

Promoting the Electrocatalytic Ethanol Oxidation Activity of Pt by Alloying with Cu

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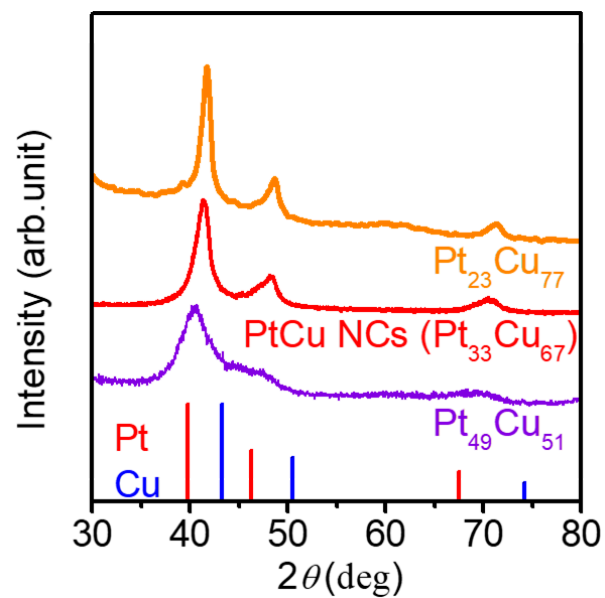


Figure S1. XRD patterns of the $\text{Pt}_{49}\text{Cu}_{51}$, PtCu NCs ($\text{Pt}_{33}\text{Cu}_{67}$), and (c) $\text{Pt}_{23}\text{Cu}_{77}$.

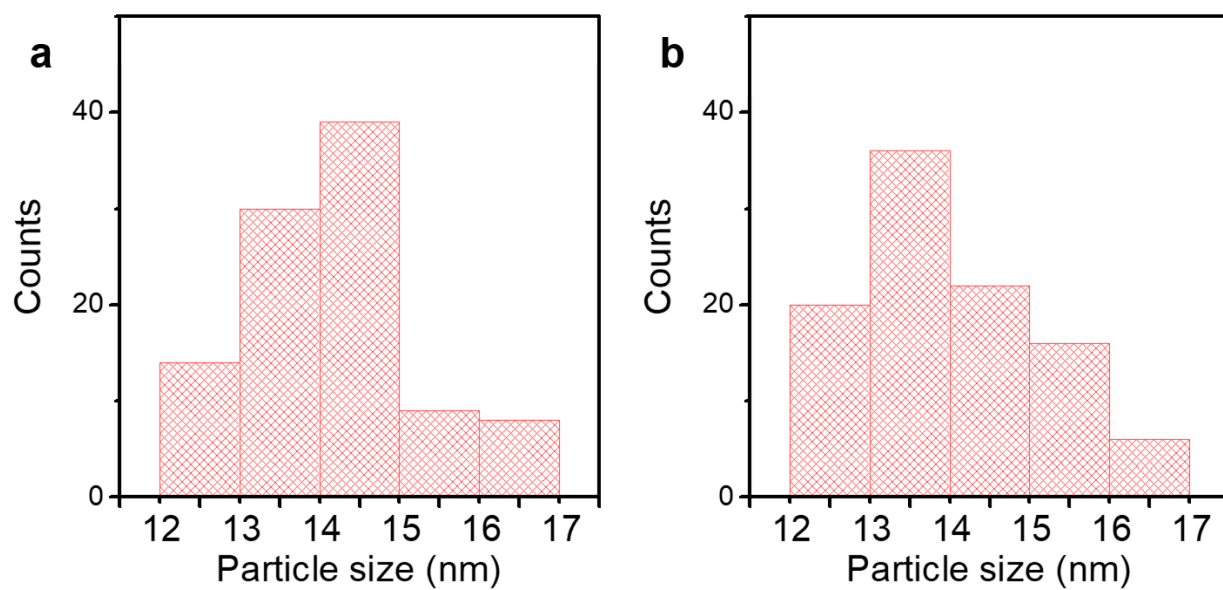


Figure S2. The histograms of size distributions of at least 100 particles. (a) PtCu NCs, (b) PtCu NPs.

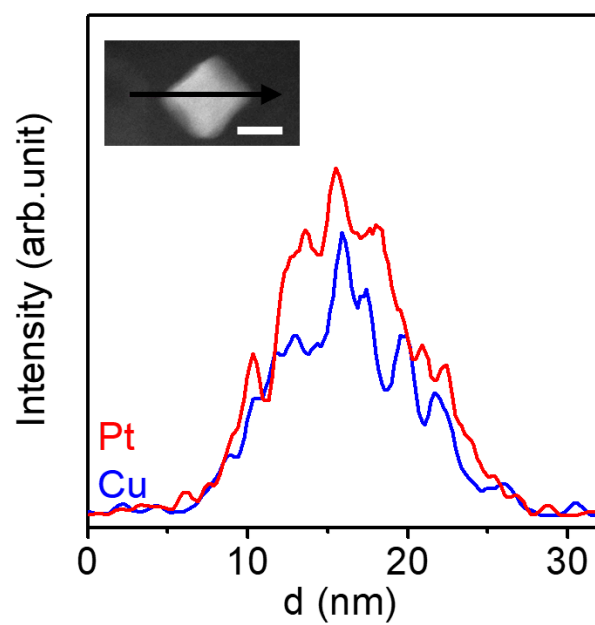


Figure S3. Line scanning profile of PtCu NC. Scale bar: 10 nm.

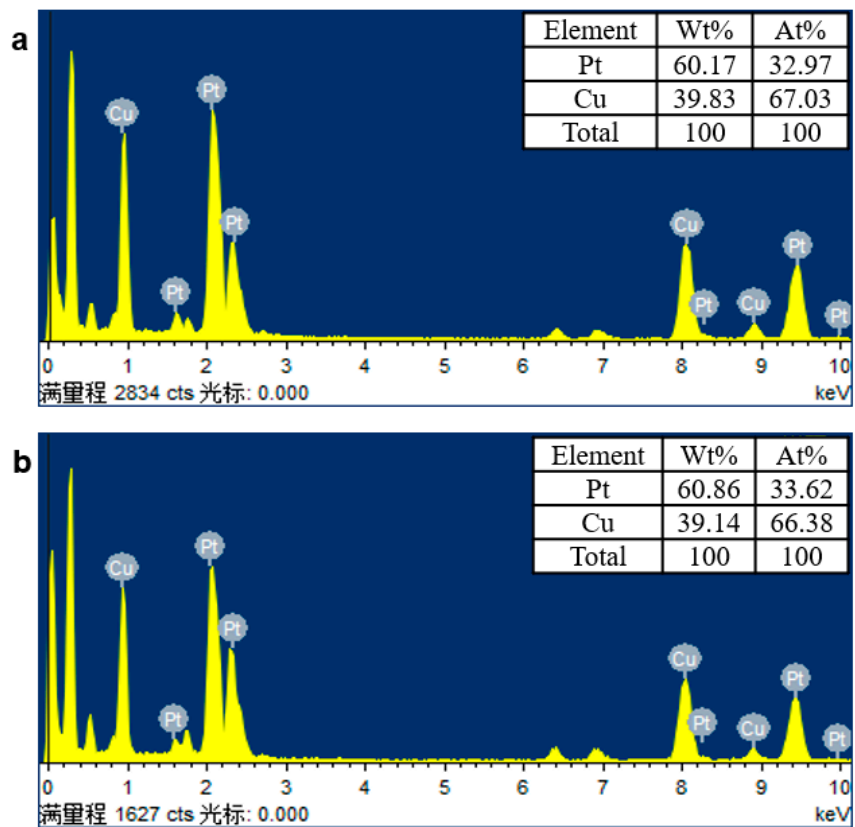


Figure S4. Elemental analysis by EDS. (a) PtCu NCs (b) PtCu NPs.

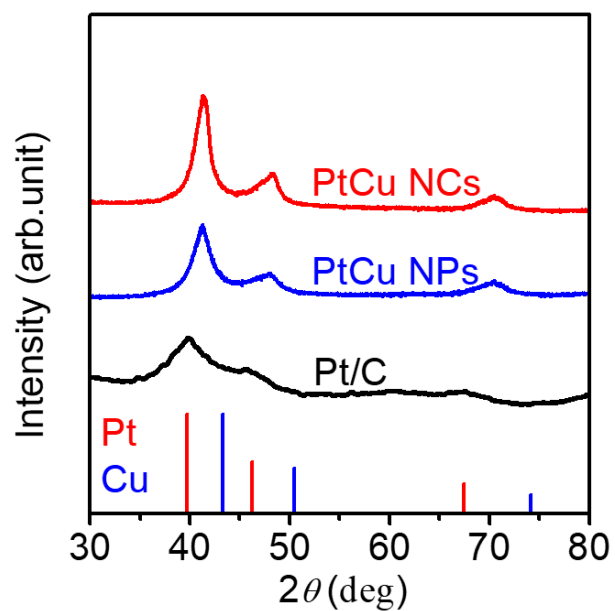


Figure S5. XRD patterns of the commercial Pt/C, PtCu NPs, and PtCu NCs.

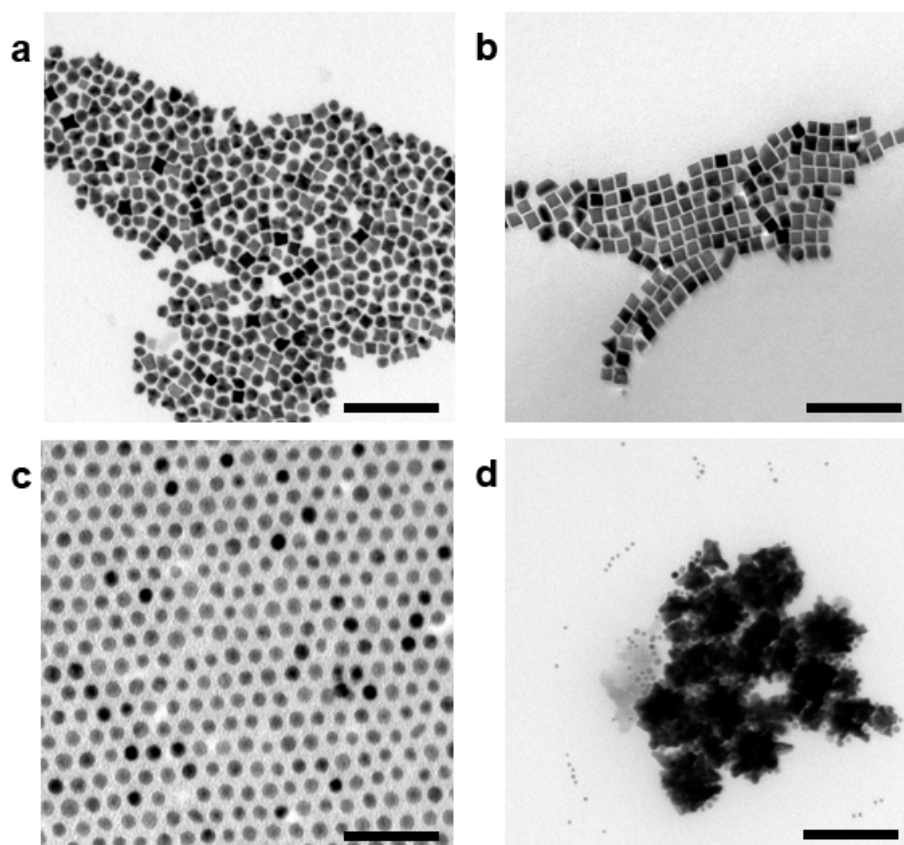


Figure S6. TEM images of the PtCu nanoparticles synthesized by using different amounts of CTAB. (a) 0.16 mmol, (b) 0.08 mmol, (c) 0.04 mmol, (d) 0.00 mmol. Scale bars: (a–d) 100 nm.

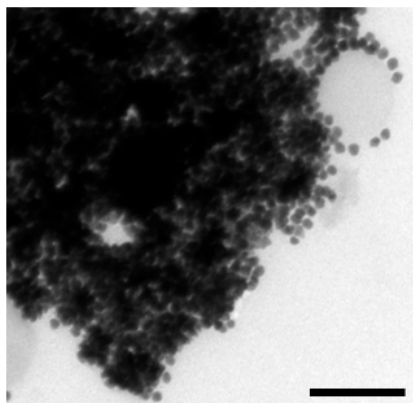


Figure S7. TEM image of the PtCu nanoparticles synthesized by using 0.08 mmol KBr. Scale bar: 100 nm.

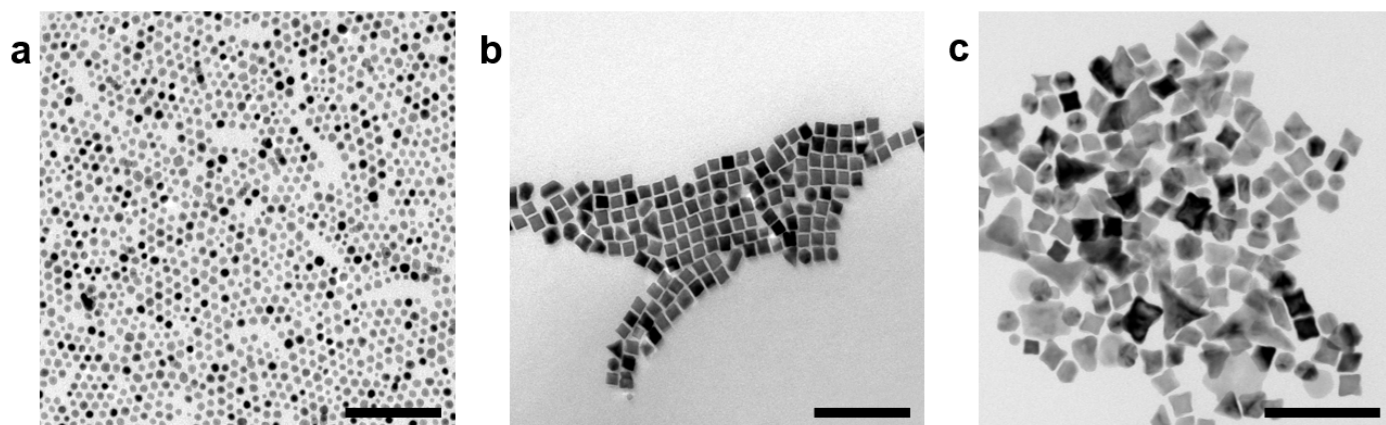


Figure S8. TEM images of the PtCu nanocrystals with different Pt/Cu atomic ratios. (a) $\text{Pt}_{49}\text{Cu}_{51}$, (b) PtCu NCs ($\text{Pt}_{33}\text{Cu}_{67}$), and (c) $\text{Pt}_{23}\text{Cu}_{77}$. Scale bars: (a–c) 100 nm.

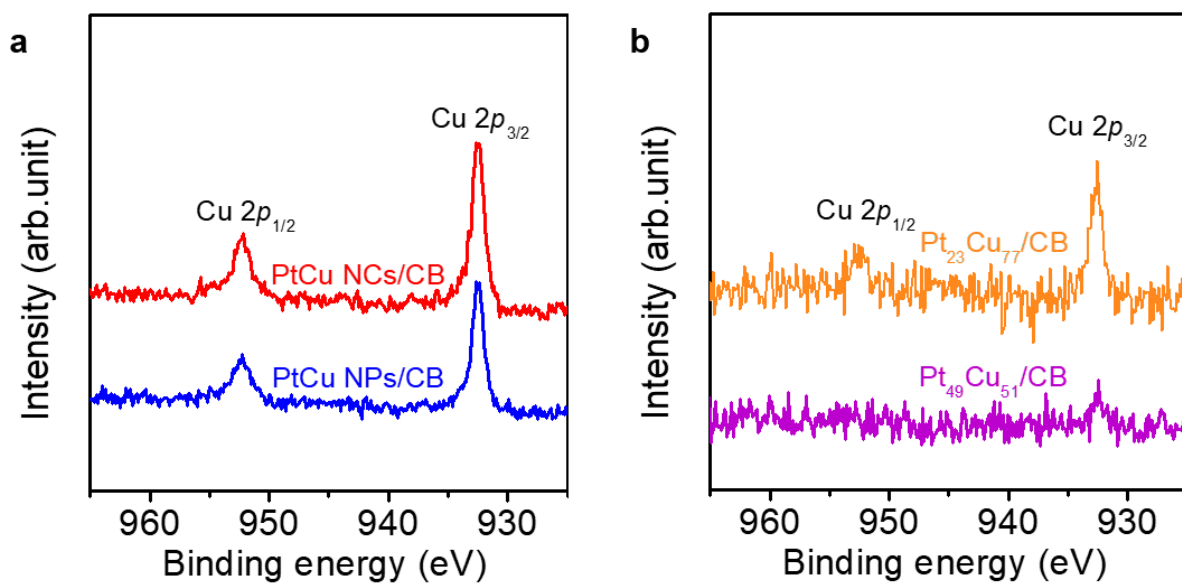


Figure S9. (a) Cu 2p XPS spectra of PtCu NCs/CB and PtCu NPs/CB. (b) Cu 2p XPS spectra of $\text{Pt}_{49}\text{Cu}_{51}/\text{CB}$ and $\text{Pt}_{23}\text{Cu}_{77}/\text{CB}$.

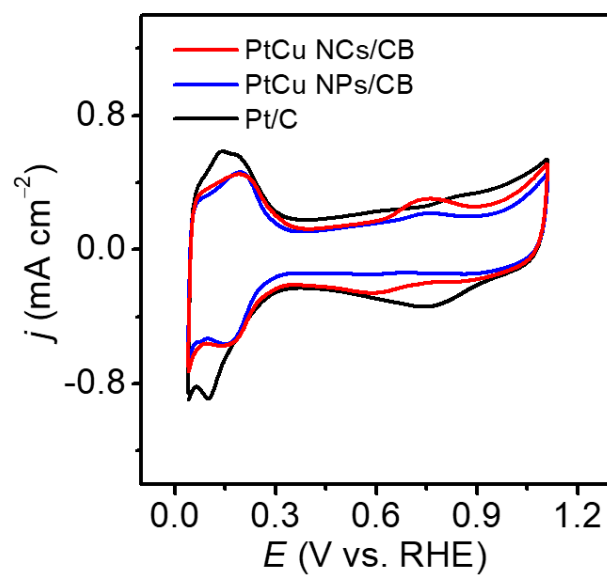


Figure S10. CV curves of PtCu NCs/CB, PtCu NPs/CB, and commercial Pt/C catalysts in N_2 -saturated 0.1 M HClO_4 at a scan rate of 50 mV s^{-1} .

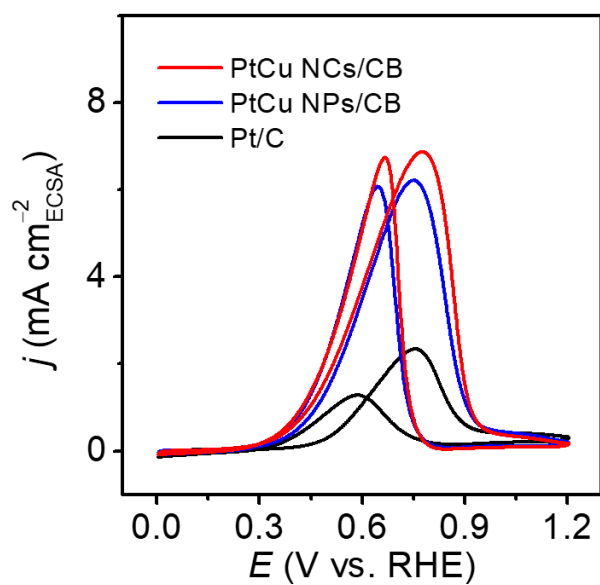


Figure S11. ECSA-normalized CV curves of the EOR on PtCu NCs/CB, PtCu NPs/CB and commercial Pt/C in the mixed electrolyte of 1.0 M KOH and 1.0 M C₂H₅OH at a scan rate of 50 mV s⁻¹.

Table S1. Summary of the ECSAs, loading, mass activities and specific activities at 0.75 V vs. RHE for Pt-based catalysts.

Catalysts	ECSA (cm ²)	Loading (μg _{Pt} cm ⁻²)	Specific activity @0.75 V vs. RHE (mA cm ⁻² (ECSA))	Mass activity @0.75 V vs. RHE (A mg _{Pt} ⁻¹)
PtCu NCs/CB	1.34	9.3	6.75	4.96
PtCu NPs/CB	1.12	10.8	6.22	3.26
Pt ₄₉ Cu ₅₁ /CB	/	12.0	/	2.70
Pt ₂₃ Cu ₇₇ /CB	/	10.9	/	3.36
Pt/C	1.41	10.2	2.34	1.67

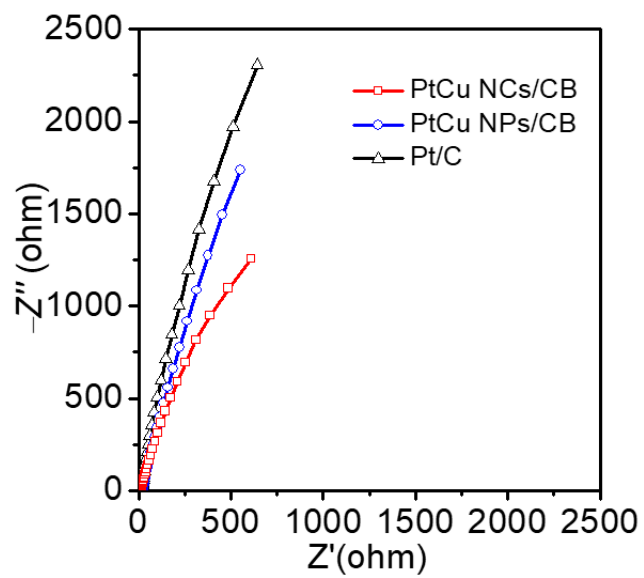


Figure S12. Nyquist plots measured at 0.75 V vs. RHE in the mixture of 1.0 M KOH and 1.0 M $\text{C}_2\text{H}_5\text{OH}$.

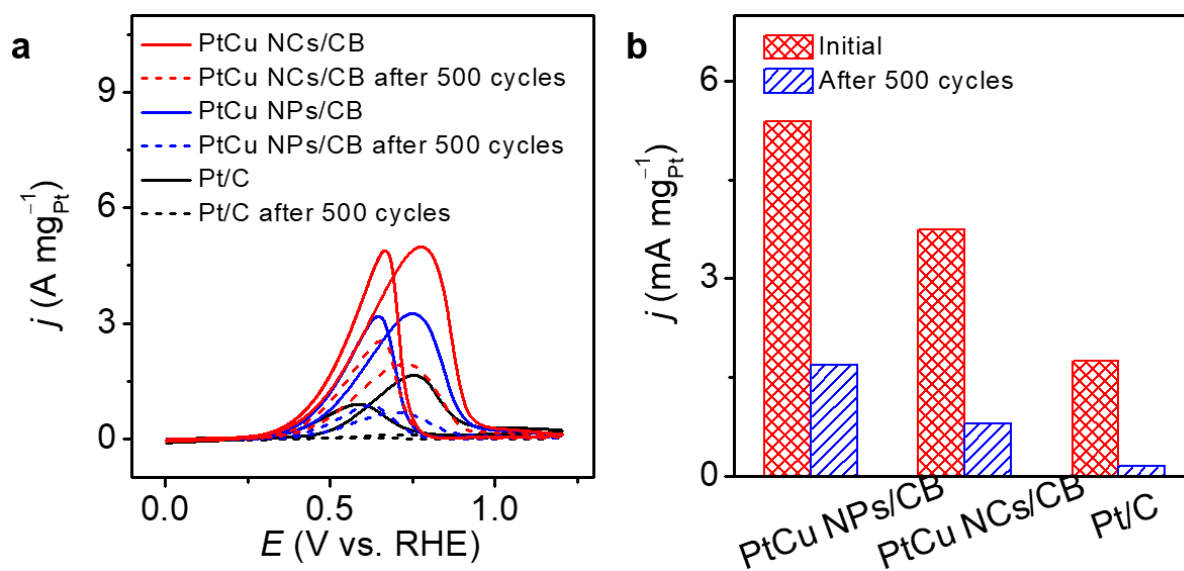


Figure S13. Mass activities of PtCu NCs/CB, PtCu NPs/CB and commercial Pt/C before and after 500 cycles in 1.0 M KOH and 1.0 M C₂H₅OH at a scan rate of 50 mV s⁻¹.

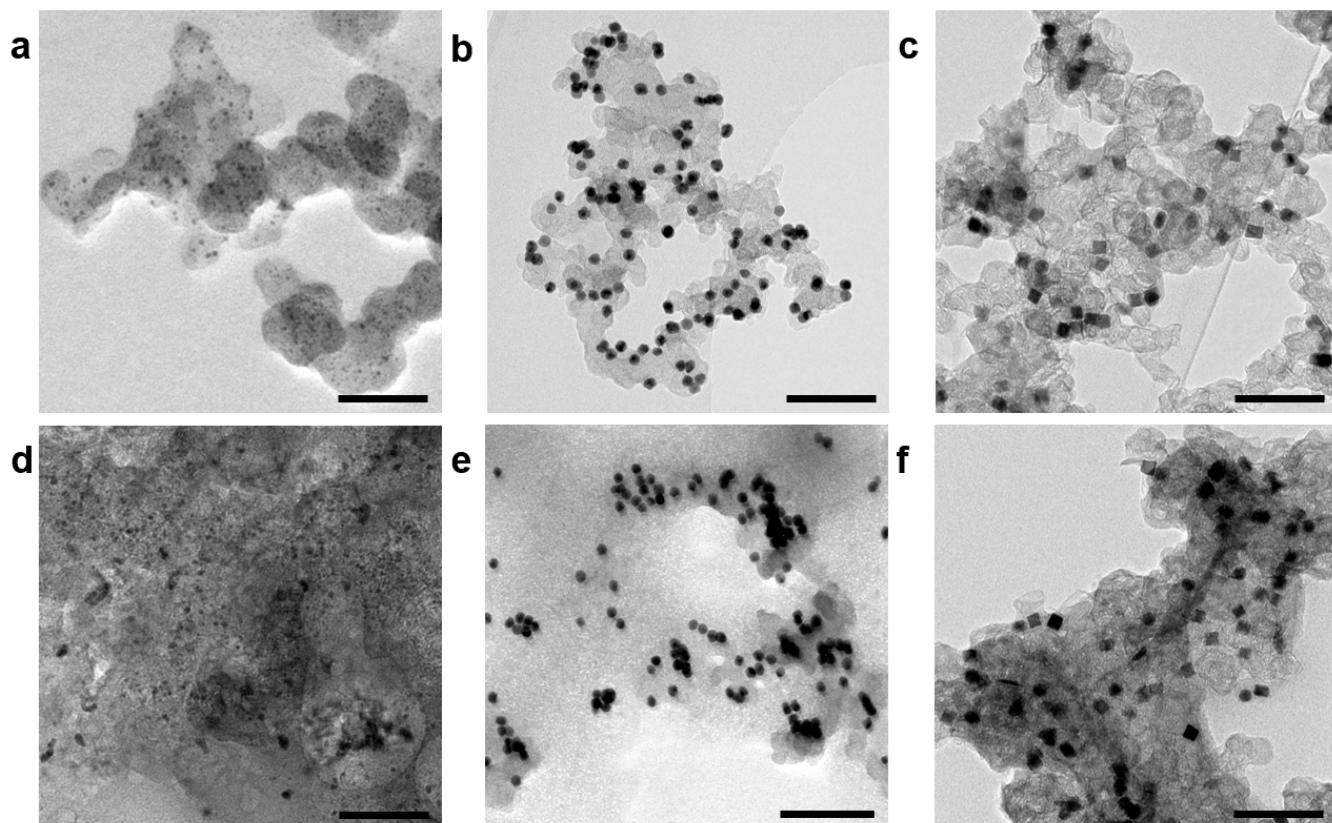


Figure S14. TEM images of (a) Pt/C, (b) PtCu NPs/CB, and (c) PtCu NCs/CB before electrochemical measurements. TEM images of (d) Pt/C, (e) PtCu NPs/CB, and (f) PtCu NCs/CB after 500 cycles in 1.0 M KOH and 1.0 M C₂H₅OH at a scan rate of 50 mV s⁻¹. Scale bars: (a, d) 50 nm, (b, c, e, f) 100 nm.

Table S2. EOR electrocatalytic activities of Pt-based catalysts in alkaline media.

Catalyst	Electrolyte	Mass activities (A mg _{Pt} ⁻¹)	Reference
PtCu NCs/CB	1.0 M KOH + 1.0 M ethanol	4.96	This work
PtCu/Cu _{2-x} Se NWs	1.0 M KOH + 1.0 M ethanol	5.03	1
SA Ni-Pt NWs	1.0 M KOH + 1.0 M ethanol	5.60	2
PtRhNi octahedrons	1.0 M KOH + 1.0 M ethanol	3.39	3
PtRhCu nanocubes	1.0 M KOH + 1.0 M ethanol	4.09	4
Pt NPs/CeO ₂	1.0 M KOH + 1.0 M ethanol	8.67	5
PtNi multicubes	1.0 M KOH + 1.0 M ethanol	2.86	6
PtFePd NWs	1.0 M KOH + 1.0 M ethanol	4.96	7
PtRh nanodendrites	1.0 M NaOH + 1.0 M ethanol	0.46	8
4H Au@PtCu nanoribbons	1.0 M KOH + 1.0 M ethanol	4.22	9
PtBi nanoplates	1.0M NaOH + 1.0M ethanol	5.95	10
PtRhNi nanoassemblies	1.0 M NaOH + 1.0 M ethanol	1.39	11
PtPdRu nanodendrites	1.0 M NaOH + 1.0 M ethanol	1.96	12
PtMo/C	0.5 M KOH + 0.5 M ethanol	1.00	13
PtCu NPs	0.5 M KOH + 0.5 M ethanol	2.33	14
PdPtAg Nanosheets	0.1 M KOH + 0.5 M ethanol	1.31	15

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