Support information

Fe/Fe_3C encapsulated in nitrogen source-mediated active-N-rich defective carbon nanotubes for bifunctional oxygen catalysis

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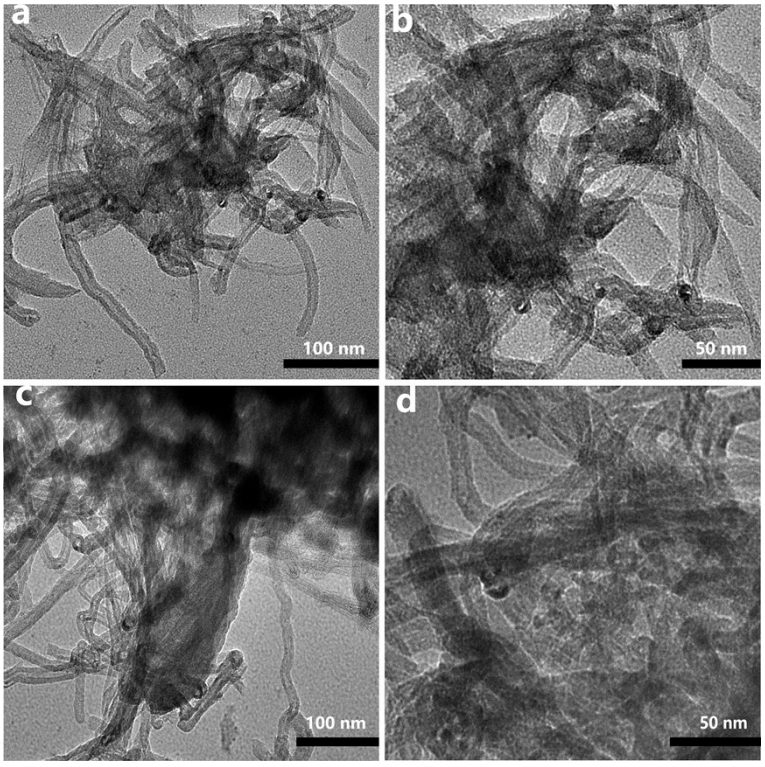

Fig. S1 (a, b) TEM images of Fe-P-OCNT catalysts, (c, d) TEM images of Fe-U-OCNT catalysts.

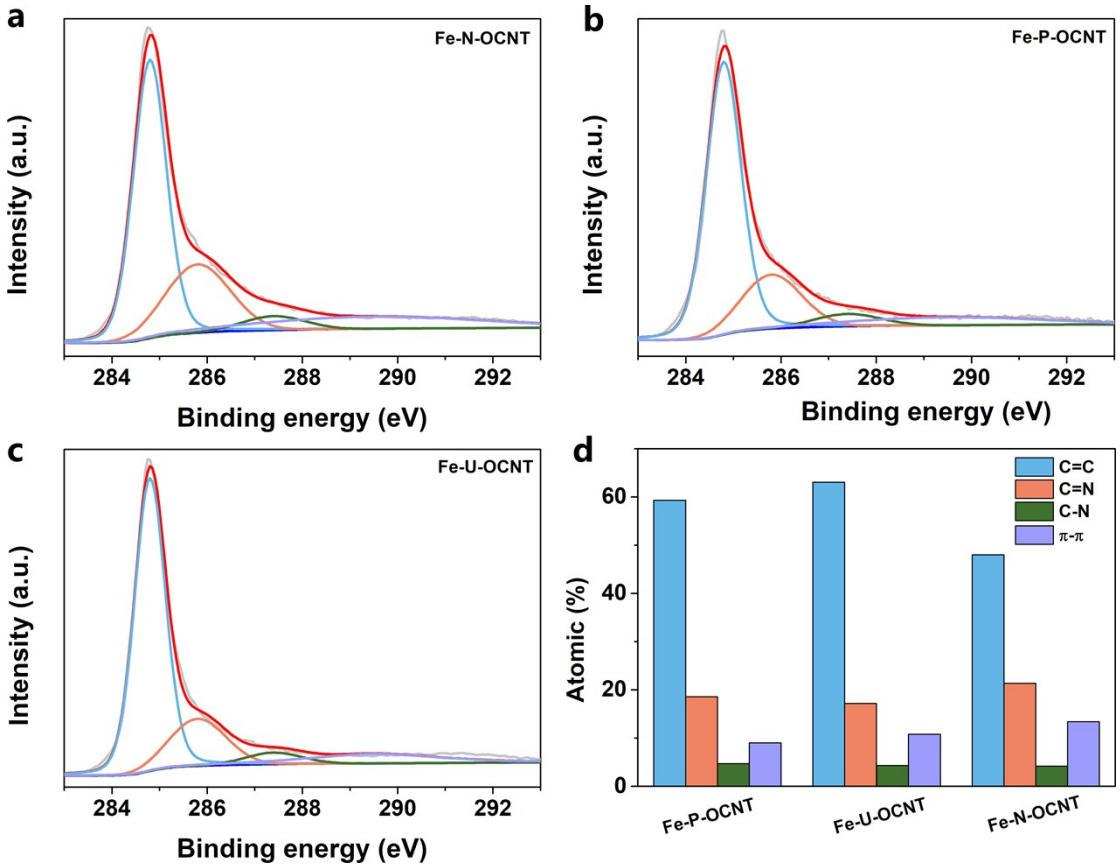

Fig. S2 (a, b, c) High resolution C 1s spectra, (d) The atomic content of carbon-related functional groups.

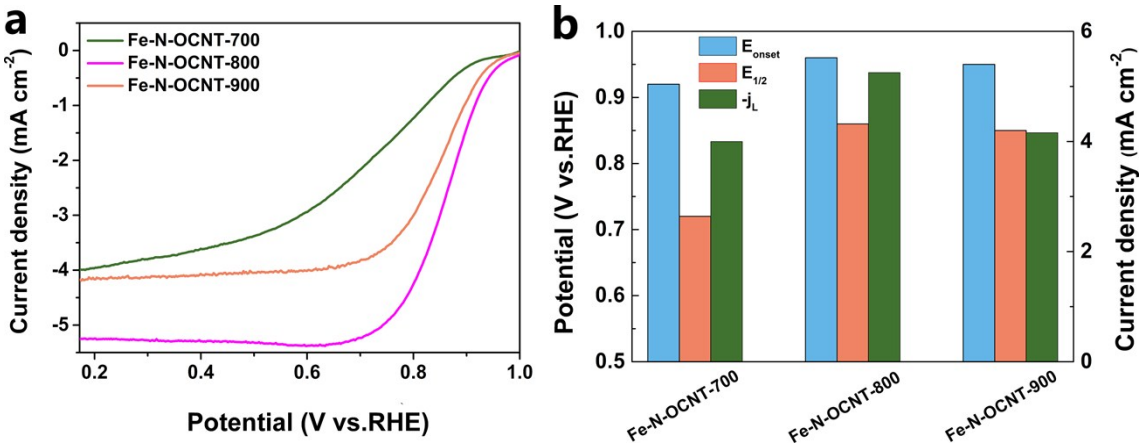

Fig. S3 (a) Comparison of LSV curves for Fe-N-C-700, Fe-N-C-800, Fe-N-C-900 catalysts, (b) Comparison of electrochemical ORR parameters of samples derived at different temperatures.

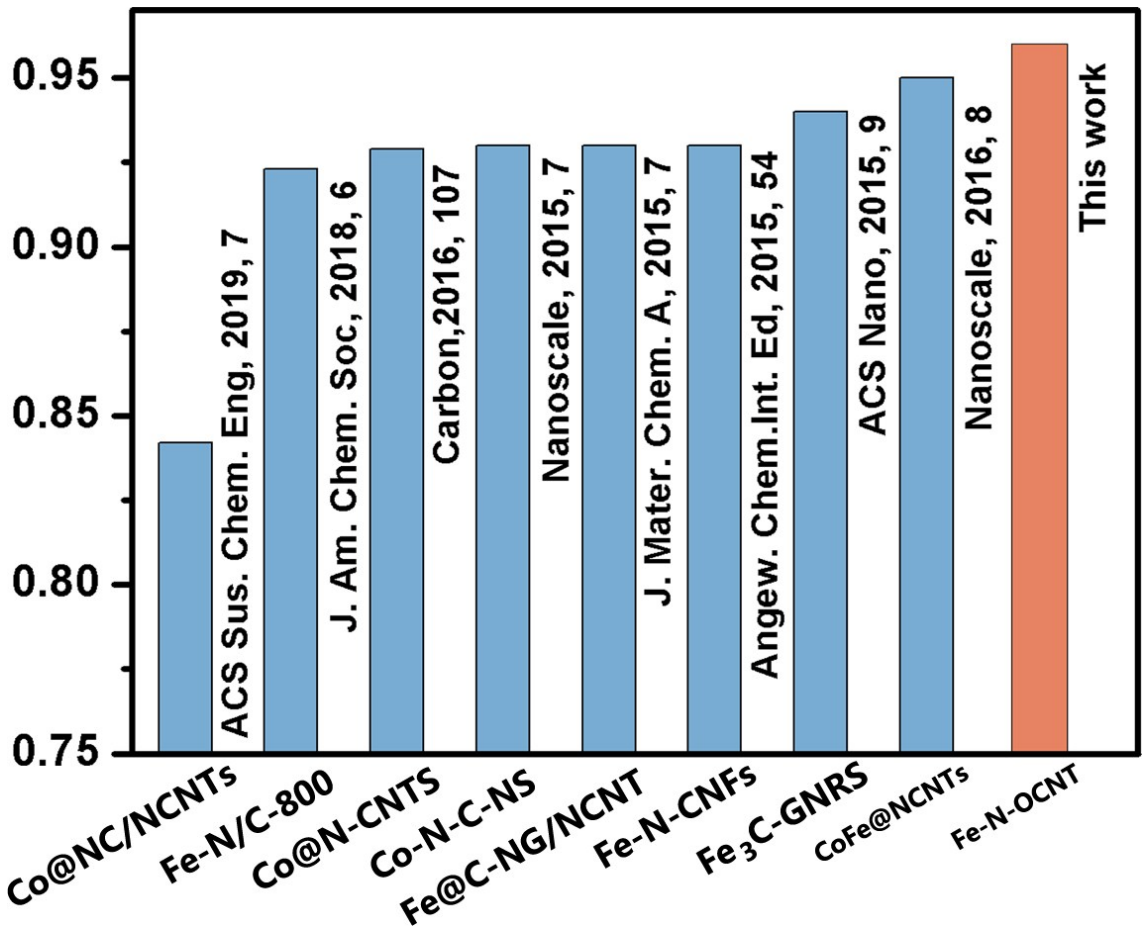

Fig. S4 The comparison of onset potentials with reported works.

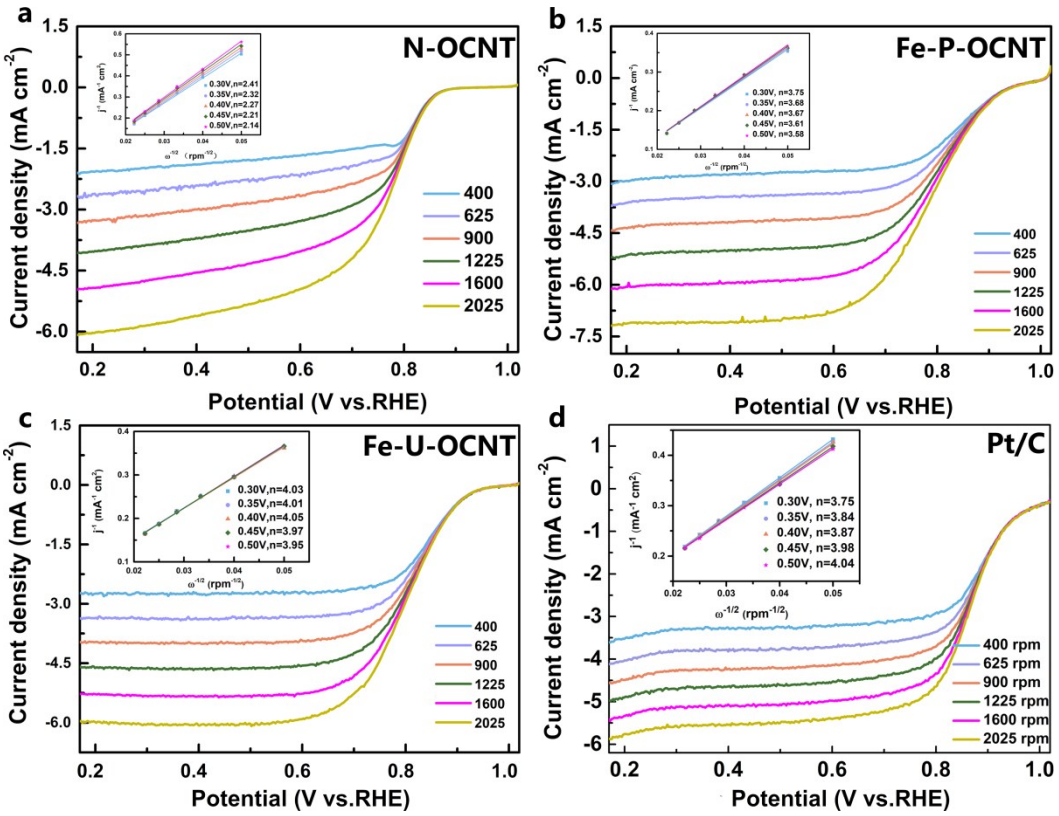

Fig. S5 (a, b, c, d) LSV curves for N-OCNT, Fe-P-OCNT, Fe-U-OCNT and Pt/C at different rotating rates, the inset is their corresponding K-L plots in the range from 0.30 to 0.50 V, respectively.

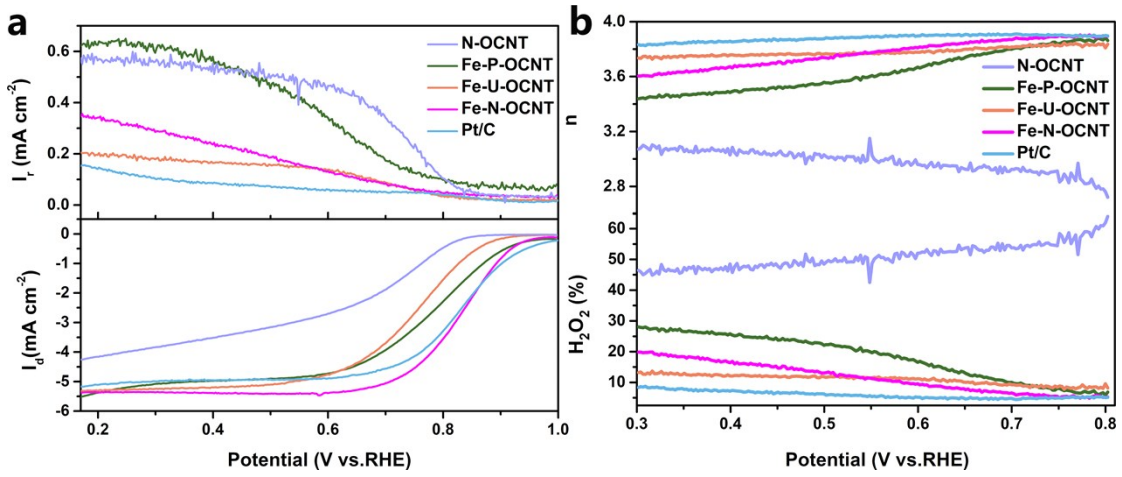

Fig. S6 (a) RRDE of LSV curves in O_2-saturated 0.1 M KOH at 1600 rpm with a scanning rate of 10 mV s^{-1}; (b) Electron transfer number (n, top panel) and peroxide yield (bottom panel) obtained based on the corresponding RRDE data.

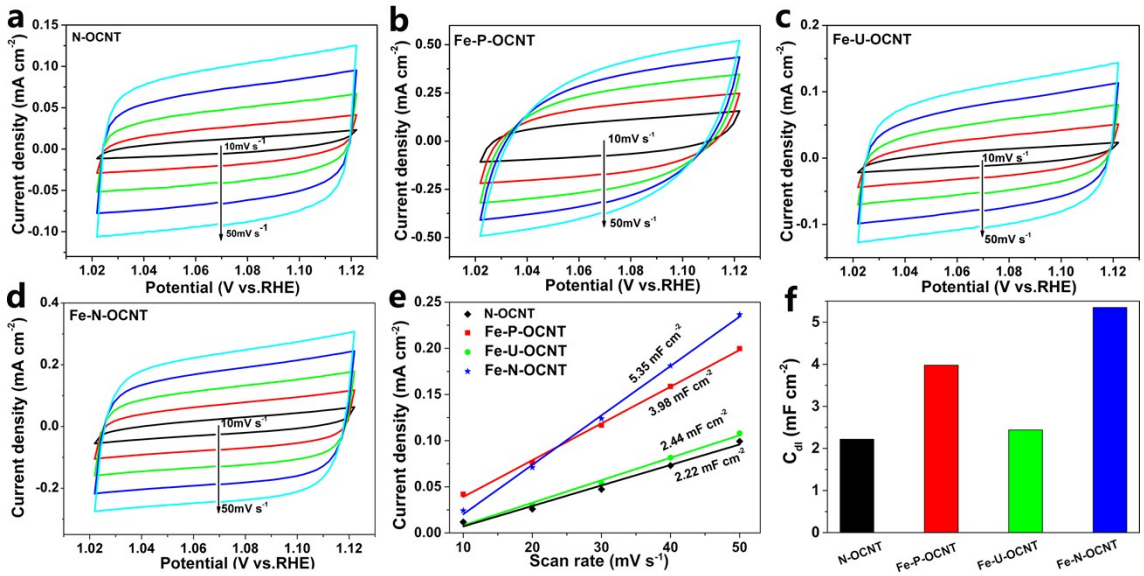

Fig. S7 (a, b, c, d) CV curves of Fe-P-OCNT, Fe-U-OCNT and Fe-N-OCNT catalysts; (e, f) The capacitive current measured at 1.072 V plotted as a function of scan rate of all catalysts.

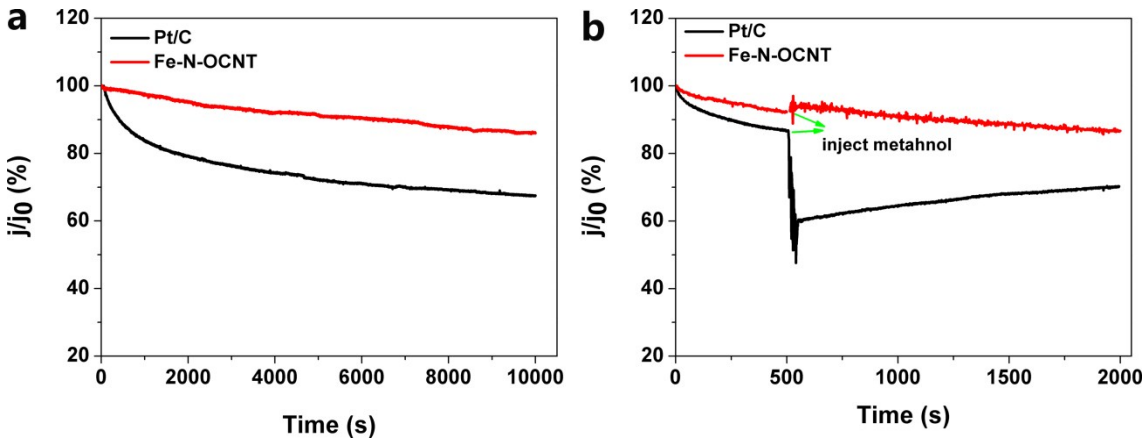

Fig. S8 (a) The choronoamperometric response curves of Fe-N-OCNT and Pt/C; (b) The comparison choronamperometric response plots of Fe-N-OCNT and Pt/C with an additional methanol of 5 mL at 500s.

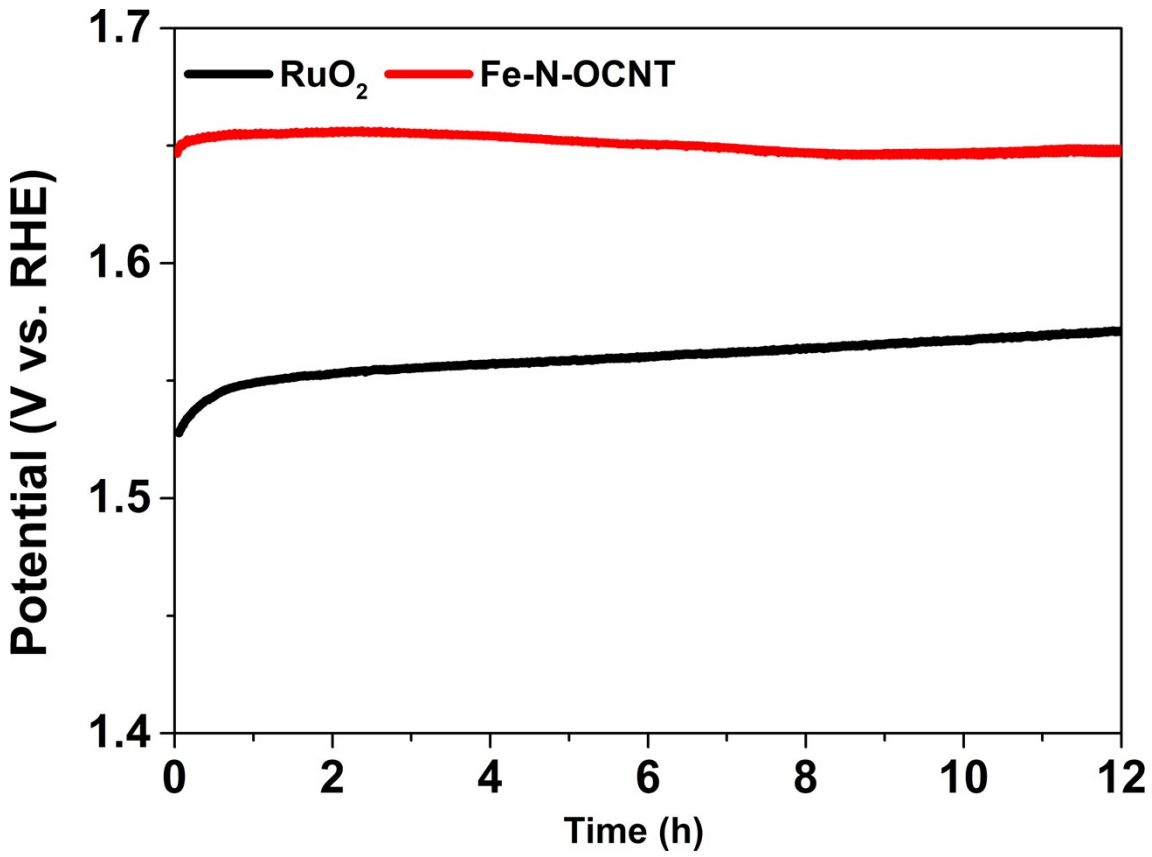

Fig. S9 OER chronopotentiometric response of Fe-N-OCNT and RuO_2 at a constant current of 10 mA cm^{-2}.

Table S1 The comparison of the bifunctional activity of electrocatalysts reported in the previous literature.

Catalysts	ORR $E_{1/2}$ (V)	OER $E_{j=10mA\ cm^{-2}}$ (V)	$\Delta E = E_{j=10} - E_{1/2}$ (V)	References
Fe-N-OCNT	0.86	1.583	0.723	*This work*
Fe@C-NG/NCNTs	0.84	1.68	0.84	*J. Mater. Chem. A, 2018, 6(2): 516-526.*
N-NiO	0.69	1.50	0.81	*ACS Appl. Mater. Int., 2019, 11(34): 30865-30871*
FeCo-N_x-C	0.89	1.67	0.78	*Angew Chem. Int. Ed. Engl. 2018;57:1856-62.*
Co_3O_4NS/ZTC	0.70	1.61	0.91	*J. Mater. Chem. A, 2019, 7(16): 9988-9996.*
$Fe_{1.2}$Co@NC/NCNTs	0.82	1.58	0.76	*ACS Sus. Chem. Eng. 2019, 7, 9, 8530-8541.*
N-GCNT/FeCo-3	0.92	1.73	0.81	*Adv. Energy Mater. 2017, 7, 1602420.*
Co-N-CNTs	0.90	1.69	0.79	*Adv. Funct. Mater. 2018, 28, 1705048.*
Co-N,B-CSs	0.83	1.66	0.83	*ACS Nano 2018, 12, 1894-1901.*
FeN_x/PNC	0.86	1.63	0.77	*ACS Nano 2018, 12, 1949*
CoS_x/NCS	0.79	1.69	0.90	*Mater. Res. Bull., 2020, 125, 110770.*
FeNMC-2	0.885	Not given	Not given	*Appl. Catal. B: Environ., 2020, 265, 118593*
NPC-1000	0.82	Not given	Not given	*Nano-Micro Lett., 2020, 12, 20*

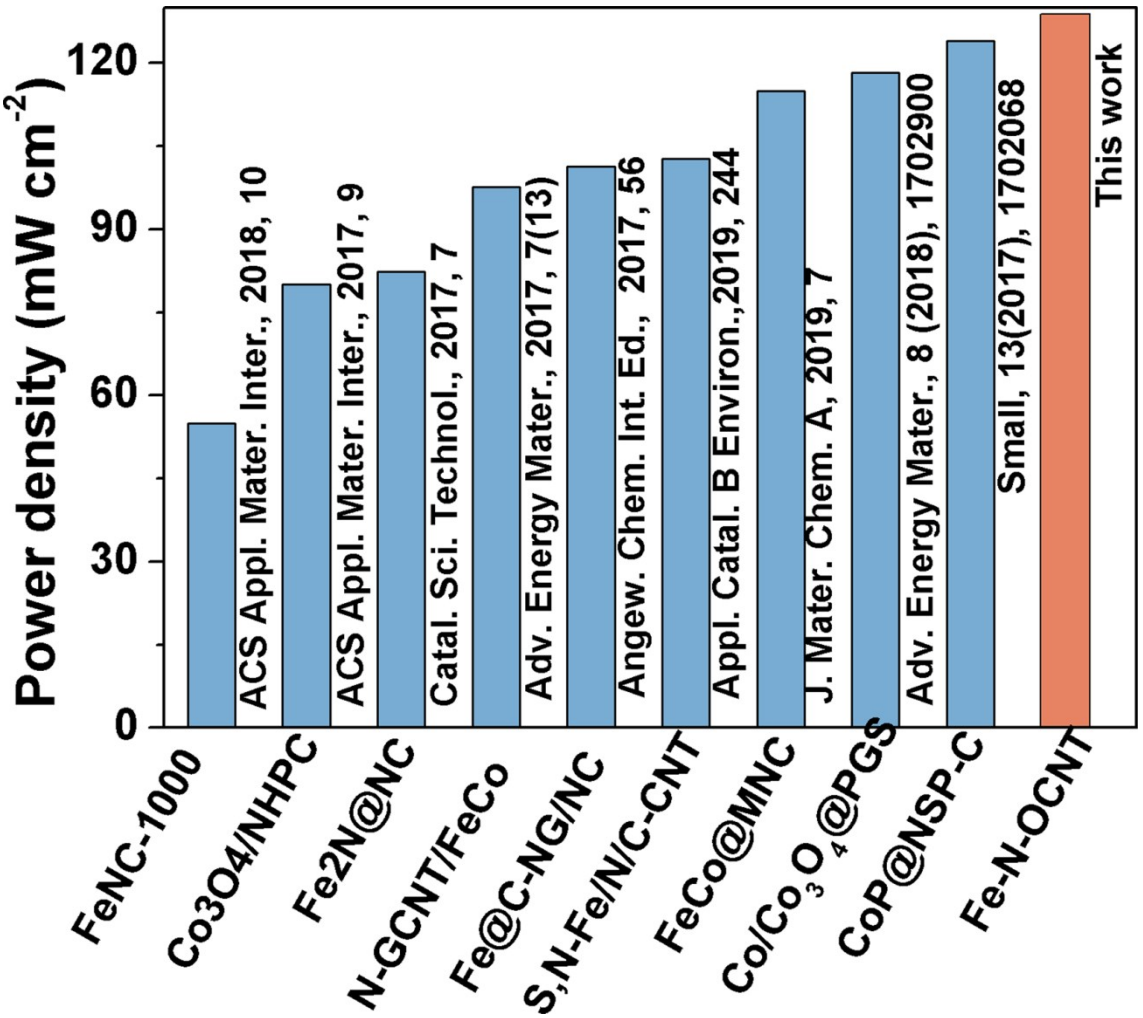

Fig. S10 Power density comparison of pioneer works.