Electronic Supplementary Material (ESI) for Materials Chemistry Frontiers.

Supporting Information:

Interface catalysis by Pt nanocluster@Ni_3N for bifunctional hydrogen evolution and oxygen evolution

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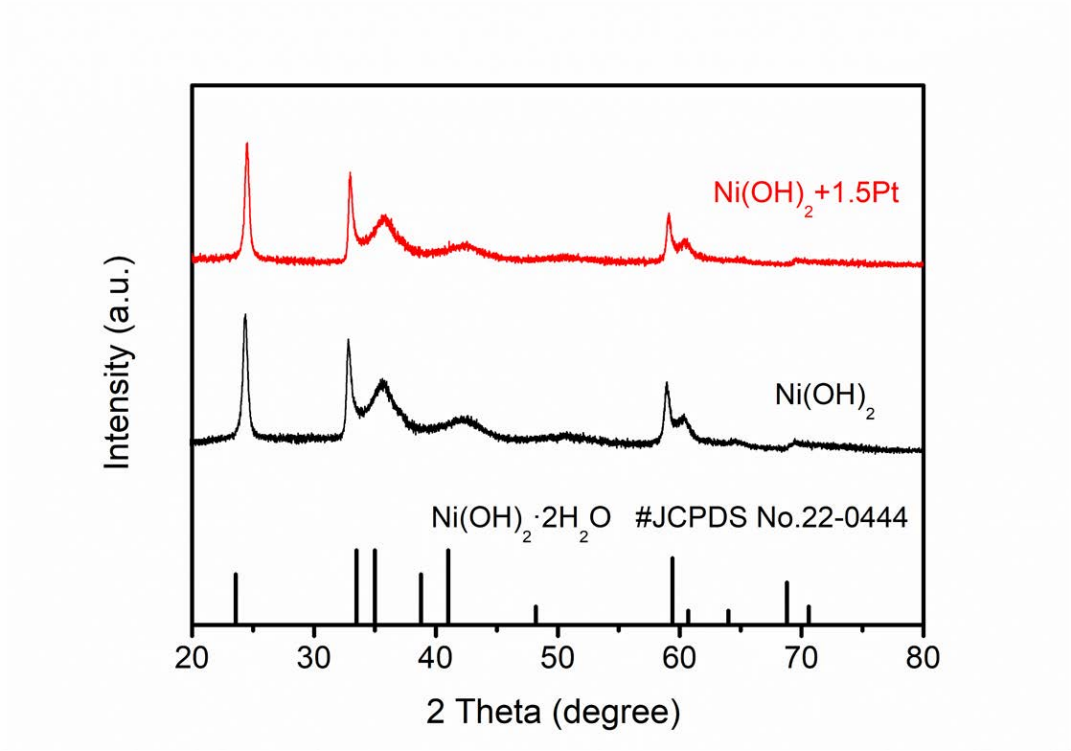

Fig. S1 The XRD of precursor $Ni(OH)_2 \cdot 2H_2O$ and $Ni(OH)_2$-1.5Pt.

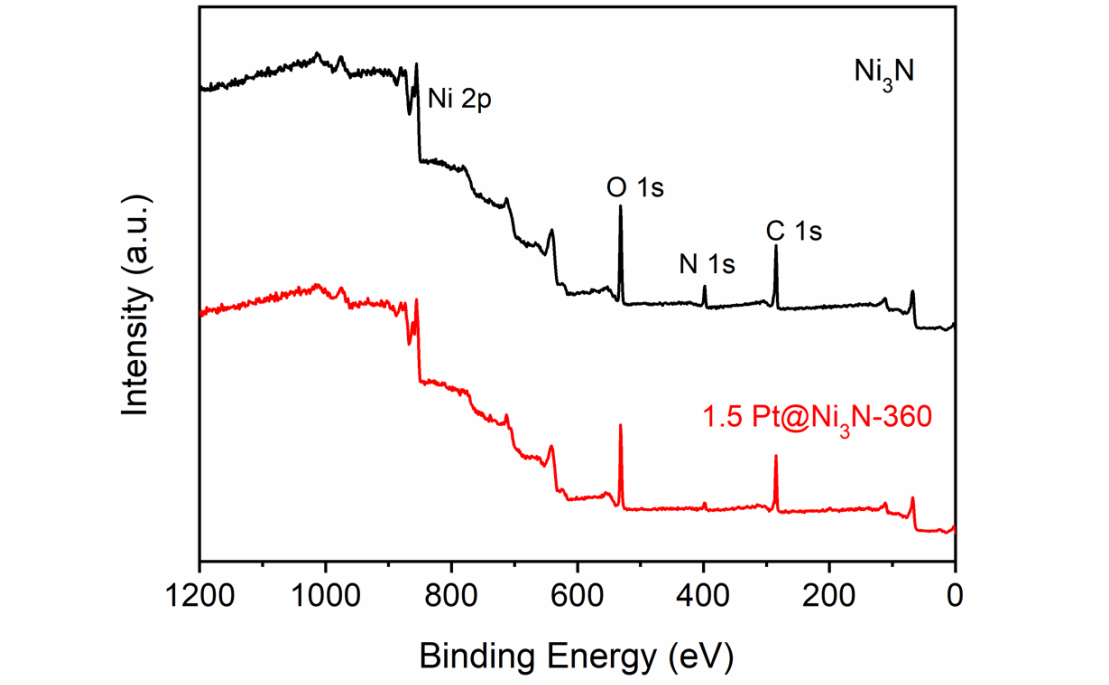

Fig. S2 XPS survey spectra of Ni_3N and 1.5 Pt@Ni_3N-360.

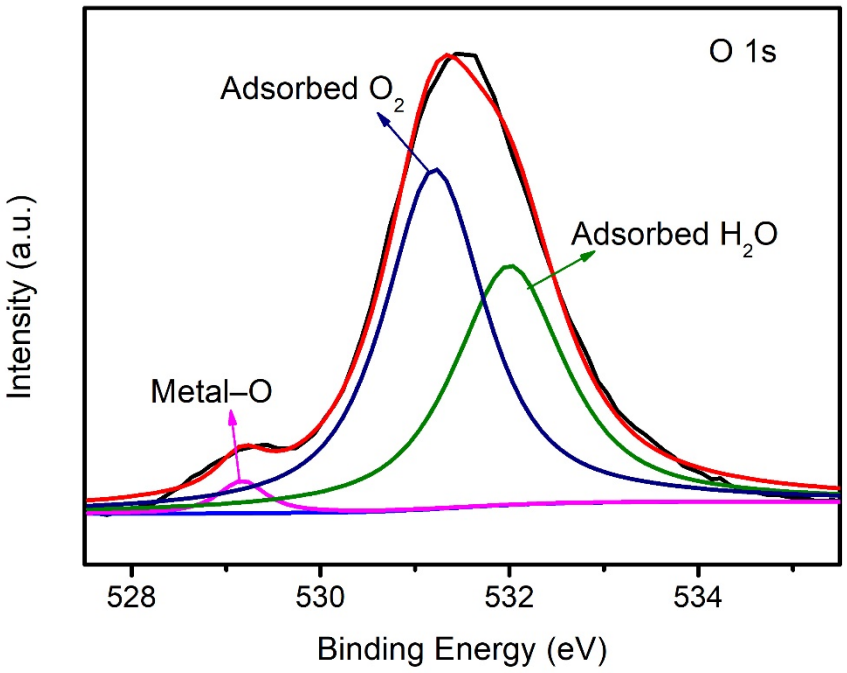

Fig. S3 O 1s XPS spectra of 1.5 Pt@Ni_3N-360.

Table S1. The comparison of 1.5Pt@Ni_3N-360 in this work and state of art literature HER catalysts in alkaline solution.

Catalyst	Pt ratio	Electrolyte	Overpotential at 10 mA cm^{-2} (mV)	Tafel slope (mV dec^{-1})	Reference
1.5Pt@Ni_3N-360	1 wt%	0.1 M KOH	71	48	This work
Pt-WS_2	-	1 M KOH	50	65	Adv. Mater., 2018, 30, 1704779.
Ni_3N/Pt	15 wt%	1 M KOH	50	36	Adv. Energy Mater., 2017, 7, 1601390
PtNWs/SL-$Ni(OH)_2$	38 wt%	1.0 M KOH	~70		Nat. Commun., 2015, 6, 6430
NiO_x/Pt_3Ni NWs	75 at%	1.0 M KOH	40		Angew. Chem. Int. Ed., 2016, 55, 12859
Pd-Pt-T	29 at%	1.0 M KOH	70		ACS Appl. Mater. Interfaces,

					2017, 9, 18008
hcp Pt–Ni	14 at%	0.1 M KOH	65	78	Nat. Commun.,
					2017, 8, 15131
PtNi-Ni NA/CC	7.7 wt%	0.1 M KOH	38	42	Inorg. Chem. Front.,
					2018, 5, 1365-1369.
Pt_3Ni_2-NWs-S/C	60.9	0.1 M KOH	42		Nat. Commun.,
	wt%				2017, 8, 14580
Pt_3Ni	73 at%	0.1 M KOH	65(E5)	46	Science,
					2014, 343, 1339

Table S2. The comparison of 1.5Pt@Ni_3N-360 in this work and state of art literature OER catalysts in alkaline solution.

Catalyst	Pt ratio	Electrolyte	Overpotential at 10 mA cm^{-2} (mV)	Tafel slope (mV dec^{-1})	Reference
1.5Pt@Ni_3N-360	1 wt%	0.1M KOH	285	57	This work
Pt/C-$LiCoO_2$	10 wt%	0.1 M KOH	440	87	J. Mater. Chem. A, 2016, 4, 4516-4524
$CoSe_{2-x}$-Pt	2.25 wt%	0.1 M KOH	314	31	Adv. Mater., 2019, 31, 1805581
Pt-CoS_2/CC	7.3 wt%	1 M KOH	300	58	Adv. Energy Mater., 2018, 8, 1800935
Pt/Fe-Au nanorods		1.0 M KOH	>570		J. Mater. Chem. A, 2018, 6, 7364-7369|
Pt-NiFe LDH	1.51wt%	1.0 M KOH	230	33	Nano Energy, 2017, 39, 30-43
Co-PB/Pt	4 wt%	1.0 M KOH	320	68	ACS Sustain. Chem. Eng., 2017, 5, 11577-11583.
Co-Pt/C	2.5 wt%	1.0 M KOH	320	72	J. Mater. Chem. A, 2018, 6,20214-20223

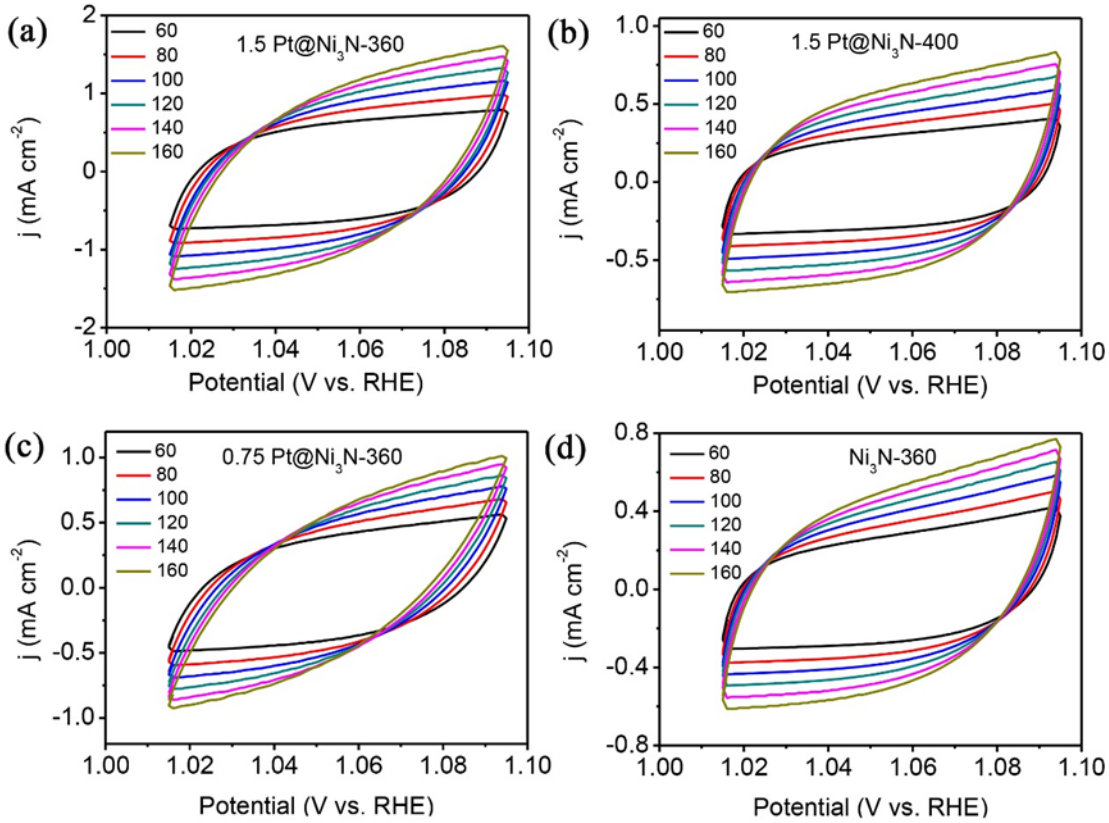

Fig. S4 Typical cyclic voltammetry curves of (a) 1.5Pt@Ni_3N-360; (b) 1.5Pt@Ni_3N-400; (c) 0.75Pt@Ni_3N-360; (d) Ni_3N-360 with different scan rate.

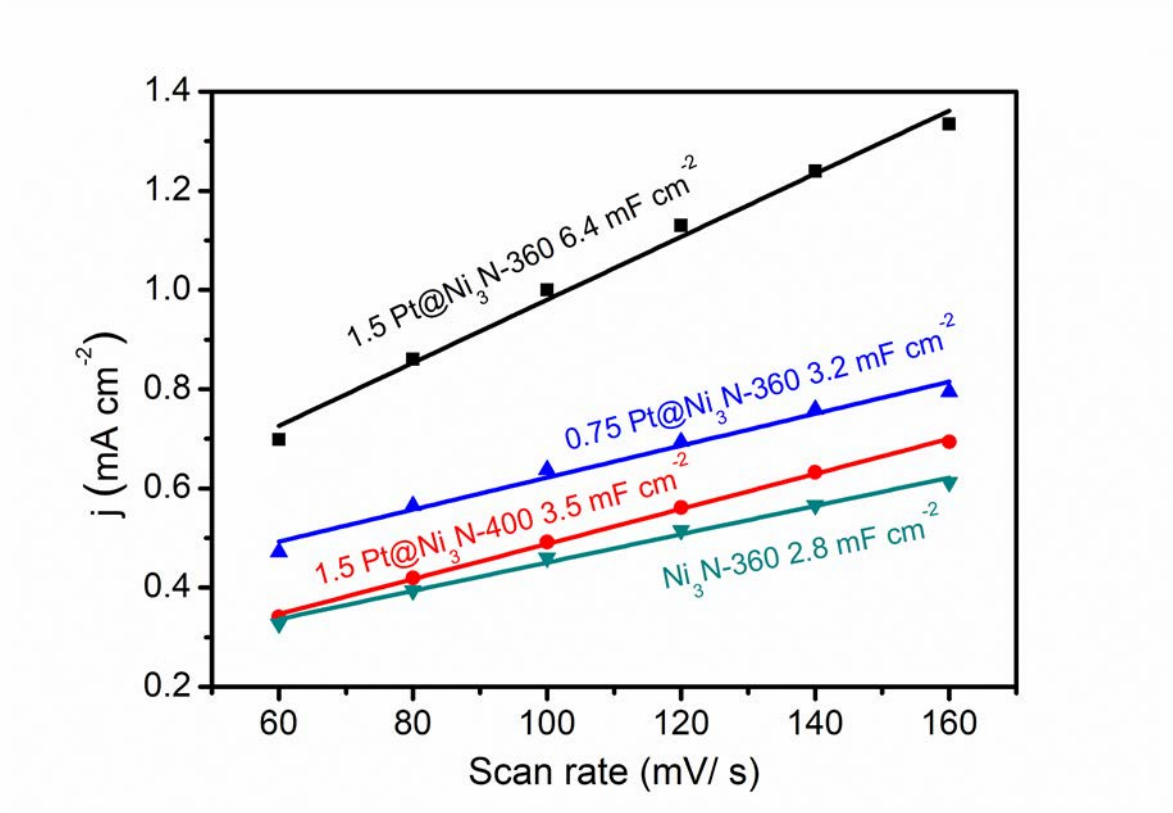

Fig. S5 The electrochemically active surface area of 1.5Pt@Ni_3N-360, 1.5Pt@Ni_3N-400, 0.75Pt@Ni_3N-360, Ni_3N-360.

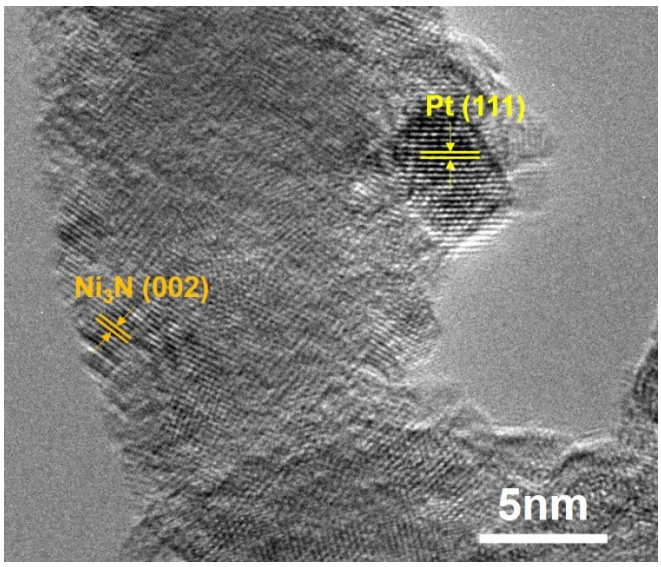

Fig. S6 HRTEM image of 1.5 Pt@Ni_3N-360 after reaction.

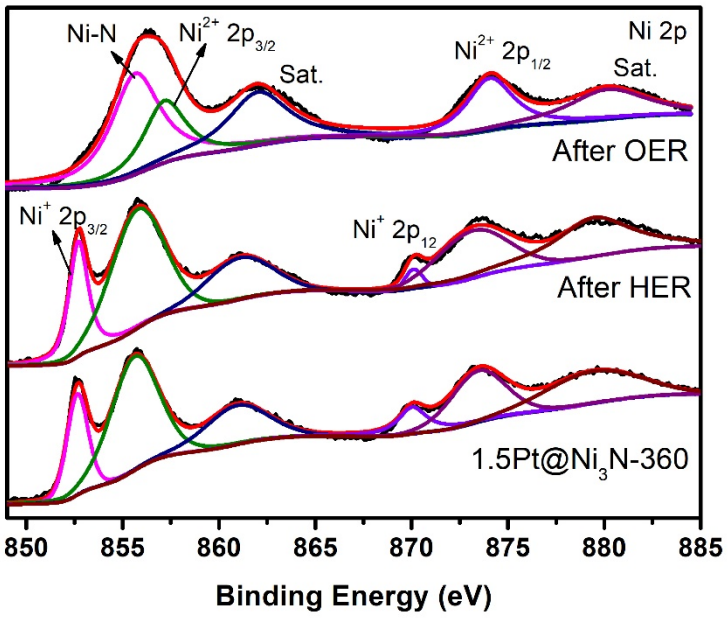

Fig. S7 Ni 2p XPS spectra of 1.5 Pt@Ni_3N-360 after HER/OER.

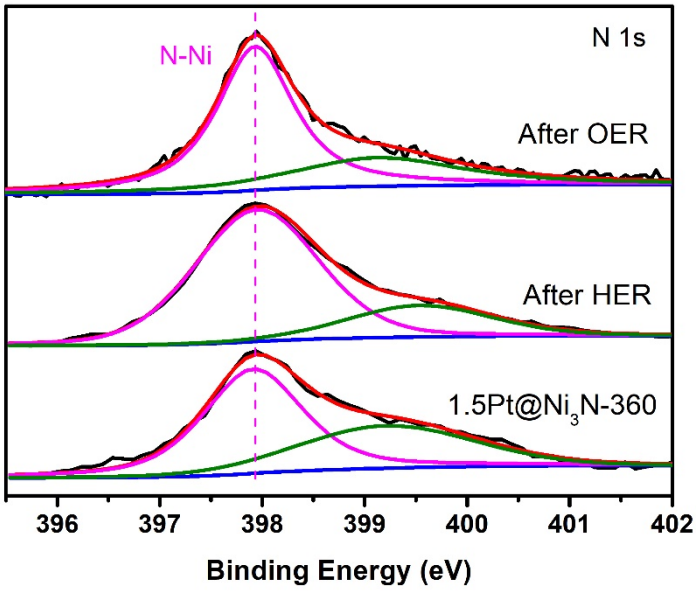

Fig. S8 N 1s XPS spectra of 1.5 Pt@Ni_3N-360 after HER/OER.

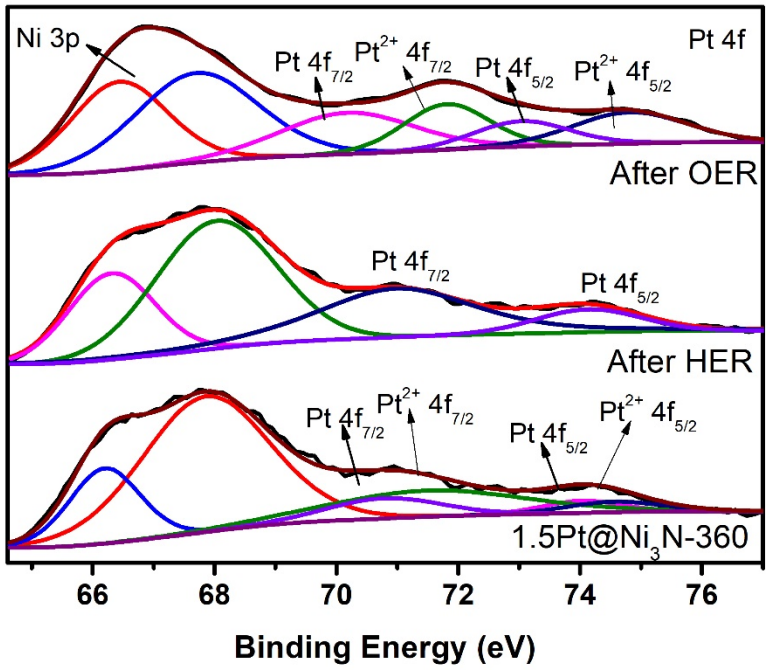

Fig. S9 Pt 4f XPS spectra of 1.5 Pt@Ni_3N-360 after HER/OER.

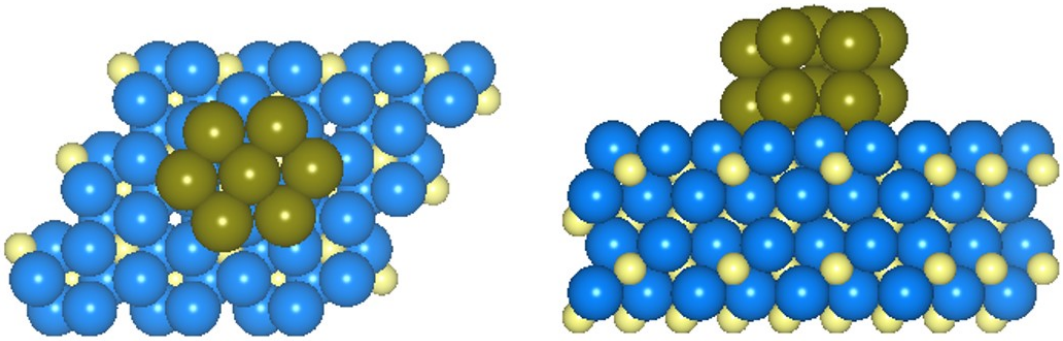

Fig. S10 Top view (left) and side view (right) of the Pt@Ni_3N.