Supporting Information

CoMo bimetallic N-doped carbon materials embedded with highly dispersed Pt nanoparticles as pH-universal hydrogen evolution reaction electrocatalyst

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1. **PXRD results.**

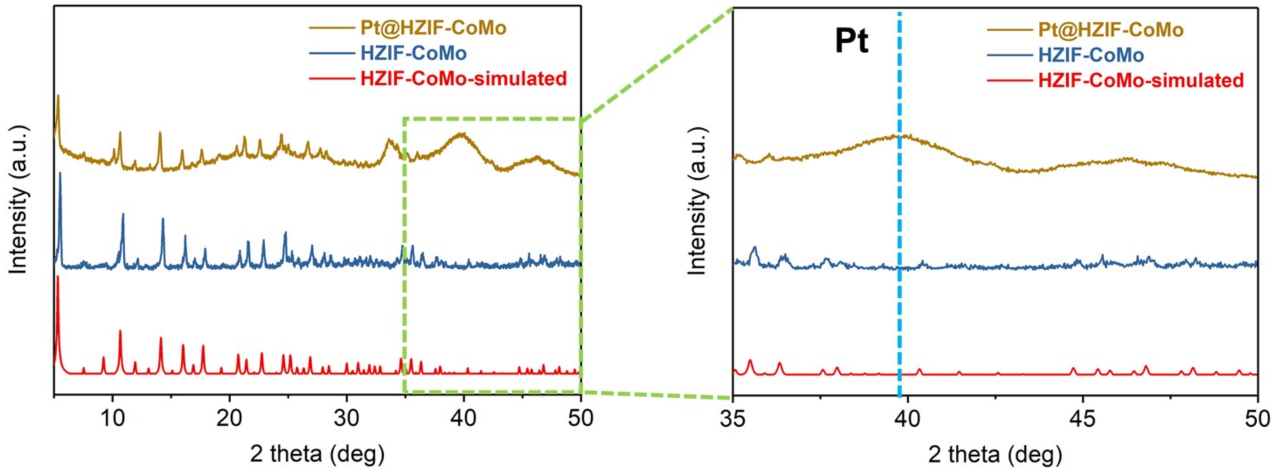

Figure S1. PXRD results of HZIF-CoMo, Pt@HZIF-CoMo comparing with the simulated data.

2. The FT-IR results

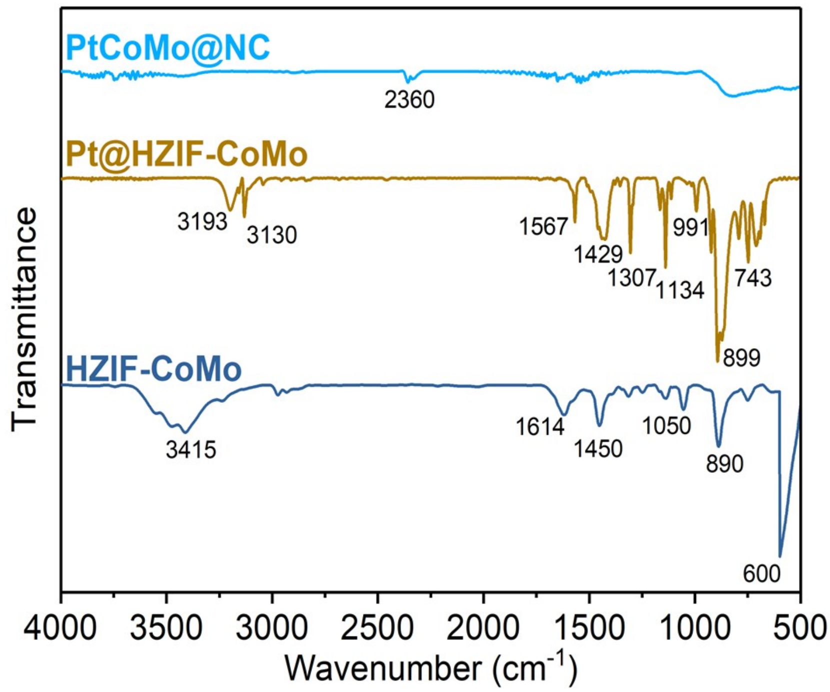

Figure S2. FT-IR spectra of HZIF-CoMo, Pt@HZIF-CoMo and PtCoMo@NC microcrystals powders.

3. TGA Results

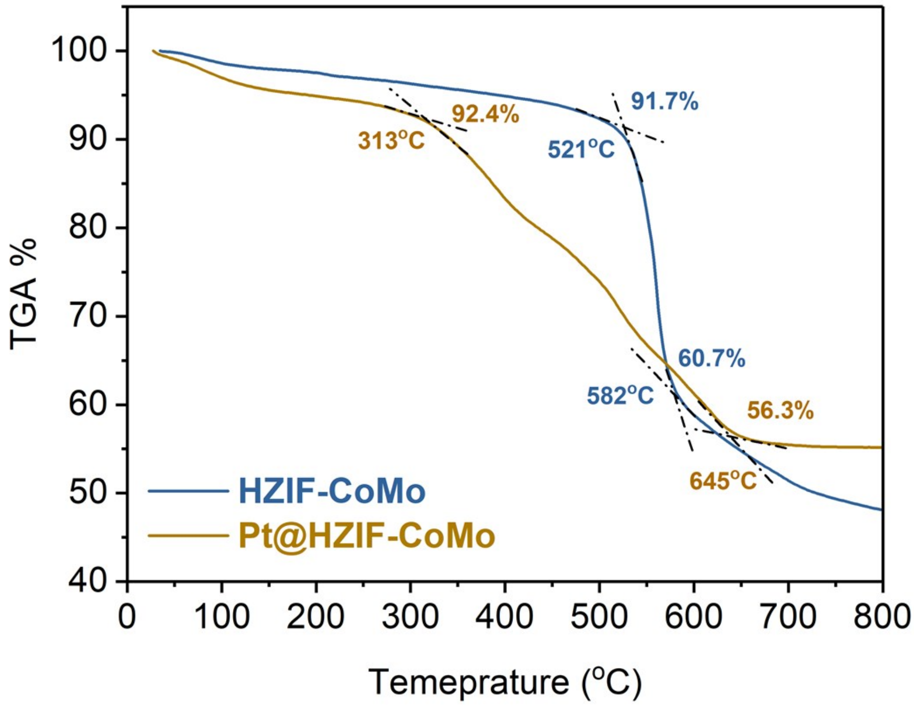

Figure S3. TGA results (under N_2 atmosphere) of HZIF-CoMo and Pt@HZIF-CoMo.

4. SEM and TEM Results

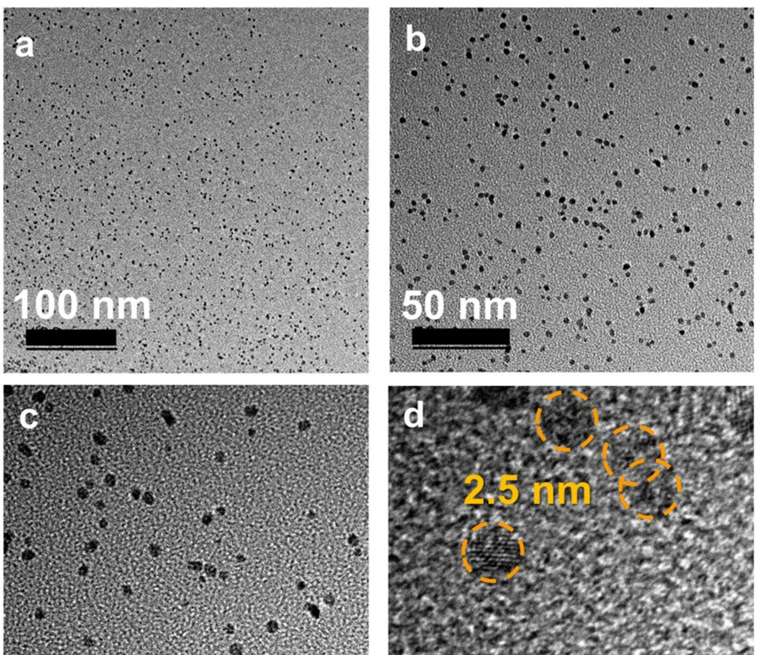

Figure S4. TEM images of the Pt NPs.

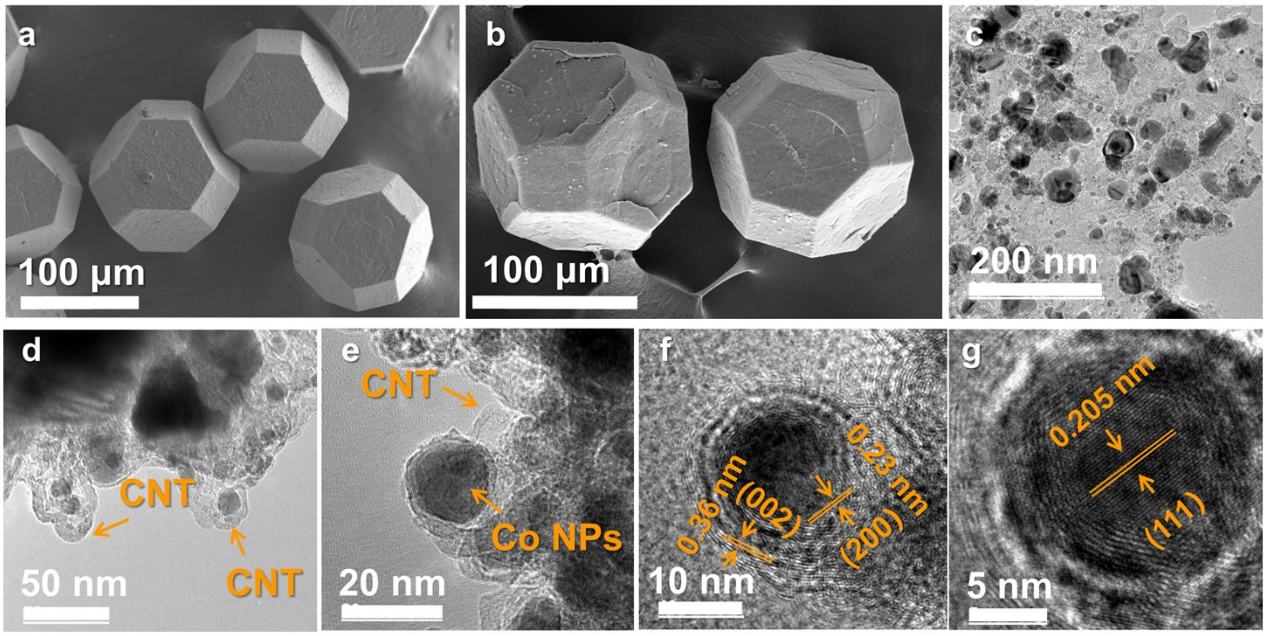

Figure S5. (a)SEM images of HZIF-CoMo, (b-g) SEM and TEM images of CoMo@NC.

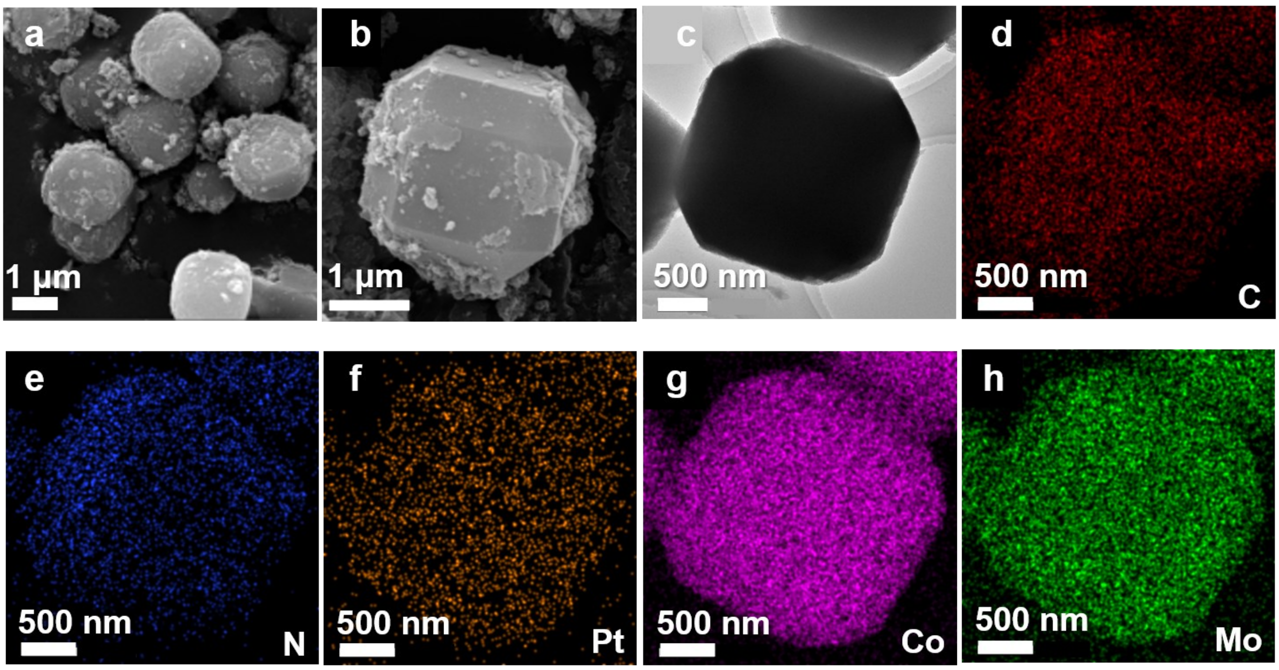

Figure S6. (a-b) SEM and (c)-(h) TEM and corresponding EDS mapping of Pt@HZIF-CoMo.

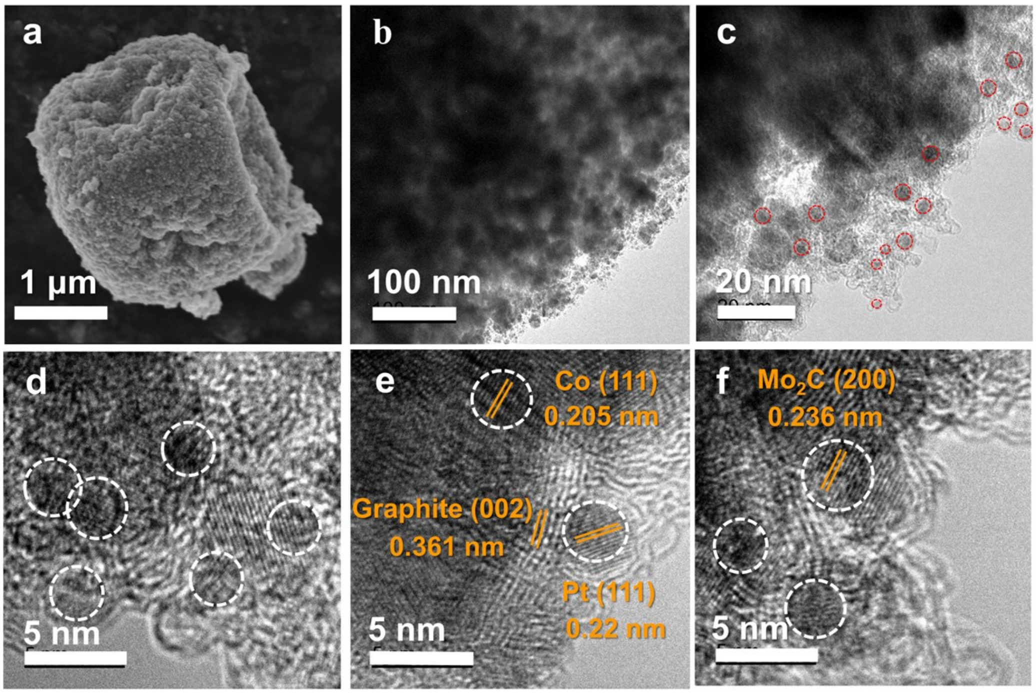

Figure S7. (a) SEM images and (b)-(f) TEM of PtCoMo@NC.

5. The HER electrocatalysis.

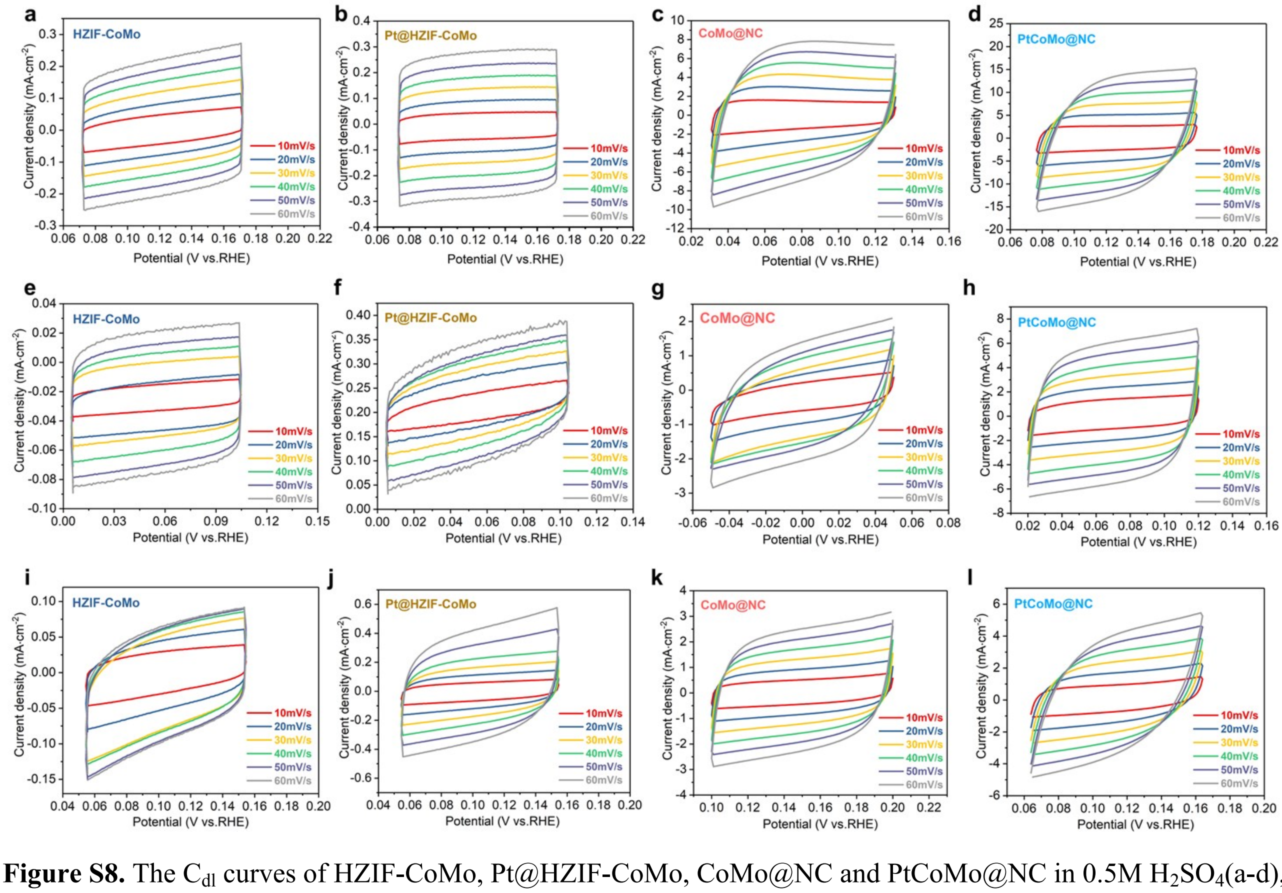

Figure S8. The C_{dl} curves of HZIF-CoMo, Pt@HZIF-CoMo, CoMo@NC and PtCoMo@NC in 0.5M H_2SO_4(a-d), 1M KOH(e-h), 1M PBS(i-l) with 10, 20, 30, 40, 50, 60 mV/s scanning rate.

7. ICP-OES result

Table S1. ICP-OES results of the PtCoMo@NC and Pt@HZIF-CoMo.

	Pt@HZIF-CoMo Synthesized ICP-OES (wt%)	PtCoMo@NC Synthesized ICP-OES (wt%)	PtCoMo@NC After Reaction in acid ICP-OES (wt%)	PtCoMo@NC After Reaction in base ICP-OES (wt%)
Pt	3.64	4.70	5.00	4.54
Co	16.21	27.45	26.23	21.36
Mo	11.70	18.94	18.85	16.85

8. The comparison of Co-based HER electrocatalysts in acid media.

Table S2. Comparison of HER electrocatalysts in 0.5 M H_2SO_4 solution.

Catalysts	**Loading ($mg{\cdot}cm^{-2}$)**	**Substrate**	η_{10} **（mV）**	**Tafel slope ($mV{\cdot}dec^{-1}$)**	**Pt Content (%)**	**Reference**
PtCoMo@NC	0.56	GCE	26	25	4.7	This work
Pt@POMOF-1/KB	0.849	GCE	23	71.29	0.43	CrystEngComm. 2018, 20, 5387
A-CoPt-NC	0.419	GCE	27	31	0.16	Angew. Chem. Int. Ed. 2019, 58, 9404
Pd@MOF-74-Co-3	0.16	GCE	40	57	\	Electrochimica Acta. 2019, 306, 627
Pt-Ni@PCN920	1	GCE	42	82	10	Journal of Power Sources, 2018, 402, 34
PtCoFe@CN	0.285	GCE	45	32	4.6	ACS Appl. Mater. Interfaces 2017, 9, 3596
Ru-HPC	0.2	GCE	61.6	66.8	\	Nano Energy. 2019, 58, 1
Co-Fe-P	0.283	GCE	66	72	\	Nano Energy. 2019,56, 225
CoP/NCNWs	0.25	GCE	95	50	\	Electrochimica Acta. 2019, 299, 423
Co-NC@Mo_2C	0.83	GCE	143	60	\	Nano Energy. 2019, 57, 746
PtNPs/CNFs	1	NF	175	50	\	Electrochimica Acta. 2015, 167, 48
AB&Co–Cl_4-MOF(3:4)	0.285	GC	284	86	\	J. Solid State Chem. 2020, 281, 121052
Pt@CIAC-121	0.25	GCE	480	58	\	J. Am. Chem. Soc. 2016, 138, 16236

9. The comparison of Co-based HER electrocatalysts in alkali media.

Table S3. Comparison of HER electrocatalysts in 1 M KOH solution.

Catalysts	Loading/ ($mg·cm^{-2}$)	Substrate	η_{10} (mV)	Tafel slope ($mV·dec^{-1}$)	Pt Content (%)	Reference
PtCoMo@NC	0.56	GCE	51	74	4.7	This work
A-CoPt-NC	0.419	GCE	50	48	0.16	Angew. Chem. Int. Ed. 2019, 58, 9404
$Ni_{1.5}Co_{1.4}P$@Ru	0.28	GCE	52	49	\	J. Mater. Chem. A, 2016, 4, 3947
Pt NWs / $SLNi(OH)_2$	Pt, 0.016	GCE	70	\		Nat. Commun., 2015, 6, 6430
RuPx@NPC	0.199	GCE	74	70	\	ChemSusChem, 2018, 11, 743
Co-Fe-P	0.283	GCE	86	66	\	Nano Energy. 2019,56, 225
Co-NC@Mo_2C	0.83	GCE	99	65	\	Nano Energy. 2019, 57, 746
Co/CoN/Co_2P-NPC	0.35	GCE	99	51	\	INT J HYDROGEN ENERG. 2019, 44, 11402
CoP/NC	0.306	GCE	129	58	\	ACS Catal., 2017, 7, 3824
CoP hollow polyhedra	0.28	GCE	154	57	\	DALTON T, 2019, 48, 8920
CoP/NCNWs	0.25	GCE	154	59	\	Electrochimica Acta 2019, 299, 423
S-400℃	0.14	GCE	226	138	\	J. of Colloid Interface Sci. 2020, 561, 620
Co-BDC/MoS_2	0.45	GCE	248	86	\	Small. 2019, 1805511

10. The comparison of Co-based HER electrocatalysts in neutral media.

Table S4. Comparison of Co-based HER electrocatalysts in 0.1 M PBS solution.

Catalysts	Loading/ ($mg·cm^{-2}$)	Substrate	η_{10} (mV)	Tafel slope ($mV·dec^{-1}$)	Pt Content (%)	Reference
PtCoMo@NC	0.56	GCE	60	159	4.7	This work
$Ni_{0.5}$-NCNFs-Pt	0.28	GCE	84	38	0.023	J. Colloid Interface Sci., 2018, 514, 199
YS-Pt-CoP	0.28	GCE	88	74	0.011	Dalton T., 2019, 48, 8920
RuP_x@NPC	0.199	GCE	110	59	\	ChemSusChem, 2018, 11, 743
MoP NPs@NC	2.0	GCE	136	71	\	Nanoscale, 2016, 8, 17256

Co-Fe-P	0.283	GCE	138	138	\	Nano Energy. 2019,56, 225.