Supporting Information

Enhancing oxygen evolution reactions in nanoporous high-entropy catalysts using boron and phosphorus additives

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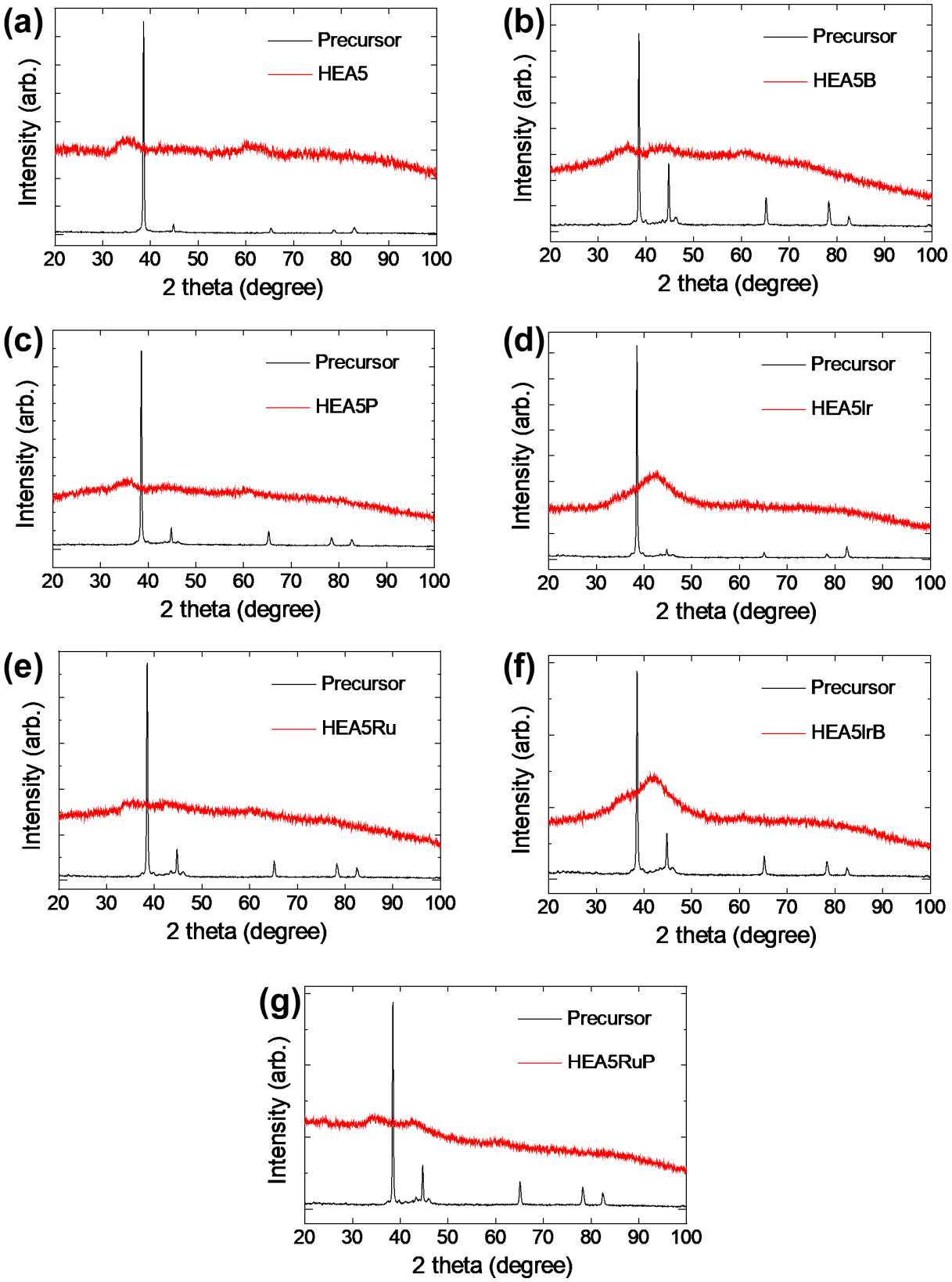

Figure S1. XRD patterns of the np-HEA catalysts and as-prepared precursor alloy ribbons: (a) HEA5, (b) HEA5B, (c) HEA5P, (d) HEA5Ir, (e) HEA5Ru, (f) HEA5IrB, and (g) HEA5RuP.

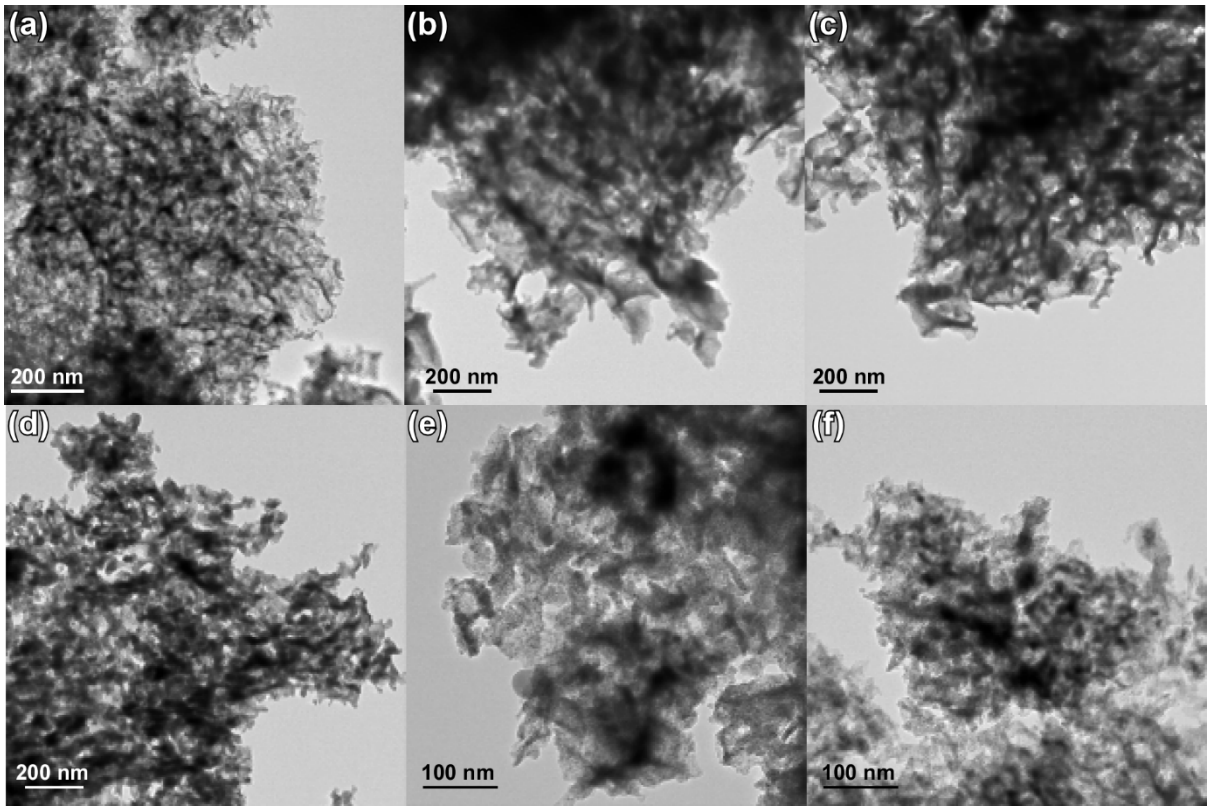

Figure S2. Low-magnification TEM images: (a) HEA5B, (b) HEA5P, (c) HEA5Ir, (d) HEA5IrB, (e) HEA5Ru, and (f) HEA5RuP.

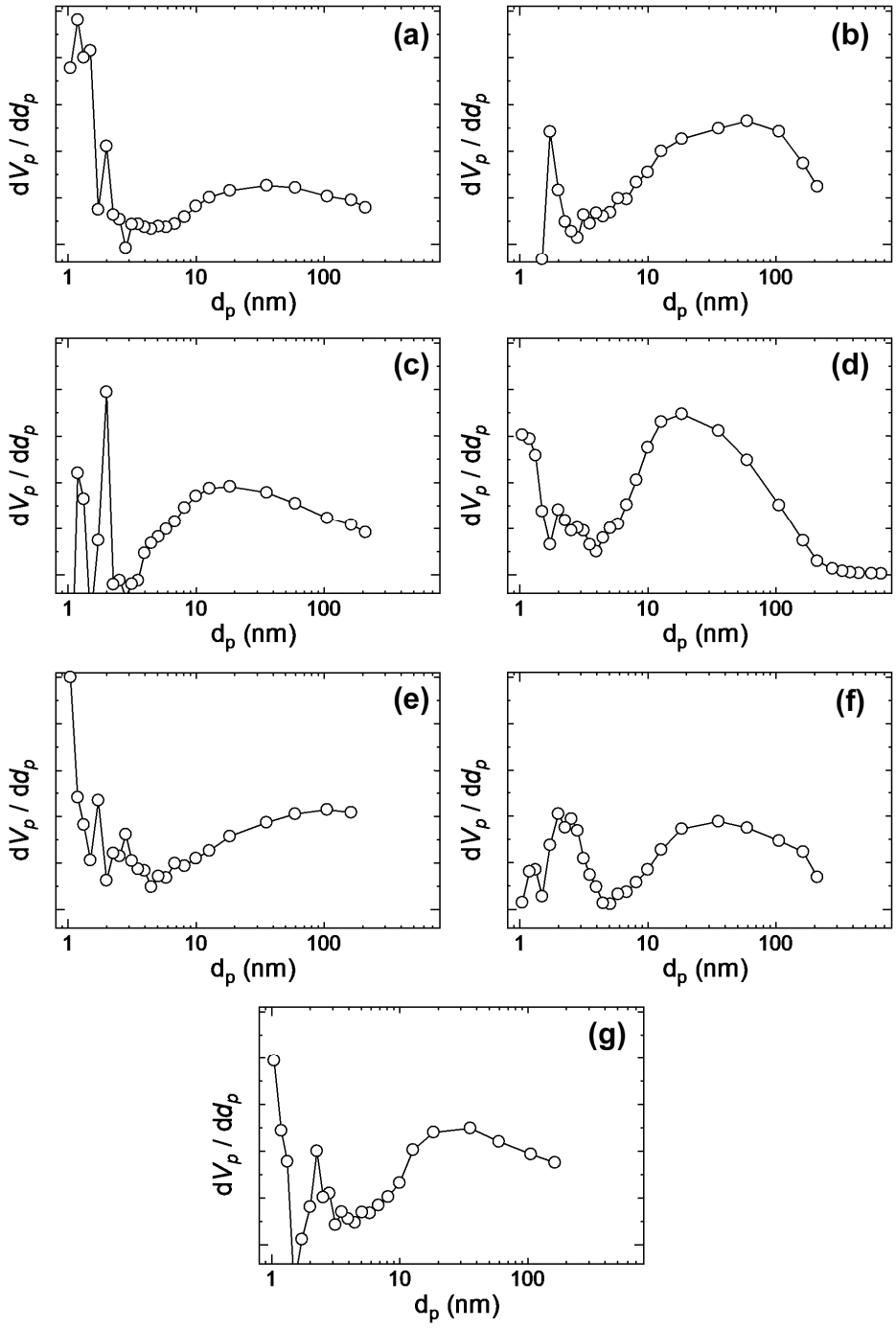

Figure S3. BJH pore size distributions, showing hierarchical distributions with a high population of ~2–5 nm and a broad peak for ~30–40 nm particles, consistent with the TEM observations. (a) HEA5, (b) HEA5B, (c) HEA5P, (d) HEA5Ir, (e) HEA5Ru, (f) HEA5IrB, (g) HEA5RuP.

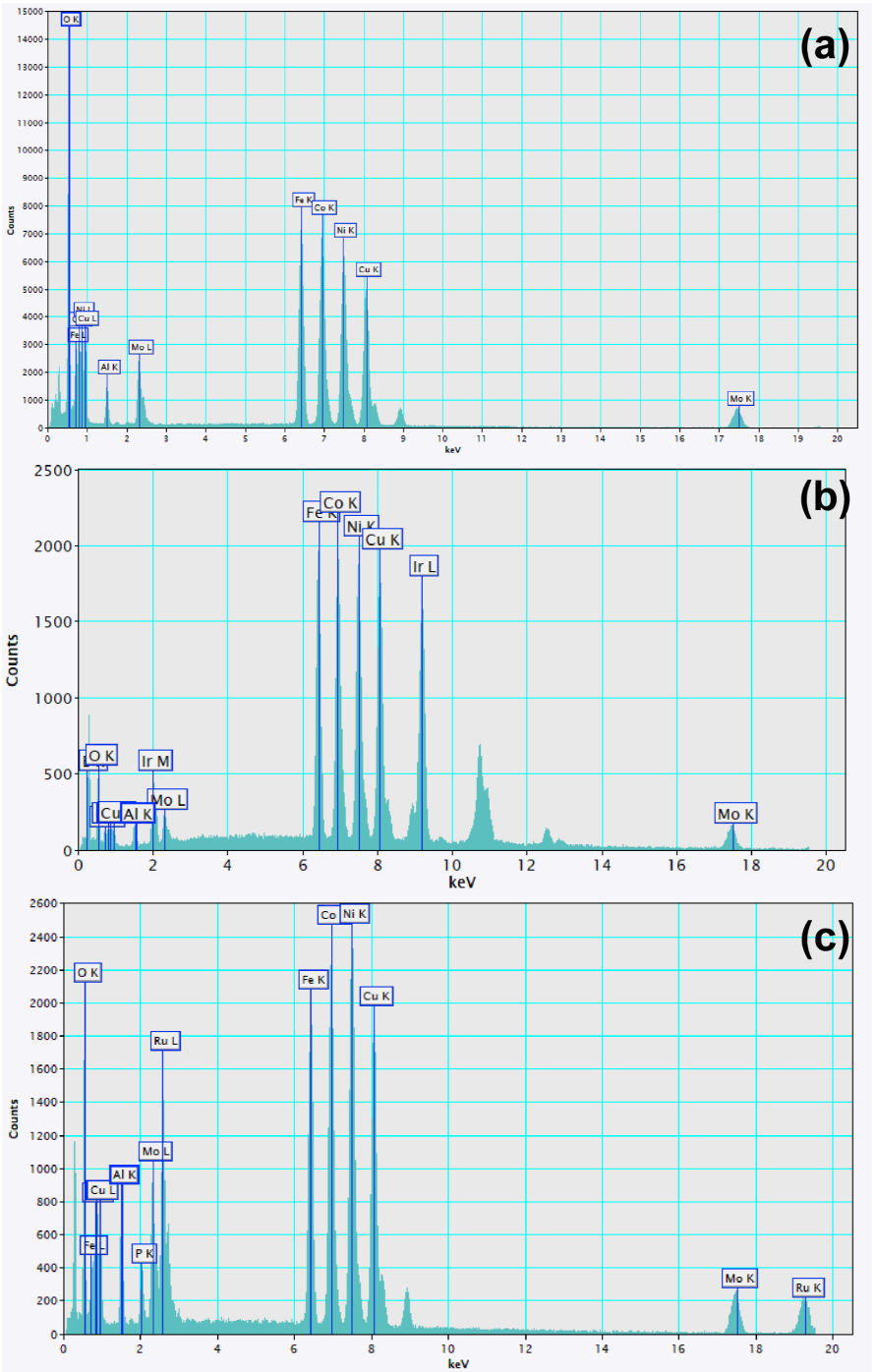

Figure S4. EDS analyses of (a) HEA5, (b) HEA5IrB, and (c) HEA5RuP.

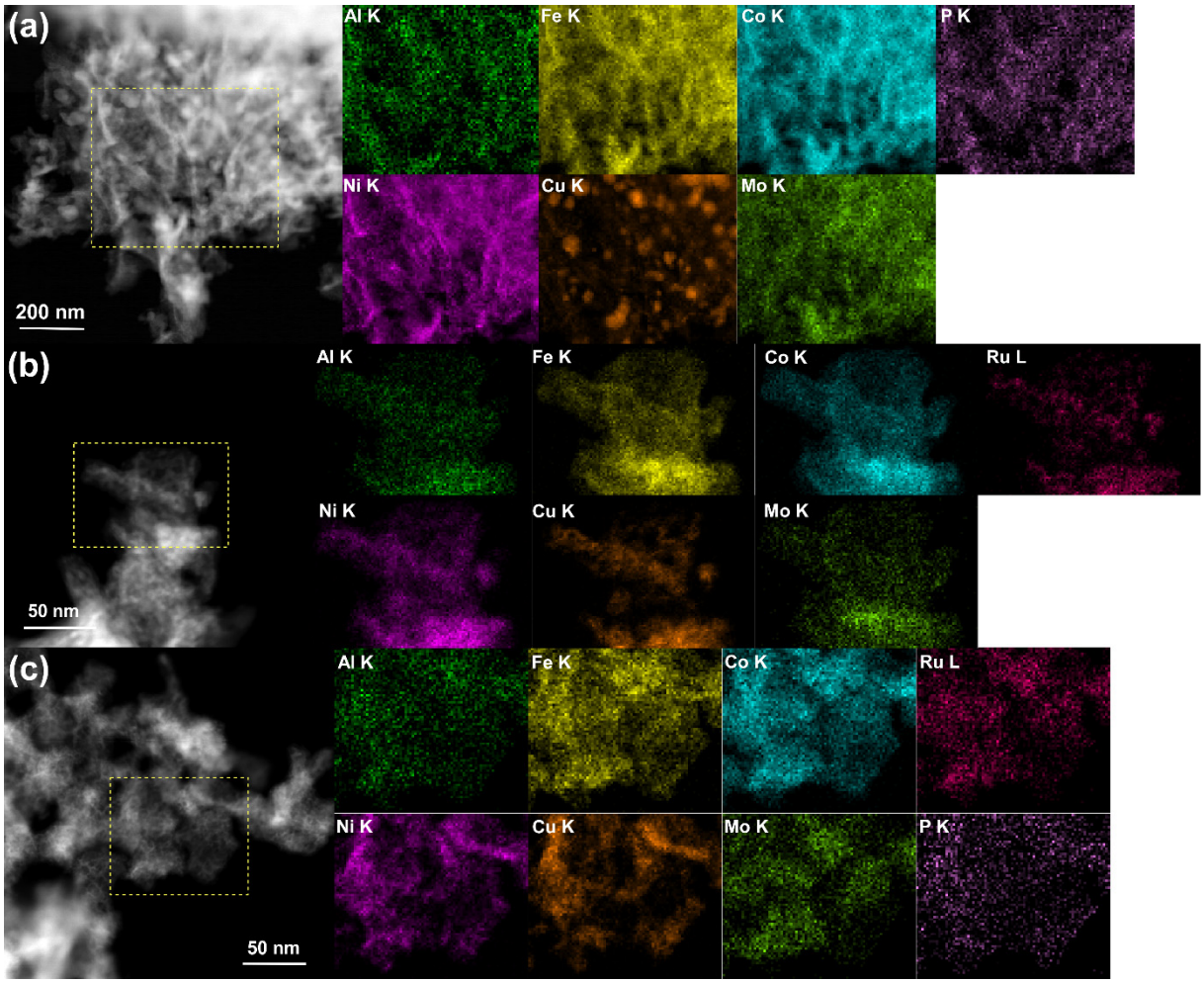

Figure S5. High-angle dark-field STEM images of the np-HEAs and corresponding EDS maps for each characteristic peak: (a) HEA5P, (b) HEA5Ru, and (c) HEA5RuP.

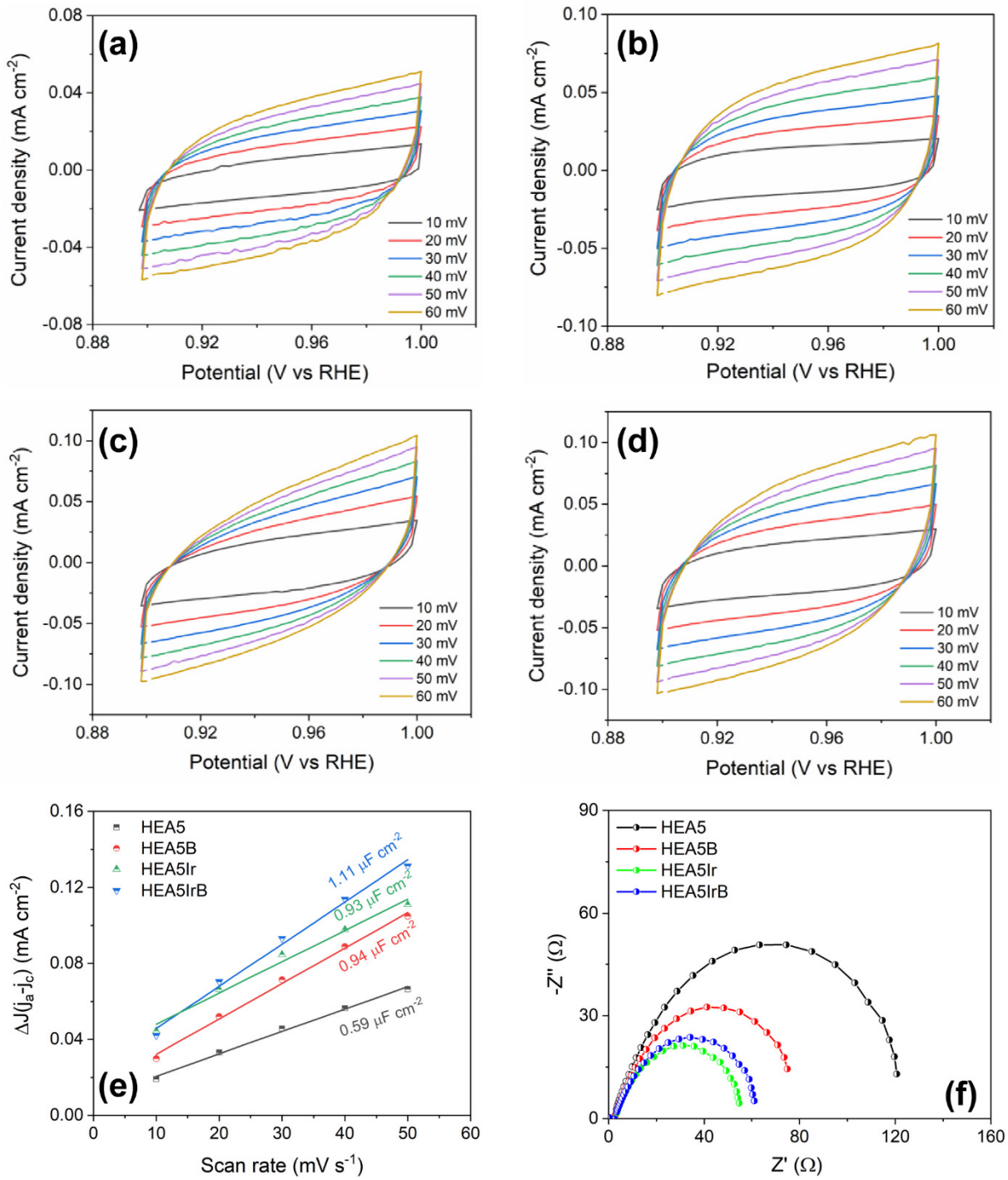

Figure S6. CV curves measured at different scan rates from 10 to 60 mV s^{-1} in 1.0 M KOH. (a) HEA5, (b) HEA5B, (c) HEA5Ir (d) HEA5IrB (The capacitive current at the middle potential of the CV curves is a function of scan rate). (f) EIS Nyquist plots of HEA5, HEA5B, HEA5Ir, and HEA5IrB.

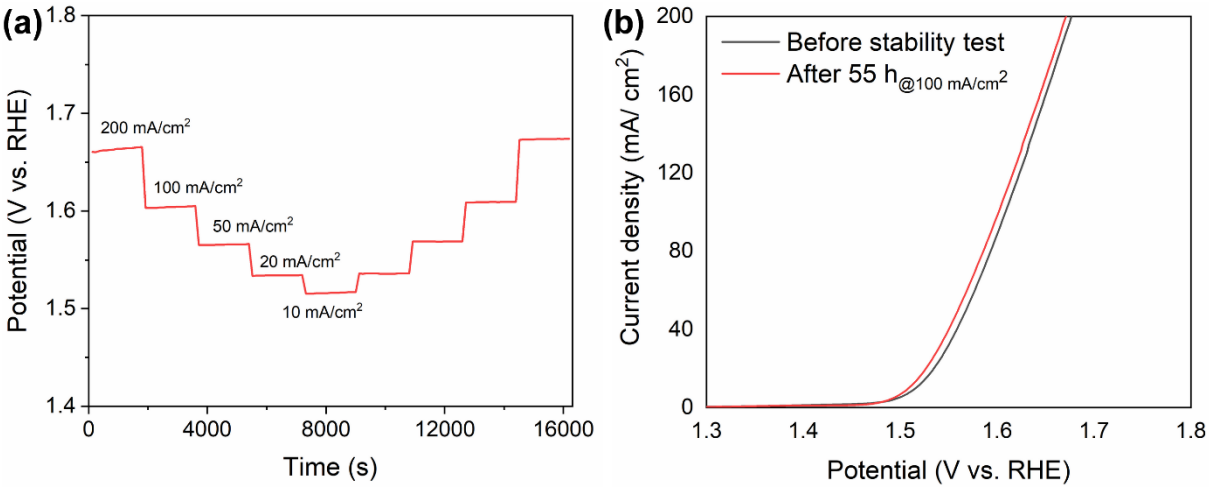

Figure S7. Electrochemical stability. (a) Potential at different current densities. (b) OER polarization curves of the spent HEA5IrB sample after the durability test (55 h@100 mA/cm^2) compared to the as-prepared sample.

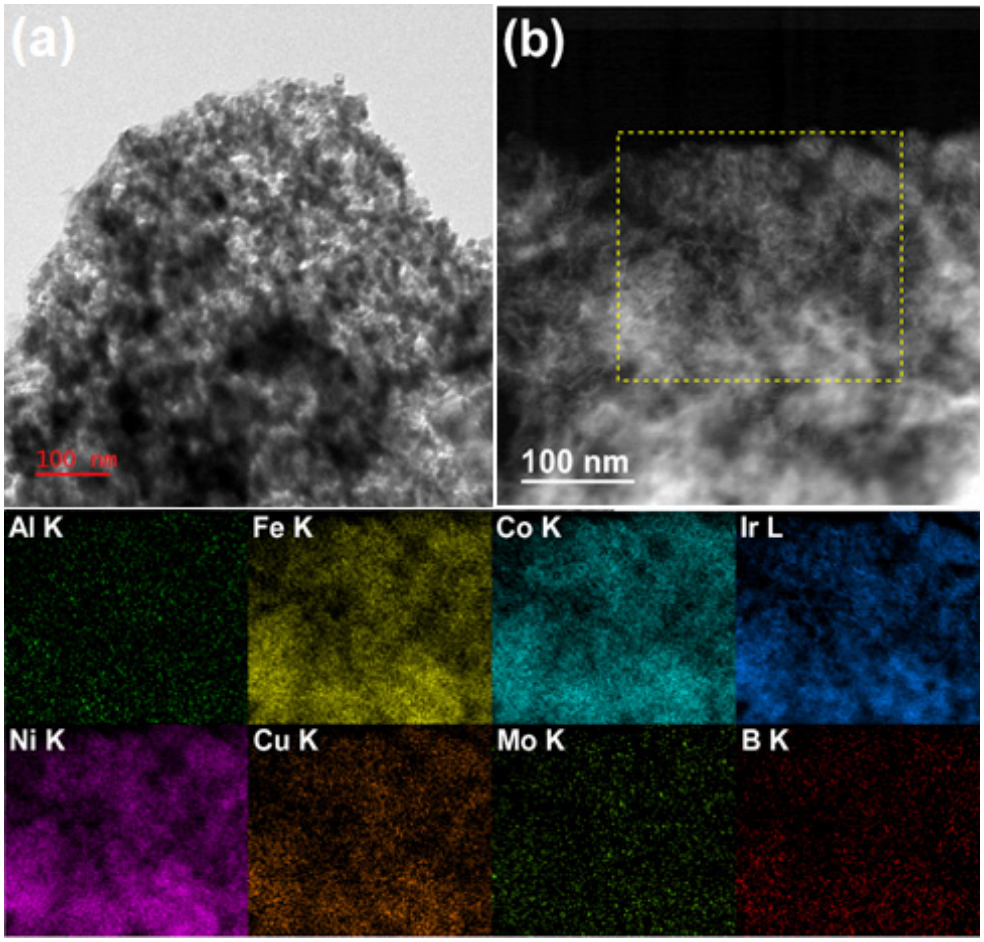

Figure S8. TEM images of the spent HEA5IrB. (a) Low-magnification TEM image. (b) High-angle dark-field STEM image of the np-HEAs and corresponding EDS maps of each characteristic peak.

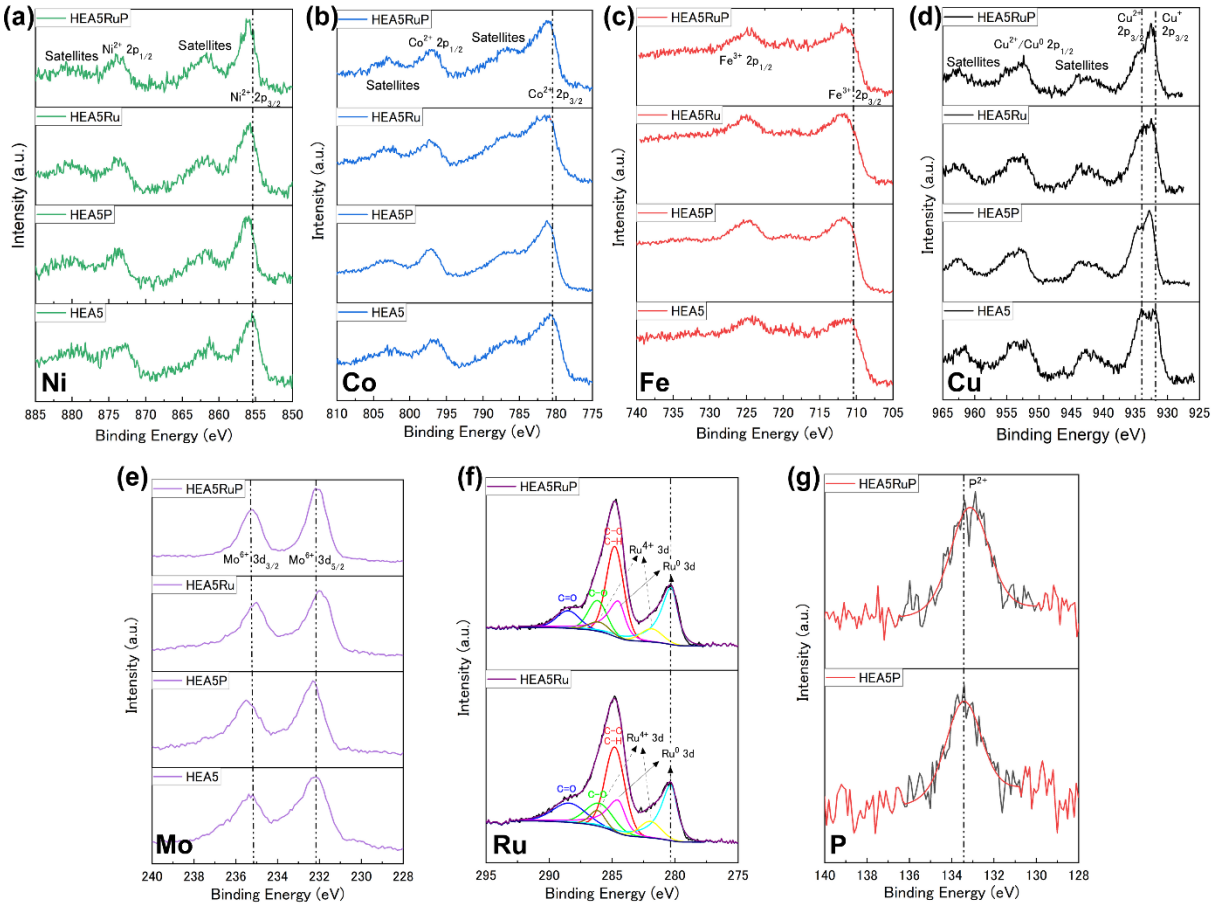

Figure S9. XPS spectra of the np-HEA catalysts, HEA5, HEA5P, HEA5Ru, and HEA5RuP. (a) Ni 2p, (b) Co 2p, (c) Fe 2p, (d) Cu 2p, (e) Mo 3d, (f) Ru 3d, and (g) P 1s.

Table S1. ICP analysis of the np-HEAs. The units represent the atomic percentage (at. %).

Element	HEA5	HEA5B	HEA5P	HEA5Ru	HEA5Ir	HEA5RuP	HEA5IrB
Al	14.2	13	14.9	15.2	14.7	16.7	15.7
Fe	18	19.4	15.6	17.5	14	12.0	13.8
Co	18.6	18.4	16.2	15	14.8	14.3	14.2
Ni	18.7	18.5	17.9	14.9	14.9	14.7	14.4
Mo	13.3	8.6	13	10.7	12.7	10.4	8.4
Cu	17.2	18.4	16.6	14.6	14.2	14.1	13.7
Ru	-	-	-	12.2	-	12.9	-
Ir	-	-	-	-	14.7	-	14.9
P	-	-	5.9	-	-	4.9	-
B	-	3.9	-	-	-	-	4.9

Table S2. BET surface of the np-HEAs.

	HEA5	**HEA5B**	**HEA5P**	**HEA5Ru**	**HEA5Ir**	**HEA5RuP**	**HEA5IrB**
BET Surface (m^2/g)	24.2	38.9	29.5	35.7	45.5	35.3	30.9