Supporting Information for

Interface functionalization of mesoporous ruthenium film with polyaniline for enhanced hydrogen evolution electrocatalysis at all-pH value

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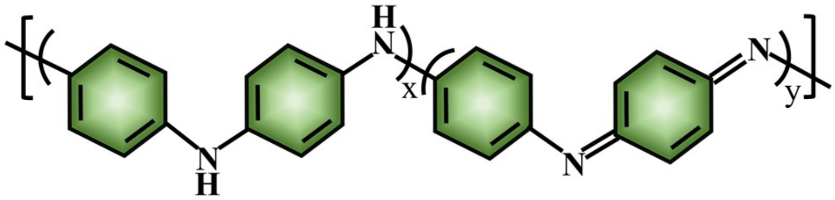

Scheme. S1 Molecular structure of PANI.

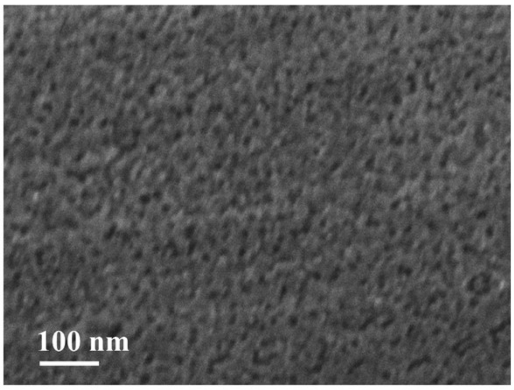

Fig. S1 SEM image of the mRu film.

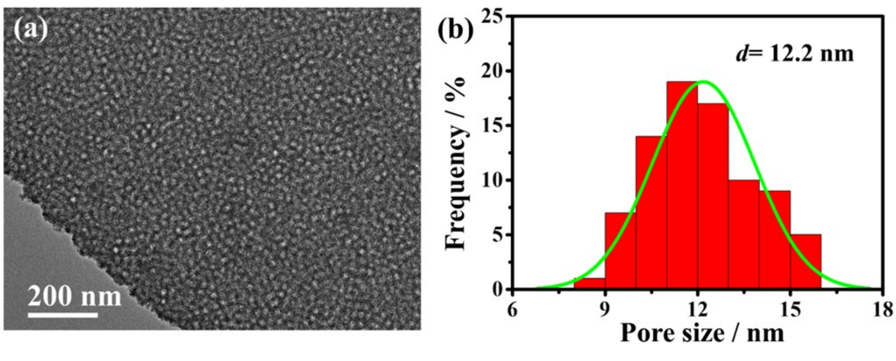

Fig. S2 (a) TEM image and (b) corresponding pore size distribution of the mRu@PANI/CP. The inserted values indicate the average values.

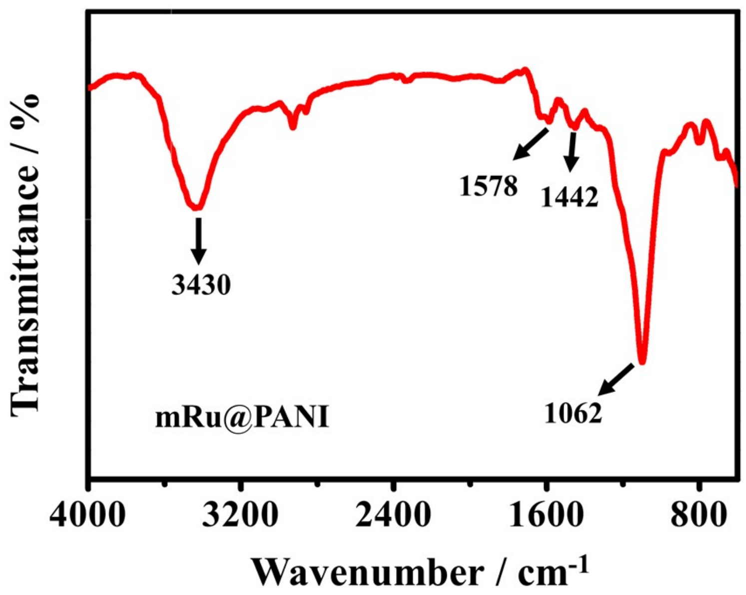

Fig. S3 FTIR spectra of mRu@PANI.

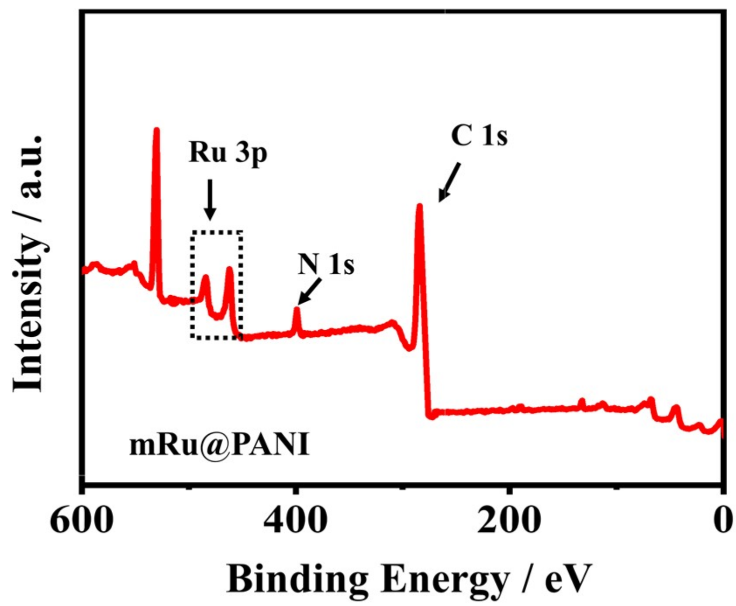

Fig. S4 XPS survey spectrum of mRu@PANI.

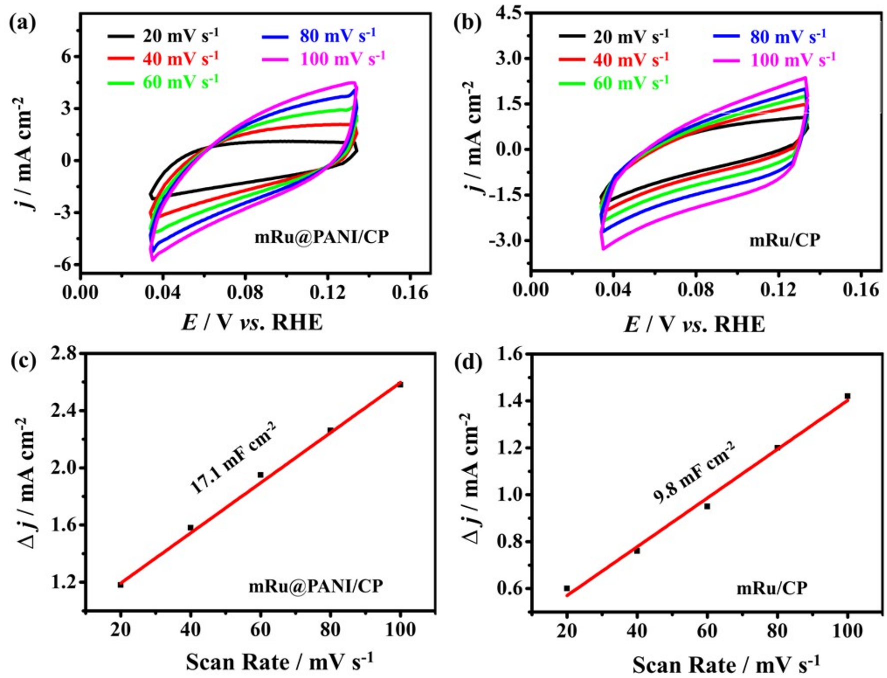

Fig. S5 Cyclic voltammogram (CV) curves of (a) mRu@PANI/CP and (b) mRu with different scan rates in 0.5 M H_2SO_4. The corresponding capacitive current densities of (c) mRu@PANI/CP and (d) mRu/CP.

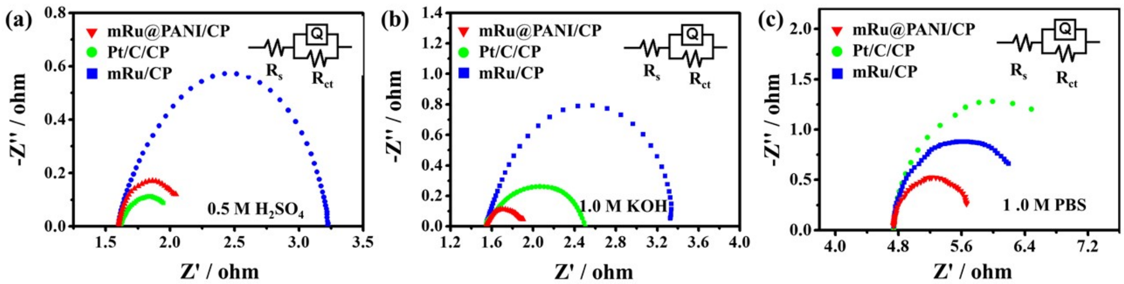

Fig. S6 EIS spectra of various catalysts in (a) 0.5 M H_2SO_4, (b) 1.0 M KOH and (c) 1.0 M PBS. The inserts show corresponding equivalent circuits.

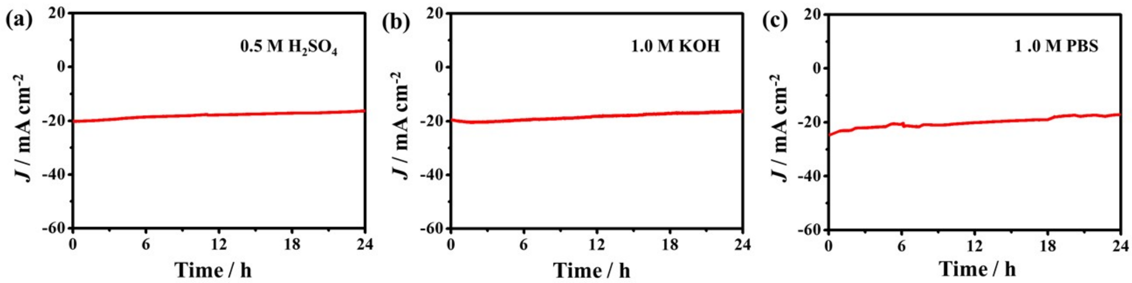

Fig. S7 Chronoamperometry (i-t) curves of mRu@PANI/CP in (a) 0.5 M H_2SO_4, (b) 1.0 M KOH and (c) 1.0 M PBS.

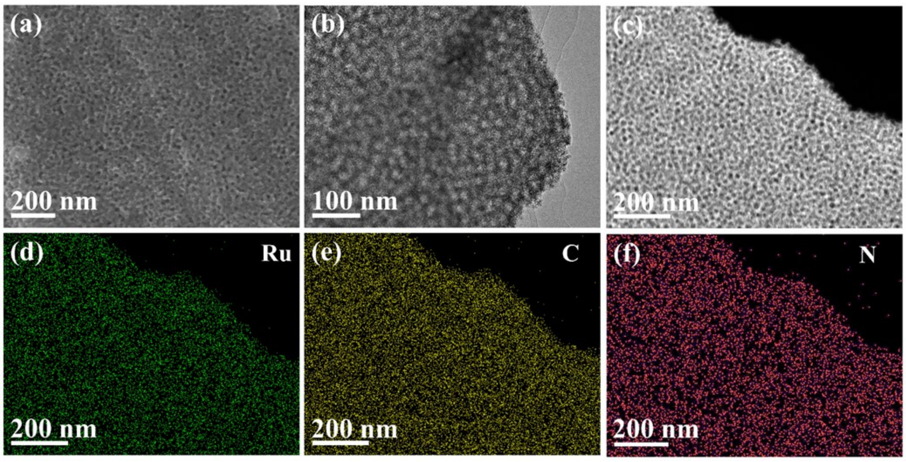

Fig. S8 The (a) SEM, (b) TEM, (c) HAAD-STEM and (d) corresponding EDS mapping of mRu@PANI/CP after stability test in 0.5 M H_2SO_4.

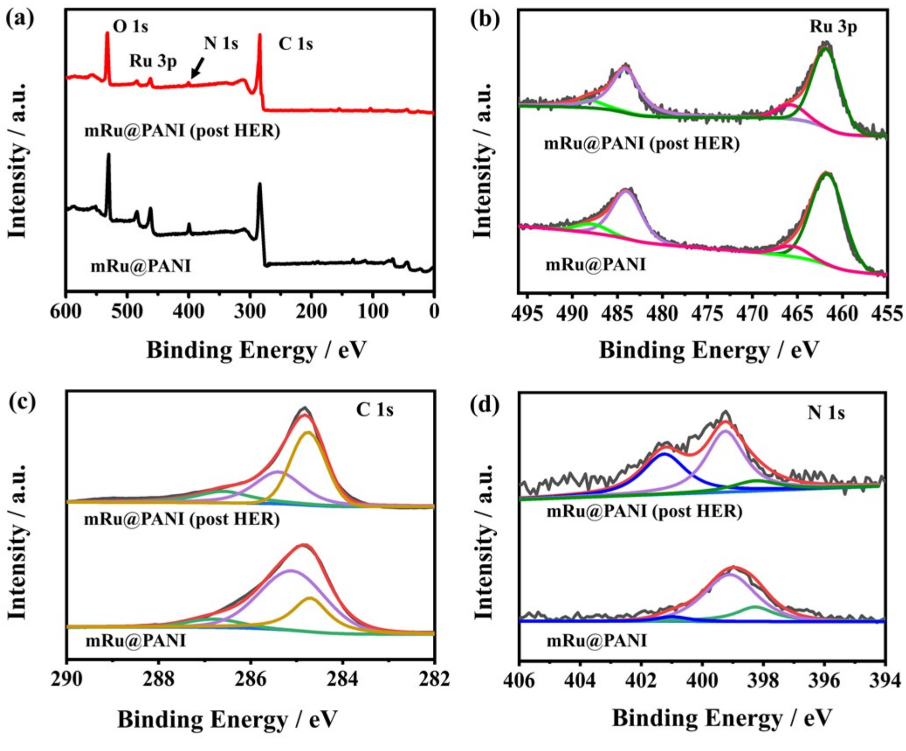

Fig. S9 (a) XPS survey spectra, (b) Ru 3P, (c) C 1s, and (d) N 1s spectra of mRu@PANI before and after stability test in 0.5 M H_2SO_4.

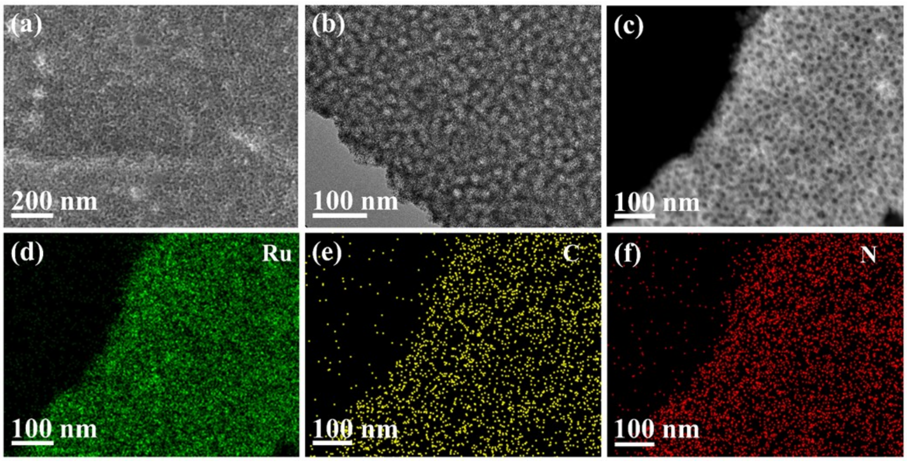

Fig. S10 The (a) SEM, (b) TEM, (c) HAAD-STEM and (d) corresponding EDS mapping of mRu@PANI/CP after stability test in 1.0 M KOH.

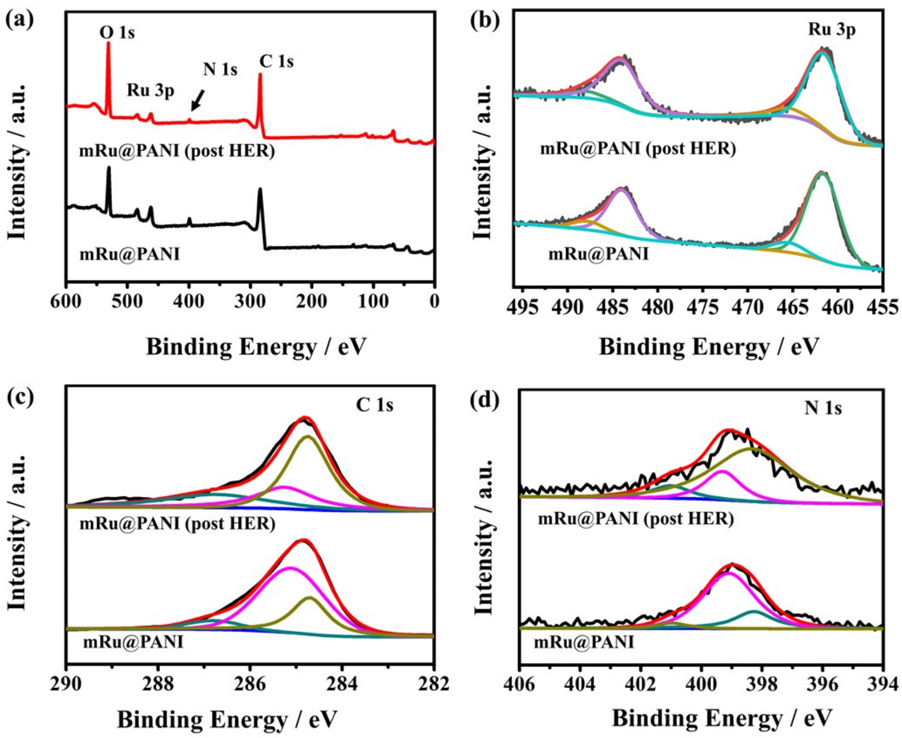

Fig. S11 (a) XPS survey spectra, (b) Ru 3P, (c) C 1s, and (d) N 1s spectra of mRu@PANI before and after stability test in 1.0 M KOH.

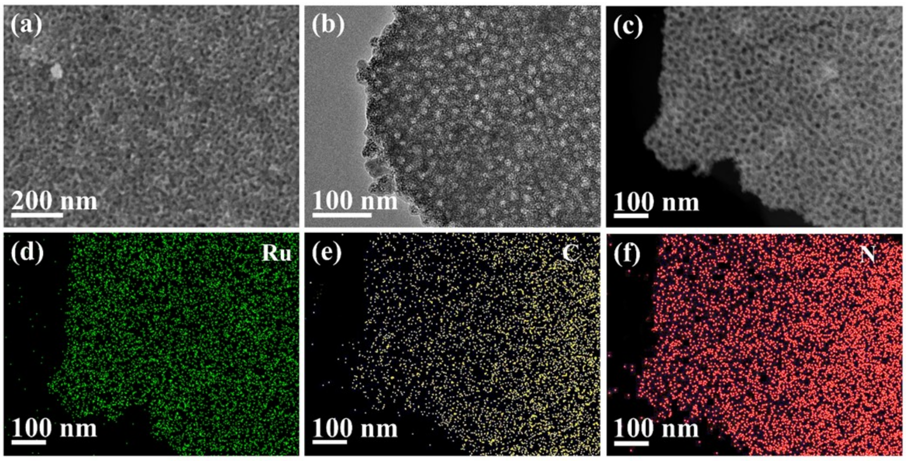

Fig. S12 The (a) SEM, (b) TEM, (c) HAAD-STEM and (d) corresponding EDS mapping of mRu@PANI/CP after stability test in 1.0 M PBS.

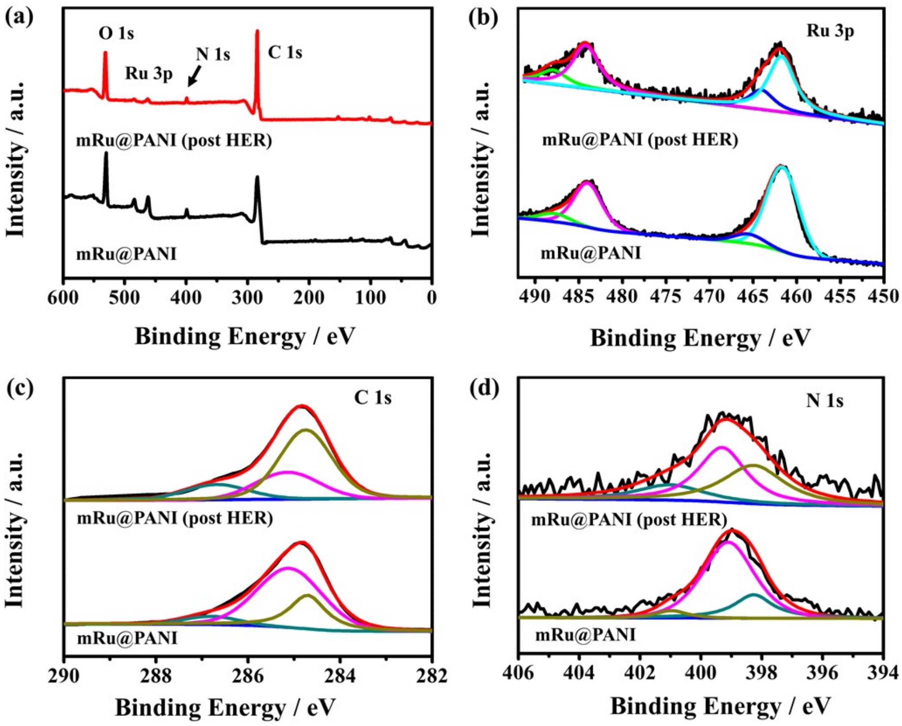

Fig. S13 (a) XPS survey spectra, (b) Ru 3P, (c) C 1s, and (d) N 1s spectra of mRu@PANI before and after stability test in 1.0 M PBS.

Table S1. HER performance comparison between the mRu@PANI/CP and some other reported Ru-based electrocatalysts in 0.5 M H_2SO_4.

Catalyst	**Electrolytes**	**Overpotential at 10 mA cm^{-2} (mV)**	**Ref.**
mRu@PANI/CP	0.5 M H_2SO_4	30	This work
Ru_xFe_yP-NCS/CNF	0.5 M H_2SO_4	66	1
RuNi NSs@PANI	0.5 M H_2SO_4	42	2
Ru_xSe@MoS_2	0.5 M H_2SO_4	120	3
Rh_2P	0.5 M H_2SO_4	55	4
Ru-MC	0.5 M H_2SO_4	40	5
Ru@N/S/TiO_2/rGO	0.5 M H_2SO_4	60	6
Ni-Ru-P	0.5 M H_2SO_4	35	7
RuC	0.5 M H_2SO_4	35	8

Table S2. HER performance comparison between the mRu@PANI/CP and some other reported electrocatalysts in 1.0 M KOH.

Catalyst	**Electrolytes**	**Overpotential at 10 mA cm^{-2} (mV)**	**Ref.**
mRh@PANI/CP	1.0 M KOH	27	This work
Ru-MoS_2/CC	1.0 M KOH	41	9
Ru–MoO_2	1.0 M KOH	29	10
Ru@CN-0.16	1.0 M KOH	32	11
Ru/Cu_{2+1}O NT/CuF	1.0 M KOH	44	12
Ru–Ru_2P/PC	1.0 M KOH	43.4	13
RuCu NWs	1.0 M KOH	32	14
S-RuP@NPSC-900	1.0 M KOH	92	15
CuRu	1.0 M KOH	85	16

Table S3. HER performance comparison between the mRu@PANI/CP and some other reported electrocatalysts in 1.0 M PBS.

Catalyst	Electrolytes	Overpotential at 10 mA cm^{-2} (mV)	Ref.
mRh@PANI/CP	1.0 M PBS	24	This work
Ru@CN-0.16	1.0 M PBS	100	11
RuCu	0.1 M PBS	73	14
CuRu	1.0 M PBS	91	16
Ni-Ru	1.0 M PBS	80	17
Ni_2P-Ru_2P/CCG	1.0 M PBS	113	18
Ru-rGo	1.0 M PBS	72	19
RuSA–N-Ti_3C_2Tx	1.0 M PBS	81	20
Rh_xRu_{100-x}@UiO-66-NH_2	1.0 M PBS	114	21

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