High-Entropy Alloy Nanocages with Highly Ordered {100} Facets and Ultrathin Feature for Water Splitting in Acidic Medium

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Figures

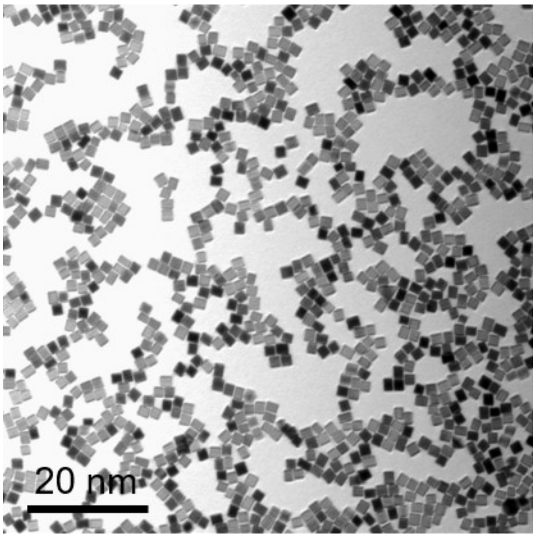

Figure S1. TEM images of the sub-18 nm Pd nanocubes.

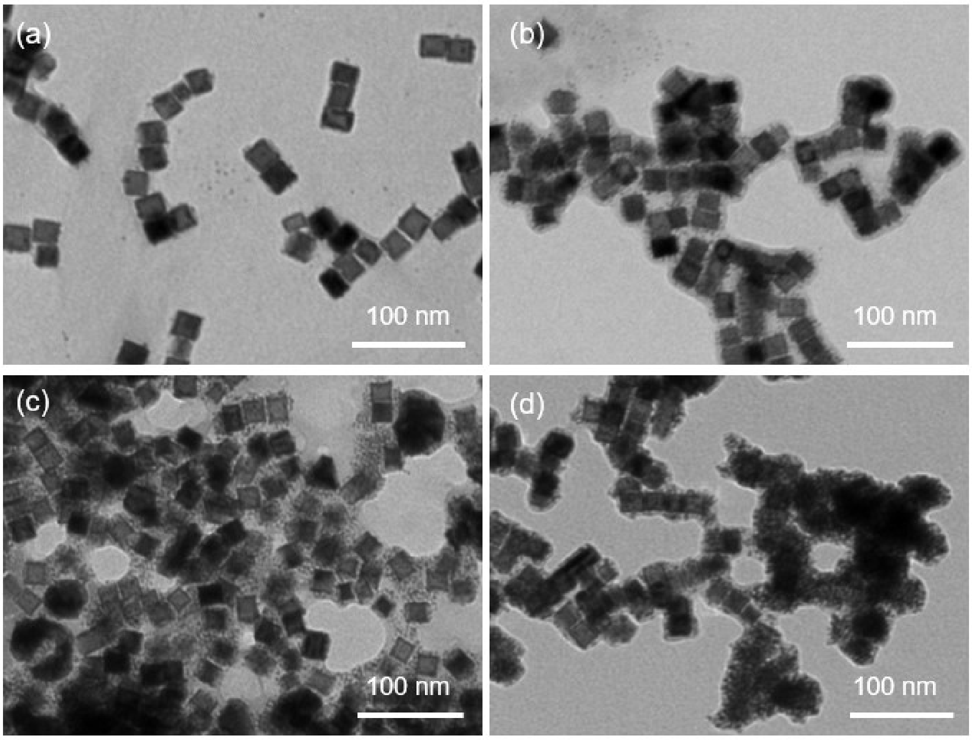

Figure S2. TEM images of the Pd@$(PtIrRuRh)_{5L}$ core-shell nanocubes recorded at different reaction temperatures: (a) 190 ℃; (b) 195 ℃; (c) 200 ℃; (d) 205 ℃.

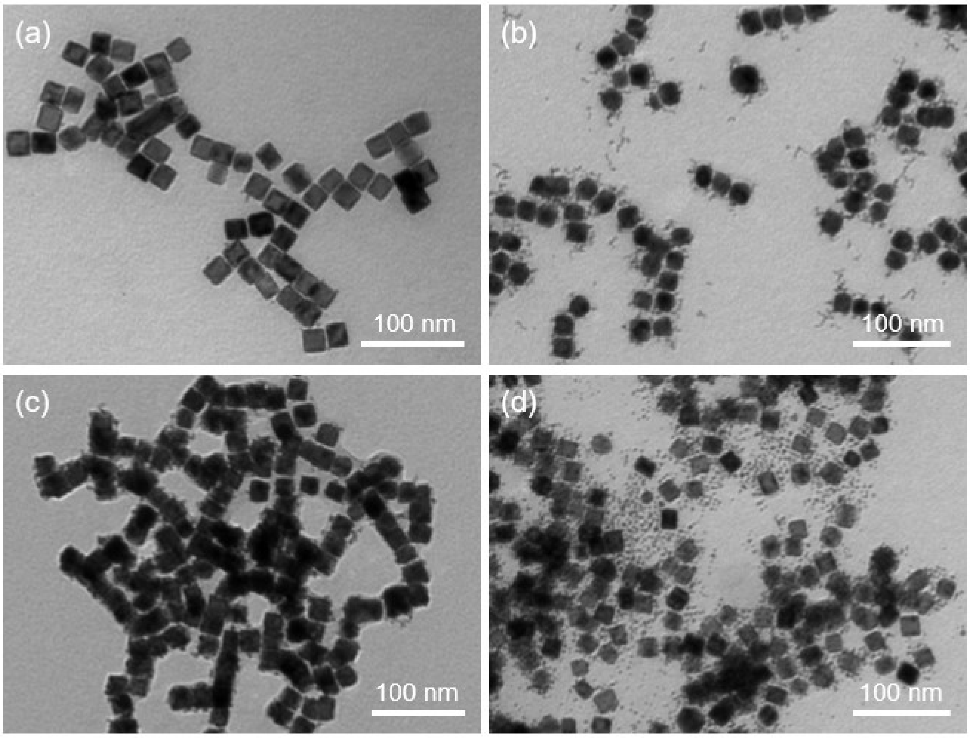

Figure S3. TEM images of the Pd@(PtIrRuRh)$_{5L}$ core-shell nanocubes prepared at different injection rates: (a) 0.5 mL h^{-1}; (b) 1 mL h^{-1}; (c) 2 mL h^{-1}; (d) 4 mL h^{-1}.

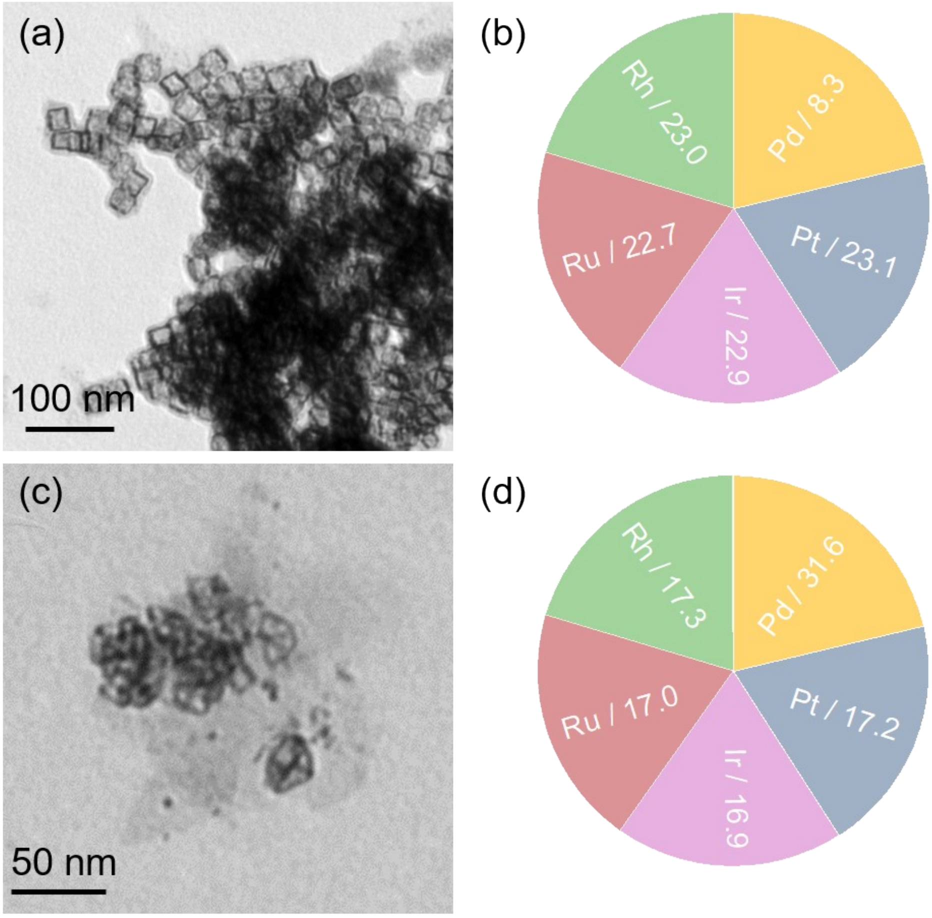

Figure S4. TEM images and corresponding metallic compositions of the PtIrRuRhPd HEA CNCs prepared by etching (a-b) the Pd@$(PtIrRuRh)_{8\ layers}$ and (c-d) the Pd@$(PtIrRuRh)_{3\ layers}$.

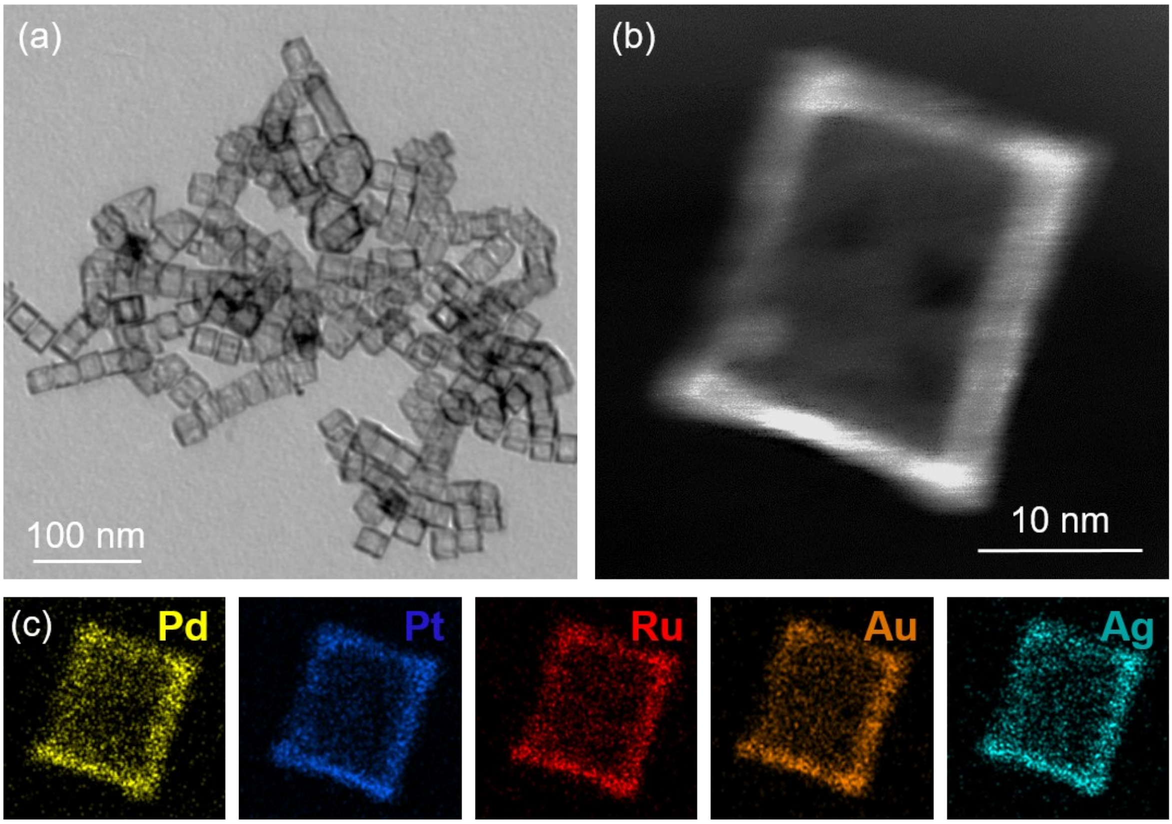

Figure S5. (a) TEM image, (b) HAADF-STEM image, and (c) corresponding EDX mapping images of the PtRuAuAgPd HEA CNCs.

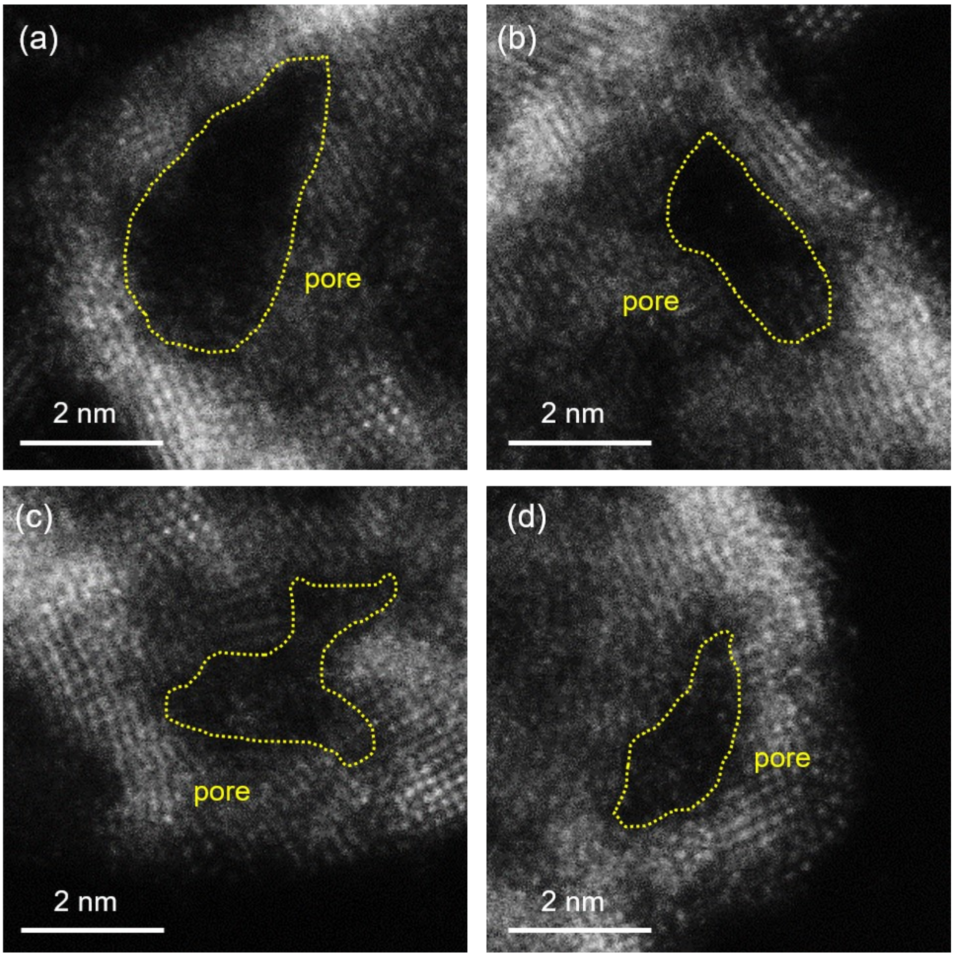

Figure S6. AC HADDF-STEM image of the PtIrRuRhPd HEA CNCs, showing the pore distribution in a HEA nanocage.

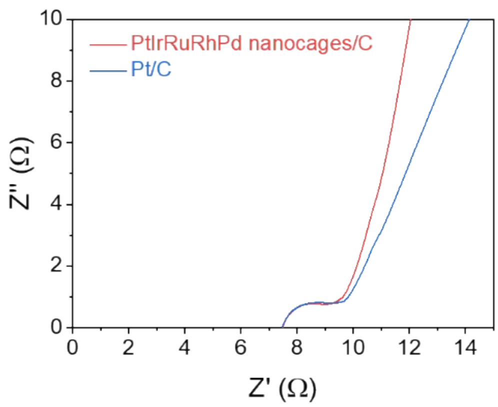

Figure S7. Nyquist plots of the PtIrRuRhPd HEA CNCs recorded at -0.45 V vs RHE.

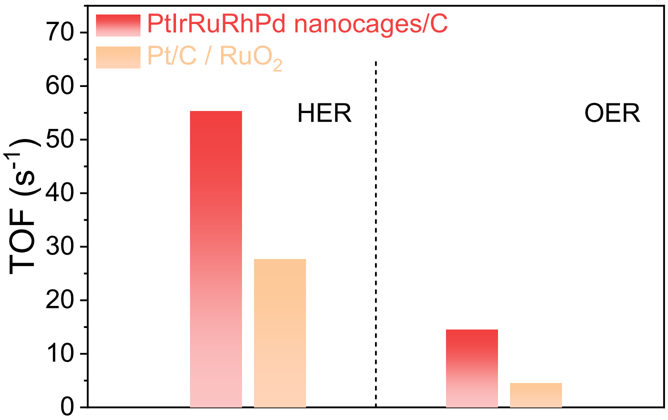

Figure S8. Comparisons of the turnover frequencies (TOF) value at -0.05 V_{RHE} for HER and at 1.5 V_{RHE} for OER.

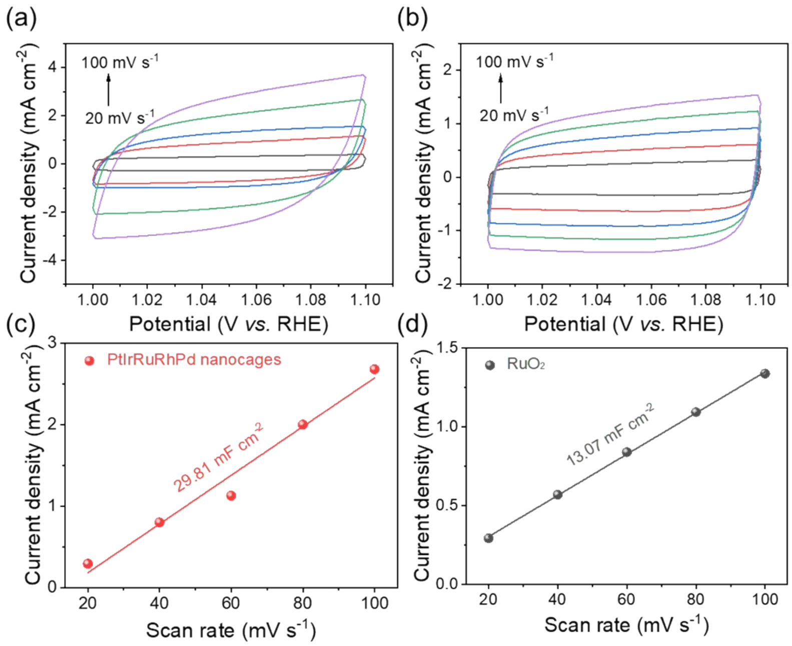

Figure S9. CV curves at different scan rates and dependence of the current density for (a, c) PtIrRuRhPd HEA CNCs and (b, d) RuO_2. The electrochemical double-layer capacitance (C_{dl}) was calculated from the linear fitting.

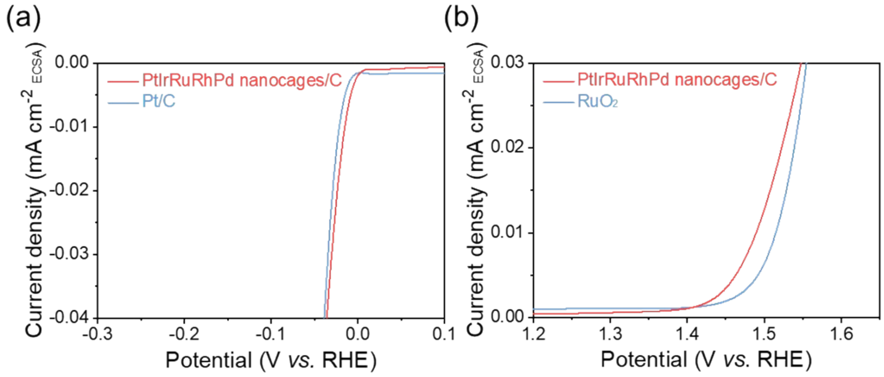

Figure S10. Comparisons of the ECSA-normalized (a) HER and (b) OER polarization curves.

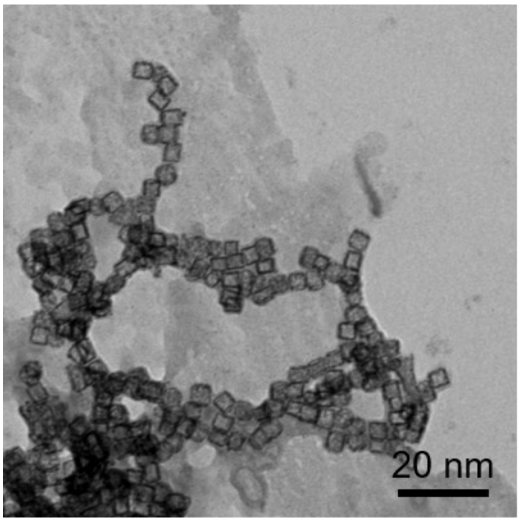

Figure S11. TEM image of the PtIrRuRhPd HEA CNCs/C after ADTs.

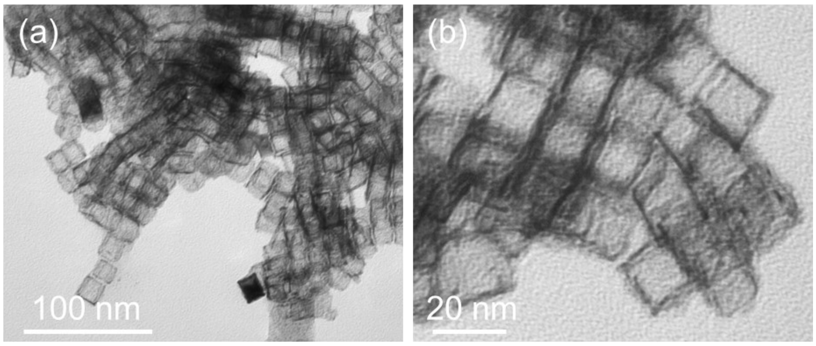

Figure S12. TEM images of the PtIrRuRhPd HEA CNCs after water electrolysis for 200,000 s.

Table S1. Bifunctional HER and OER activity of PtIrRuRhPd HEA CNCs in acidic media, in comparison with previously reported bifunctional catalysts.

sample	η_{10} for OER (mV)	η_{10} for HER (mV)	Tafel slope for OER (mV dec^{-1})	Tafel slope for HER (mV dec^{-1})	Reference
PtIrRuRhPd HEA CNCs	272	20	83.9	22.5	This work
Pt/C / RuO_2	325	35	91	31.2	This work
Au@ $AuIr_2$	261	29	58.3	15.6	*J. Am. Chem. Soc.* 2021, 143, 4639-4645[1]
Mn_6-CoO	322	37	76.8	122.6	*J. Energy Chem.* 2022, 71, 639-651[2]
RuO_2 NWs/C	224	45	48	61.5	*Adv. Funct. Mater.*2021, 31, 2007344[3]
LN-Ru	196	35	51	30	*Appl. Catal. B* 2022, 316, 121682[4]
$Au_{0.5}Ir_{0.5}$@CNT	257	27	77.6	37.0	*J. Mater. Chem. A* 2020, 8, 20168-20174[5]
a-$RuTe_2$ PNRs	245	33	47	35	*Nat. Commun.* 2019, 10, 5692[6]
Ir-NR/C	290	28	72.4	23.5	*Appl. Catal. B* 2020, 279, 119394[7]
SrIrO-1100	263	18	49.7	30.6	*Chem. Eng. J.* 2021, 419, 129604[8]
RuIrTe NTs	205	29	41.2	30.6	*J. Mater. Chem. A* 2022, 10, 2021-2026[9]
Ru@$MoO(S)_3$	226	63	51	32	*Nano Energy* 2022, 100, 107445[10]
RuO_2-WC NPs	347	58	88.5	66	*Angew. Chem. Int. Ed.* 2022, 61, e202202519[11]

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