Supporting information

Tunable fcc/hcp NiRu alloy nanoparticles anchored on hierarchical N-doped carbon nanosheets for enhanced hydrogen evolution

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Figures and Table

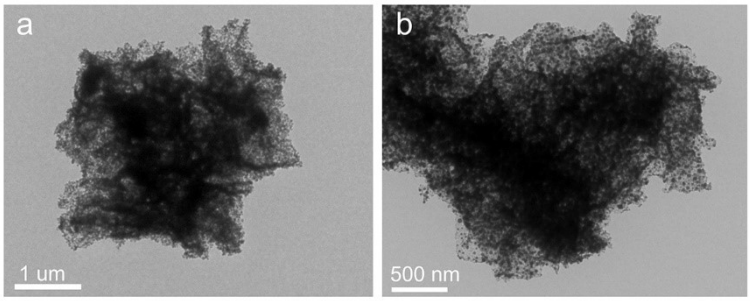

Fig. S1 TEM images of Ni_5Ru@N-C.

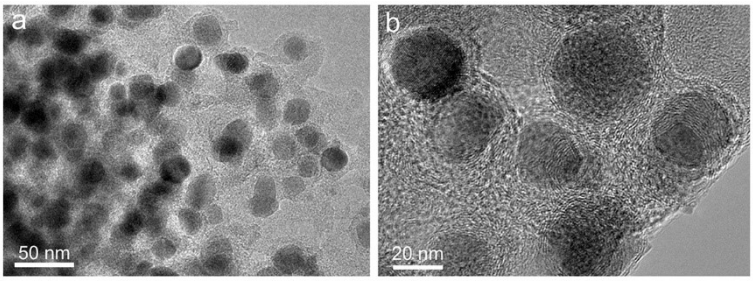

Fig. S2 TEM images of Ni_5Ru@N-C.

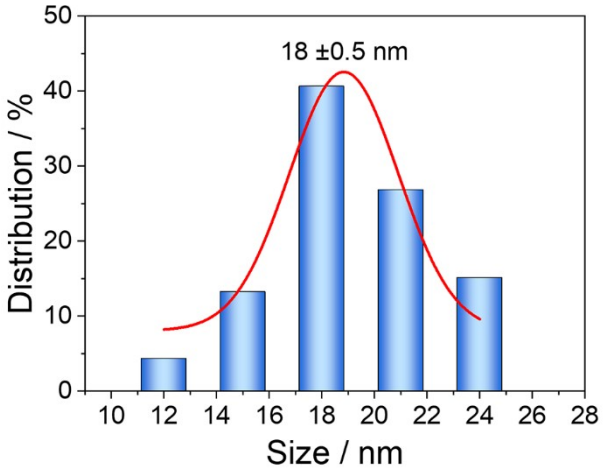

Fig. S3 Particle size distribution histogram of Ni_5Ru@N-C.

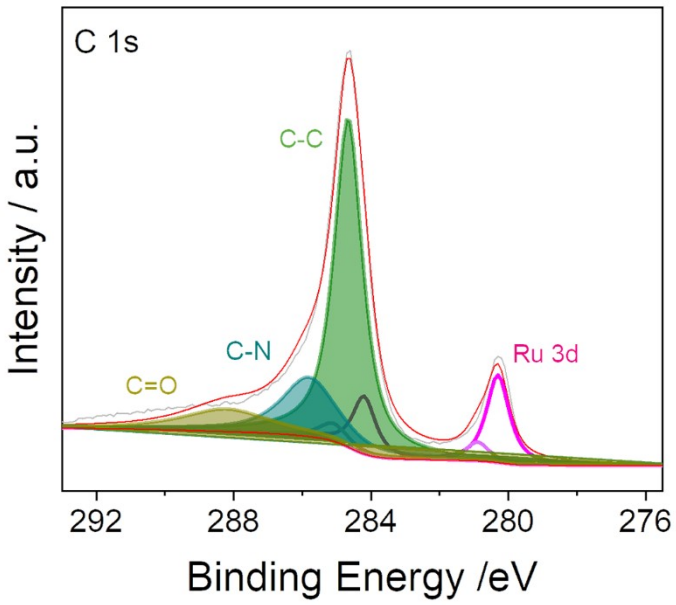

Fig. S4 C 1s XPS spectra of Ni_5Ru@N-C.

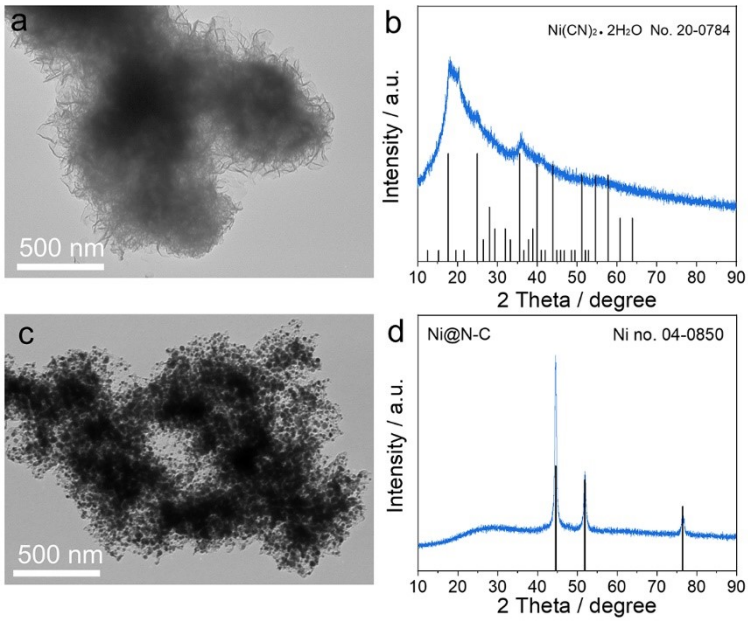

Fig. S5 (a) TEM image and (b) XRD pattern of IDAN-Ni^{II}; (c) TEM image and (d) XRD pattern of IDAN-Ni^{II}.

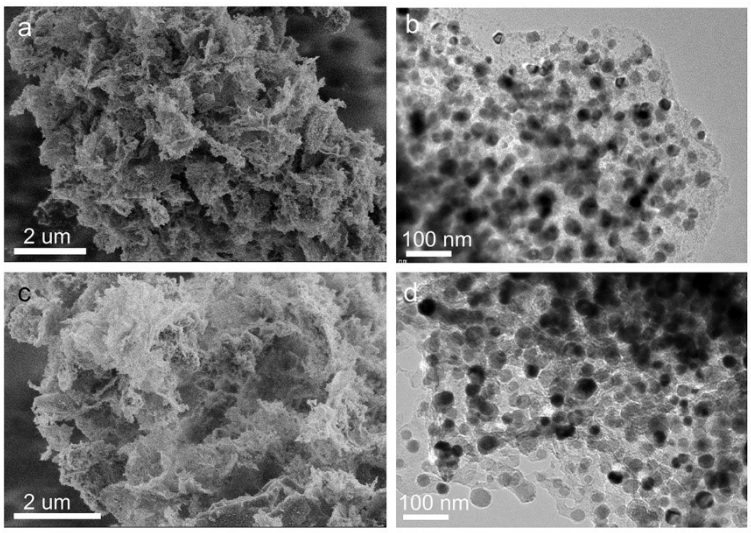

Fig. S6 (a) SEM and (b) TEM image of $Ni_{10}Ru$@N-C; (c) SEM and (d) TEM image of I Ni_3Ru@N-C.

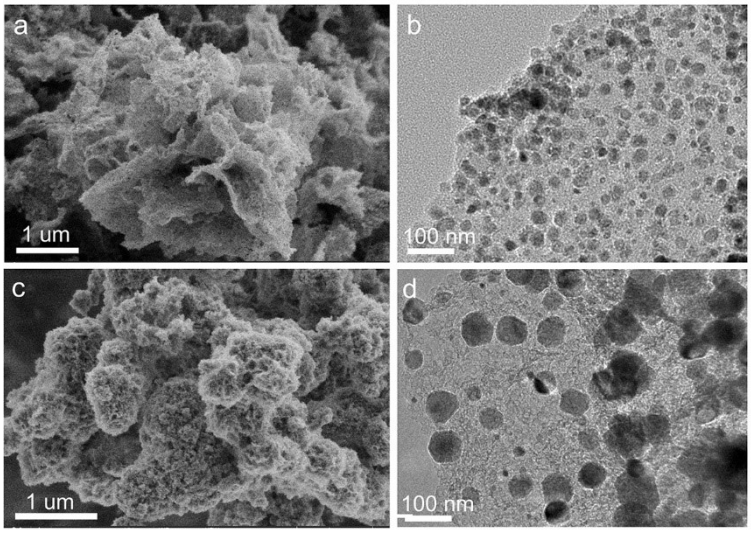

Fig. S7 SEM and TEM image of Ni_5Ru@N-C with different temperatures: (a-b) 600 ^oC; (c-d) 800 ^oC.

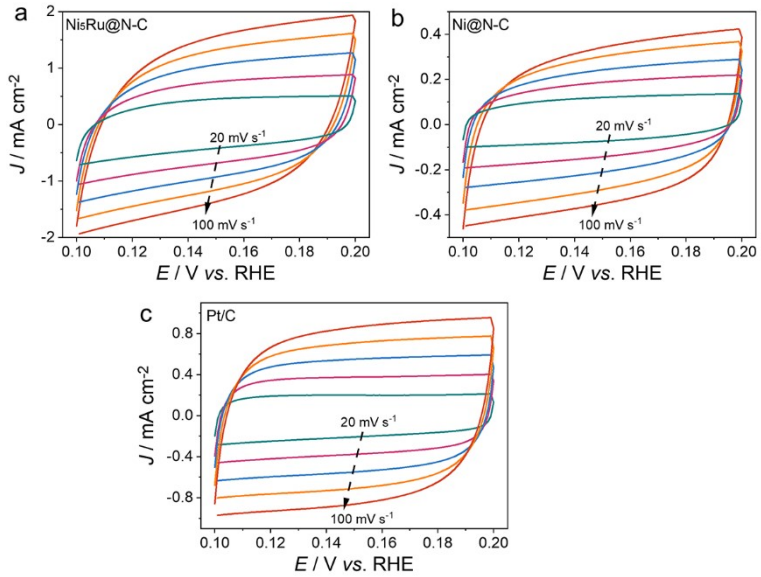

Fig. S8 CVs of (a) Ni_5Ru@N-C, (b) Ni@N-C and (c) Pt/C at different sweeping rates from 20 mV s^{-1} to 100 mV s^{-1} in 1.0 M KOH solution.

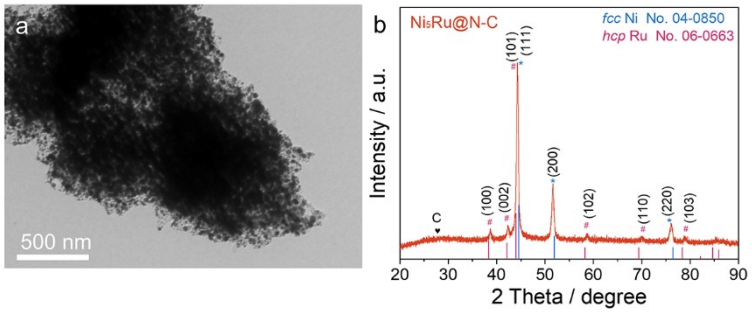

Fig. S9 TEM image and XRD pattern recovered Ni_5Ru@N-C after the stability.

Table S1. Summary of recently reported Pt/Ru-based HER electrocatalysts in 1 M KOH solution.

Catalysts	Overpotential (mV) @10 mA cm^{-2}	Tafel slope (mV dec^{-1})	**Ref.**
Ni_5Ru@N–C	**17**	**30.2**	**This work**
Pt/C	**27**	**43.7**	**This work**
$Pt_{0.47}$-Ru/Acet	17	66.6	*Chem. Eng. J.,* 2022, 448, 137611
Pt_3Co@NCNT	36	34.8	*Angew. Chem. Int. Ed.,* 2021, 60, 19068
$CoPt_3$@Co2P/ Co@NCNT	19	48	*Small,* 2021, 17, 2104656
NiRu/NiO	18	43.3	*Chem. Commun., 2022, 58, 8556–8559*
Ni_{91}Ru19@NC-600(mix)	27	42	*Chem. Eur. J.* 2023, 29, e202300062
PtRu@C_2N	59	63	*Chem. Eng. J.,* 2022, 428, 131085
$NiRu_2$@NC-600	53	37.95	*Dalton Trans.*,2020, 49,13647–13654
PtRu/EC-700	18	44.54	*Nanoscale,* 2021, 13, 10044
Pt_3Fe/NMCS-A	29	52	*Adv. Mater.,* 2023, 35, 2303030
MI-PtZnCo	29	64.2	*Adv. Energy Mater.*, 2022, 12, 2201478
T-Pt-Co_4N	31	35	*ACS Nano*, 2022, 16, 11, 18038-18047
$Ni_{0.90}Ru_{0.10}$DPA-NPs	20	66.4	*Small Methods 2022, 6, 2101188*
Pt_3Co@NCNT	36	34.8	*Angew. Chem. Int. Ed.*, 2021, 60, 19068-19073
Pt_x@Ni_y-rGO	37	43	*Nano Res.,* 2022, 15, 965-971
PtSi	38	47	*Adv. Energy Mater.,* 2022, 12, 20, 2200293
NiRu@NC	19	37	*Chem. Eng. J. 426 (2021) 130762*
d-$PtSe_2$	59	88	*Adv. Energy Mater.*, 2022, 12 2102359