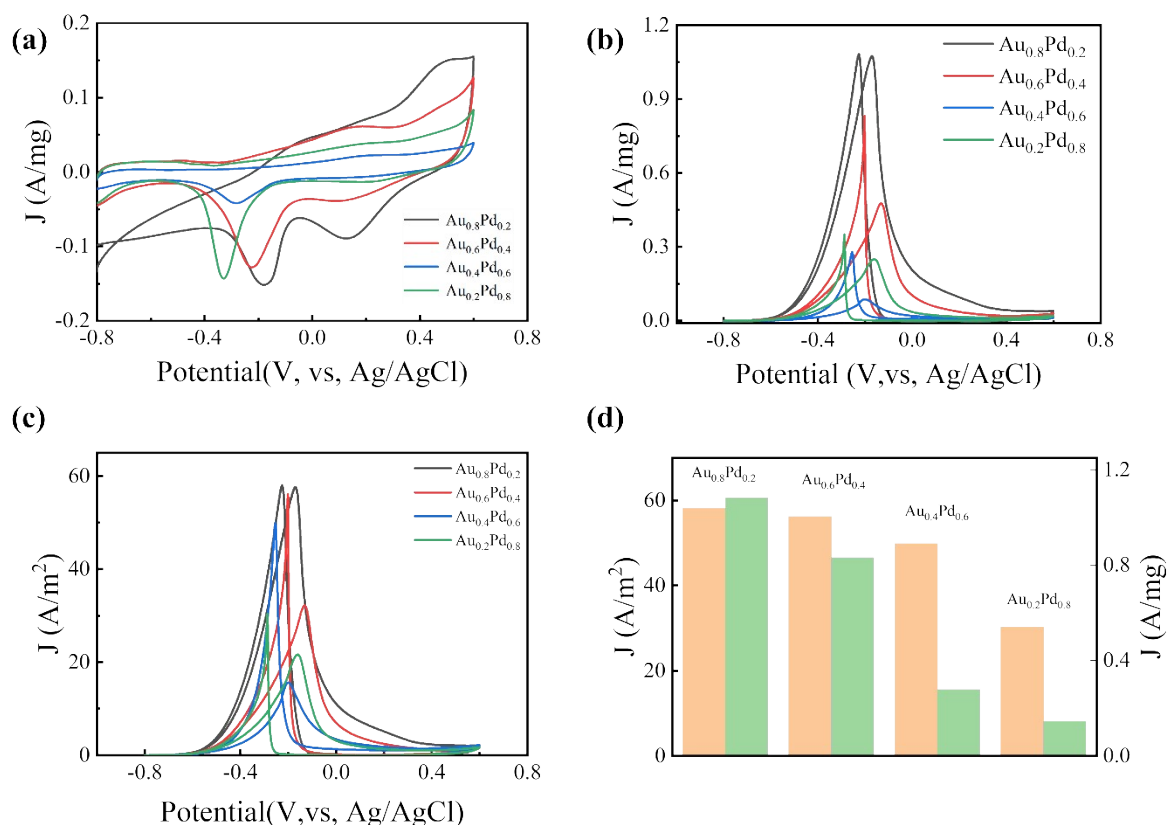


Fig. S4 (a) Cyclic voltammograms for the AuBPs@Au_xPd_{1-x} nanocatalysts in N₂-saturated KOH (0.3M) solution at a scan rate of 50 mV s⁻¹. (b) CV curves for the AuBPs@Au_xPd_{1-x} nanocatalysts in N₂-saturated KOH (0.3M) solution containing ethanol (0.5M) at a scan rate of 50 mV s⁻¹. (c) CV curves by the ECSAs. (d) Mass activities (green) and specific activities (orange) of AuBPs@Au_xPd_{1-x} nanocatalysts from measurement. Note: AuBPs@Au_xPd_{1-x} nanocatalysts were obtained with addition of 0.2 mL HAuCl₄ and 0.2 mL H₂PdCl₄.

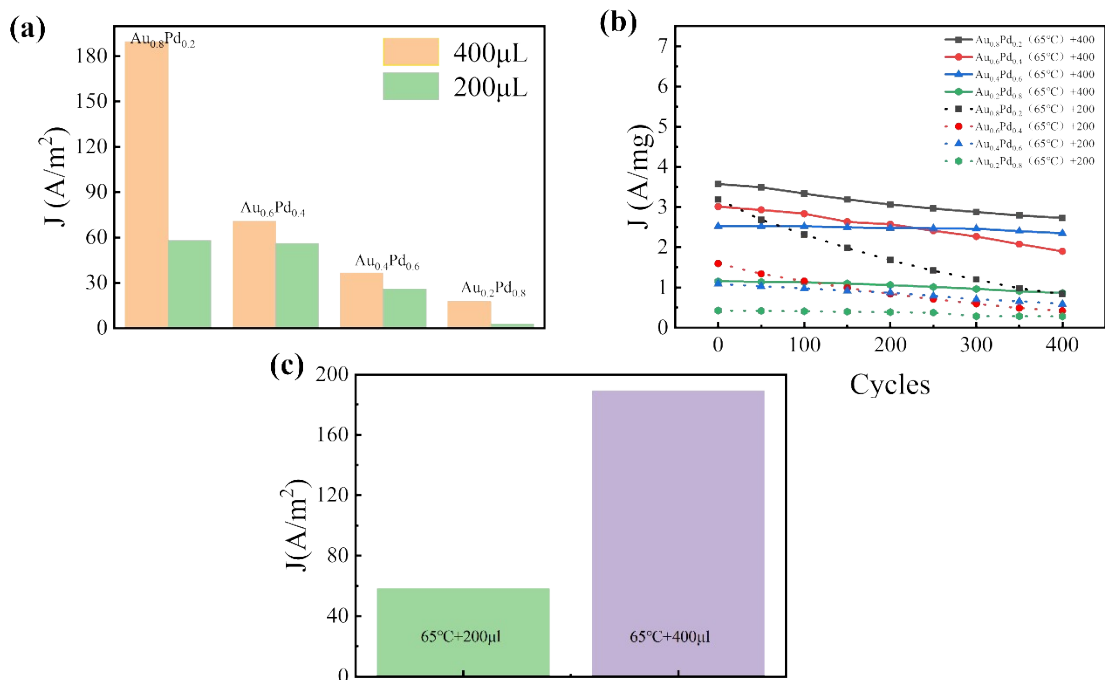


Fig. S5 (a) specific activity of the AuBPs@Au_xPd_{1-x} nanostructures obtained at 65°C with addition of HAuCl₄/H₂PdCl₄ precursor (0.2 mL and 0.4 mL). (b) Cycling measurement of the AuBPs@Au_xPd_{1-x} nanocatalysts obtained at 65°C with addition of HAuCl₄/H₂PdCl₄ precursor (0.2 mL and 0.4 mL). (c) specific activity of the AuBPs@Au_{0.8}Pd_{0.2} nanocatalysts obtained at 65°C with addition of different volume of HAuCl₄/H₂PdCl₄ precursor (0.2 mL and 0.4 mL).

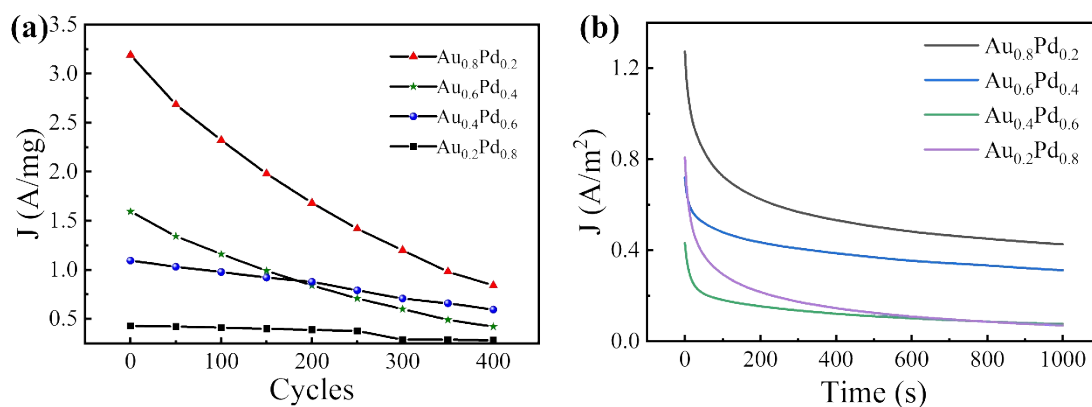


Fig. S6 (a) Cycling measurement for AuBPs@Au_xPd_{1-x} nanocatalysts with addition of 0.2 mL HAuCl₄/H₂PdCl₄ precursor. (b) Chronoamperometric curves in mixture solution of KOH (0.3M) and ethanol (0.5M) for 1000s at -0.23V versus Ag/AgCl potential.

Table S1 The AuBPs@Au_xPd_{1-x} with different concentration for Au and Pd precursors

Sample	Concentration of H ₂ PdCl ₄ (mM)	Concentration of HAuCl ₄ (mM)	Amount of H ₂ PdCl ₄ (mL)	Amount of HAuCl ₄ (mL)
AuBPs@Au _{0.8} Pd _{0.2}	1	0.25	0.4	0.4
AuBPs@Au _{0.6} Pd _{0.4}	1	1.5	0.4	0.4
AuBPs@Au _{0.4} Pd _{0.6}	1.5	1	0.4	0.4
AuBPs@Au _{0.2} Pd _{0.8}	0.5	2	0.4	0.4
AuBPs@Au ₀ Pd ₁	2.5	0	0.4	0.4

Table S2 Comparison of the AuBPs@Au_xPd_{1-x} with different mole fractions for Au and Pd precursors.

Sample	Pd amount of substance concentration (mg/ L)	Pd mass percent	Au/Pd atomic ratio
AuBPs@Au _{0.8} Pd _{0.2}	0.32	40.5%	44.2:55.8
AuBPs@Au _{0.6} Pd _{0.4}	0.50	50.0%	35.0:65.0
AuBPs@Au _{0.4} Pd _{0.6}	0.96	65.3%	25.5:74.5
AuBPs@Au _{0.2} Pd _{0.8}	1.92	80.3%	11.6:83.4
AuBPs@Au ₀ Pd ₁	3.02	82.9%	9.9:90.1