

## Supporting Information

# Three-Dimensional PdPtCu Nanoalloys with Controllable Composition and Spiny Surface for the Enhancement of Ethanol Electrocatalytic Properties

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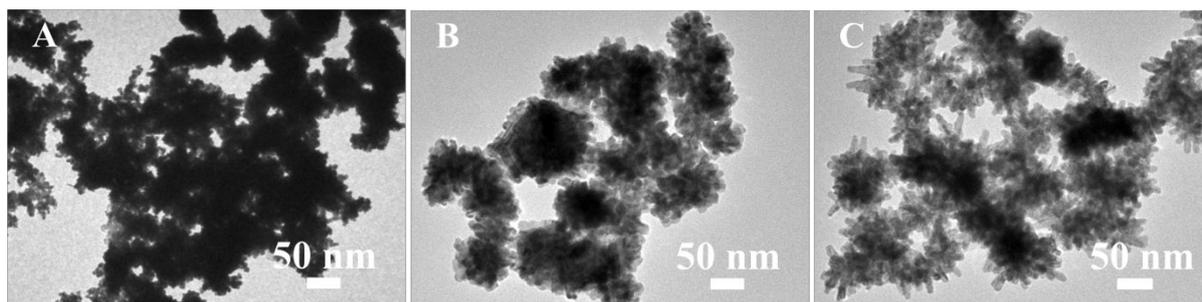
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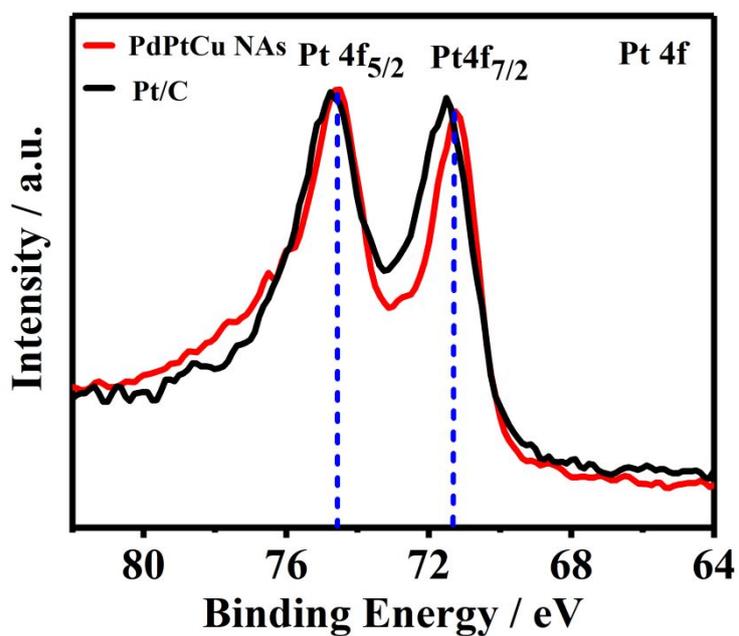
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**Table S1.** The ICP-AES results of different components Pt-based NMs

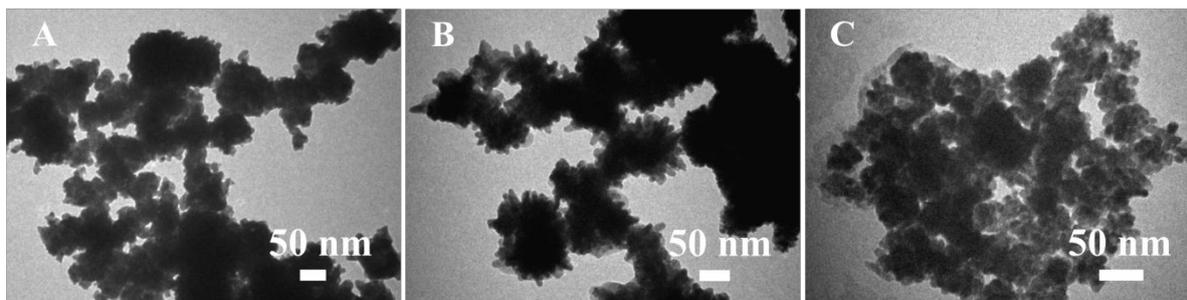
Samples	Atomic ratio of (Pd), Pt and Cu
PtCu NPs	49.13:50.87
Pd <sub>0.5</sub> PtCu NAs	20.78:39.26:39.96
PdPtCu NAs	34.89:28.95:36.16
Pd <sub>2</sub> PtCu NAs	51.85:27.13:21.02



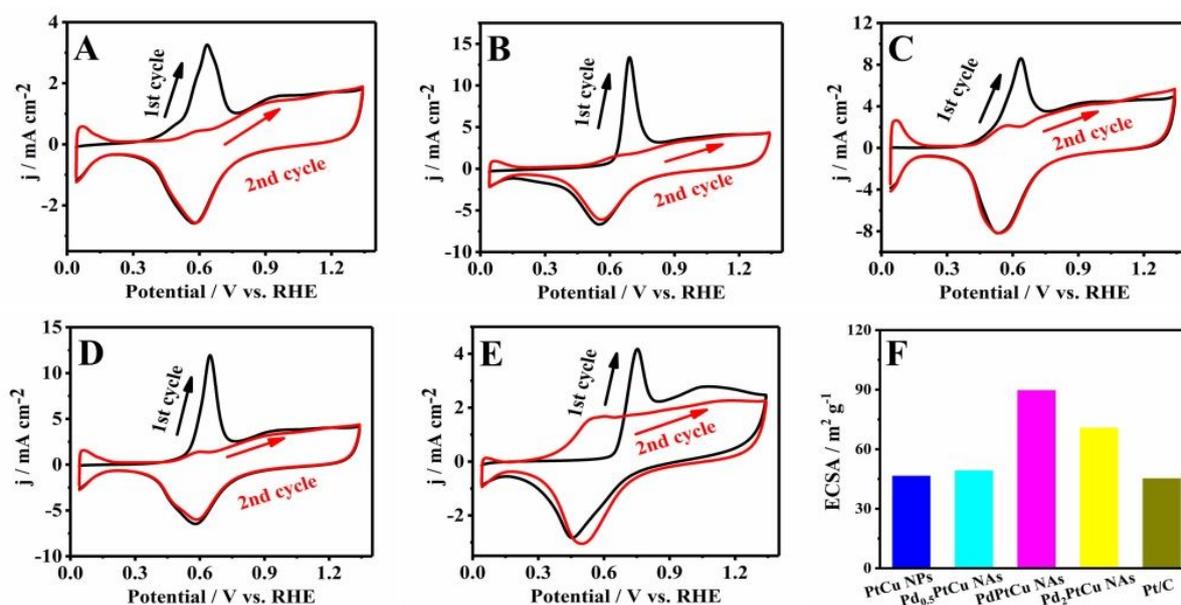
**Figure S1.** The TEM images of NMs with different components: (A) PtCu NPs, (B) Pd<sub>0.5</sub>PtCu NAs and (C) Pd<sub>2</sub>PtCu NAs.



**Figure S2.** The XPS spectra of Pt 4f in PdPtCu NAs and Pt/C catalysts.



**Figure S3.** The TEM images of PdPtCu NPs: (A) without PF-127, (B) 0.06 g PF-127 and (C) 0.03 g PVP.



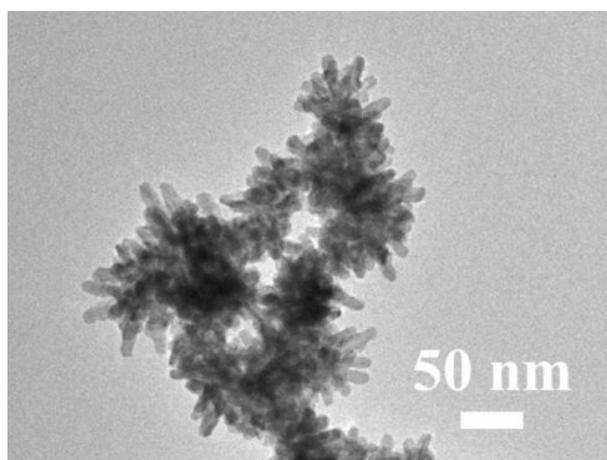
**Figure S4.** The CV curves of CO stripping test: (A) PtCu NPs, (B) Pd<sub>0.5</sub>PtCu NAs, (C) PdPtCu NAs, (D) Pd<sub>2</sub>PtCu NAs and (E) Pt/C catalysts; (F) The histogram of ECSA values of the corresponding catalysts.

**Table S2.** The electrochemical performance parameters of all samples toward EOR

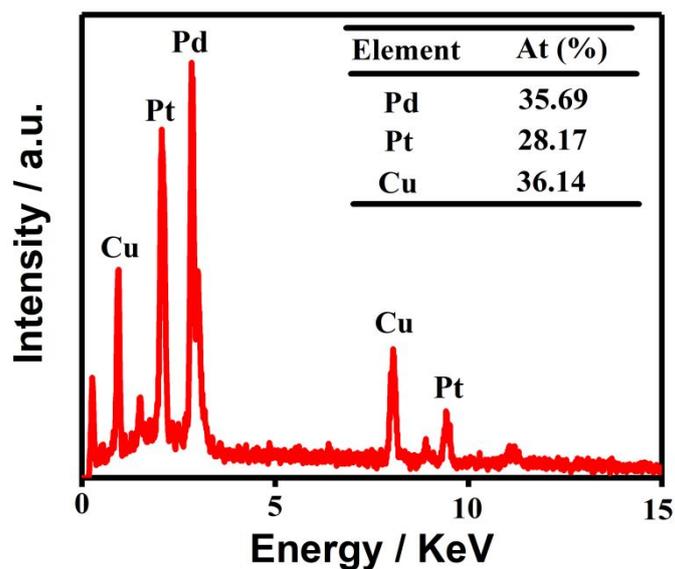
Samples	ECSA (m <sup>2</sup> g <sup>-1</sup> )	Peak current density (j/mA cm <sup>-2</sup> )	Mass activity (j <sub>MA</sub> /mA mg <sup>-1</sup> )	Specific activity (j <sub>SA</sub> /mA cm <sup>-2</sup> )
PtCu NPs	46.47	69.19	695.25	1.43
Pd <sub>0.5</sub> PtCu NAs	49.18	105.70	847.68	2.62
PdPtCu NAs	89.59	225.87	1679.87	4.21
Pd <sub>2</sub> PtCu NAs	70.73	143.07	849.67	3.53
Pt/C	45.21	10.87	484.72	1.09

**Table S3.** The electrocatalytic properties of ternary Pt-based nanocatalysts toward EOR in alkaline medium

Samples	Electrolyte condition	Mass activity ( $j_{MA}/mA\ mg^{-1}$ )	Ref.
Pt-Pd-Cu nanodendrites	0.1 M KOH +0.5 M ethanol	2588.00	20
Pd-Pt-Ag nanosheets	0.1 M KOH +0.5 M ethanol	1387.00	50
Pt <sub>1</sub> Ru <sub>0.5</sub> Sn <sub>0.5</sub> -RGO	1.0 M KOH +1.0 M ethanol	1517.00	51
PdPtCu NAs	1.0 M KOH +1.0 M ethanol	1679.87	This work



**Figure S5.** The TEM images of PdPtCu NAs after EOR stability tests.



**Figure S6.** EDS spectrum of PdPtCu NAs after EOR stability tests.