Supporting Information

Constructing B and N separate codoped carbon nanocapsules wrapped Fe/Fe_3C for oxygen reduction reaction with high current density

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Table S1. The detailed experimental parameters for all the compared samples.

samples	The dosage of melamine (g)	The dosage of H_3BO_3 (g)	The dosage of $Fe(NO_3)_3 \cdot 9H_2O$ (g)	Pyrolysed temperatuare (^oC)
NGFe-800	3	0	3	800
B_1NGFe_2-800	3	0.4	3	800
B_2NGFe_2-800	3	0.6	3	800
B_3NGFe_2-800	3	0.8	3	800
BNC-800	3	0.6	0	800
B_2NGFe_1-800	3	0.6	2	800
B_2NGFe_3-800	3	0.6	4	800
B_2NGFe_2-700	3	0.6	3	700
B_2NGFe_2-900	3	0.6	3	900

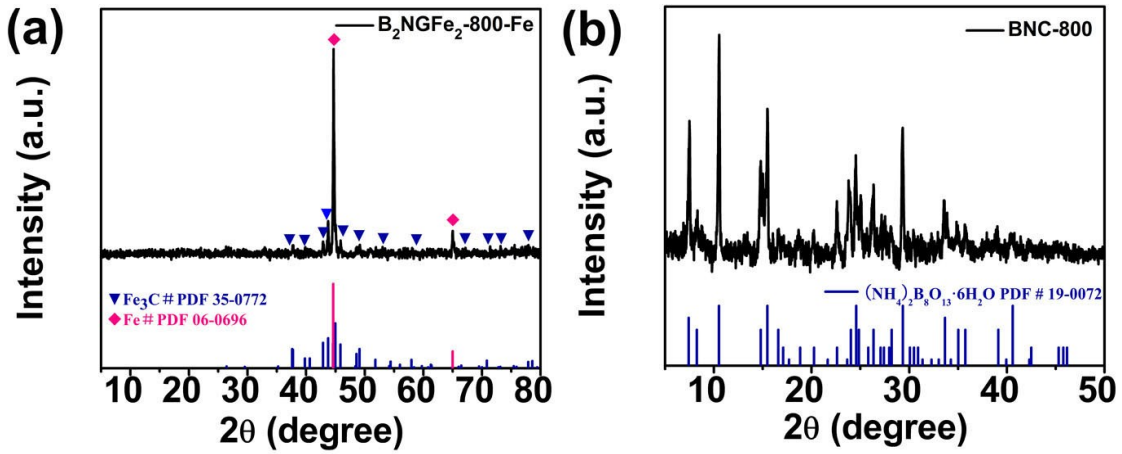

Fig. S1 XRD patterns of (a) B_2NGFe_2-800-Fe and (b) the BNC-800 composites.

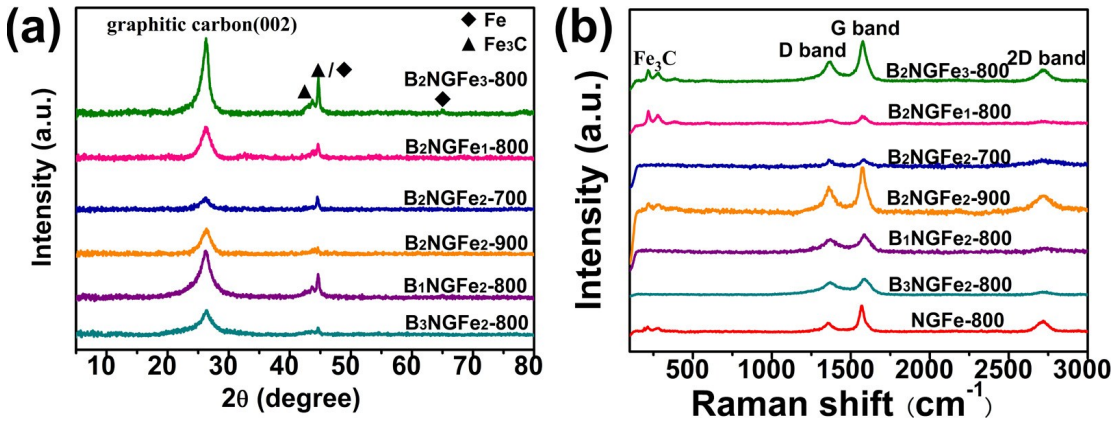

Fig. S2 (a) XRD patterns and (b) Raman spectra of all the compared samples synthesized from different dosages of boric acid and iron nitrate, and different pyrolysed temperatures.

Table S2. The high-resolution XPS spectrum analytic results of B1s, N1s and Fe2p for B_2NGFe_2-800 and other compared samples.

samples	B content (at.%)	C content (at.%)	N content (at.%)	O content (at.%)	Fe content (at.%)	B/N	B/Fe
B_2NGFe_2-800	1.35	90.11	2.77	4.87	0.89	0.49	1.5
B_1NGFe_2-800	1.00	86.34	5.44	6.77	0.44	0.18	2.3
B_3NGFe_2-800	9.97	69.59	11.55	8.64	0.26	0.86	38
B_2NGFe_1-800	1.62	87.30	4.41	5.90	0.78	0.37	2.1
B_2NGFe_3-800	1.84	87.36	5.83	3.91	1.05	0.32	1.8
B_2NGFe_2-700	2.62	78.52	10.06	7.99	0.80	0.26	3.3
B_2NGFe_2-900	10.84	66.71	11.40	10.79	0.26	0.95	42
NGFe-800	0.00	90.17	3.23	6.04	0.56	0	0

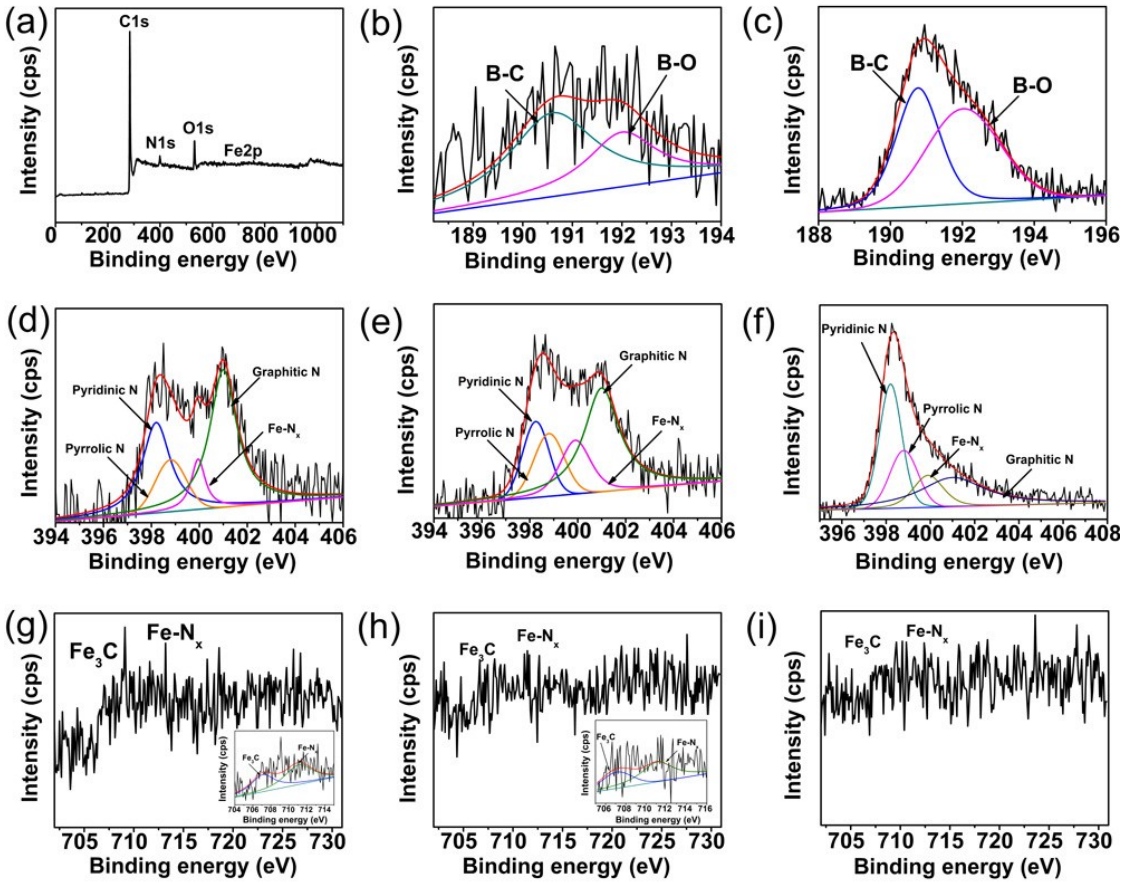

Fig. S3 (a) Survey XPS spectrum, (d) N1s and (g) Fe2p XPS spectra of NGFe-800 composite; (b) B1s, (e) N1s and (h) Fe2p XPS spectra of B_1NGFe_2-800 composite; Survey XPS spectrum, (c) B1s, (f) N1s and (i) Fe2p XPS spectra of B_3NGFe_2-800 composite.

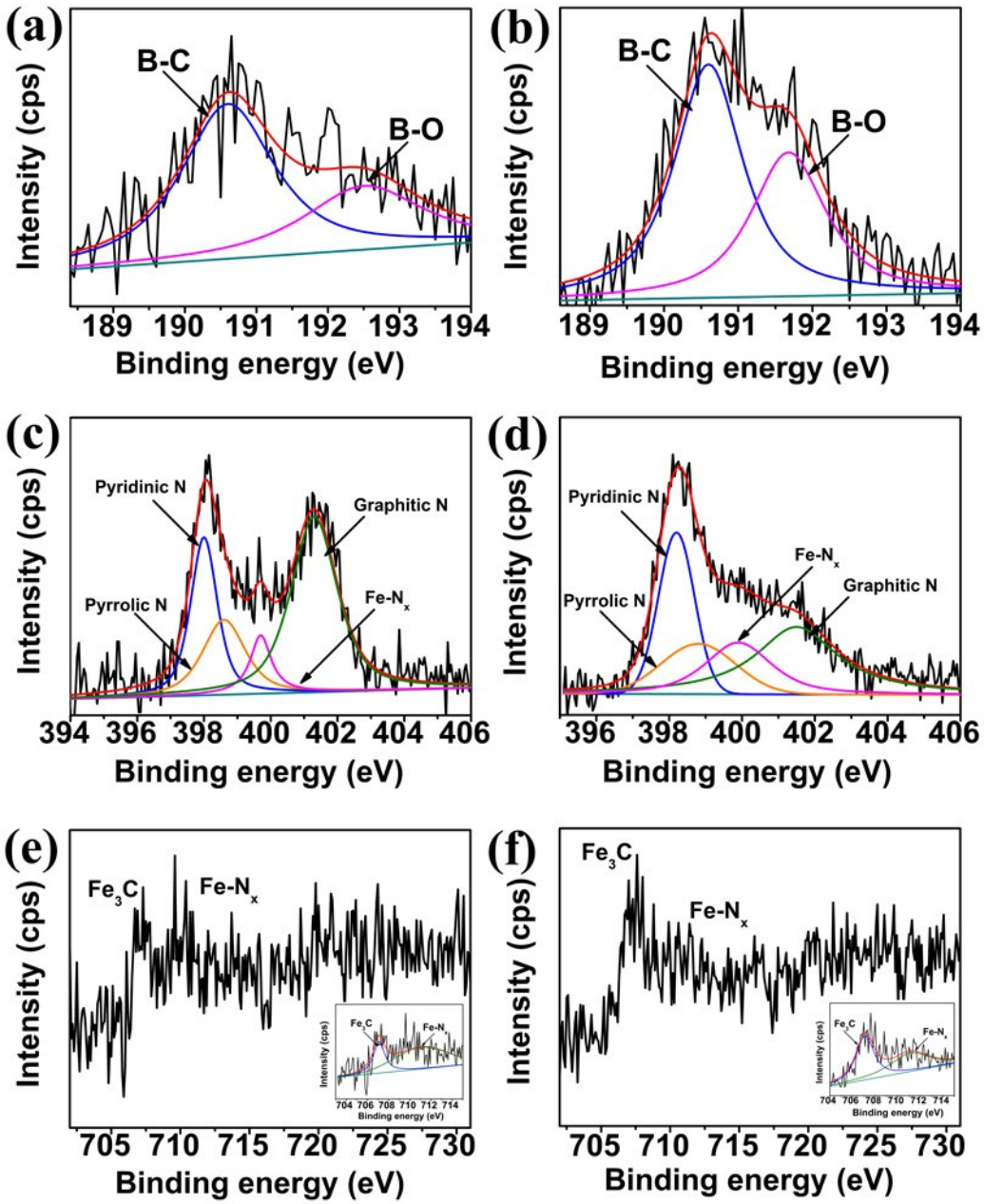

Fig. S4 (a) B1s, (c) N1s and (e) Fe2p XPS spectra of B_2NGFe_3-800 composite; (b) B1s, (d) N1s and (f) Fe2p XPS spectra of B_2NGFe_1-800 composite.

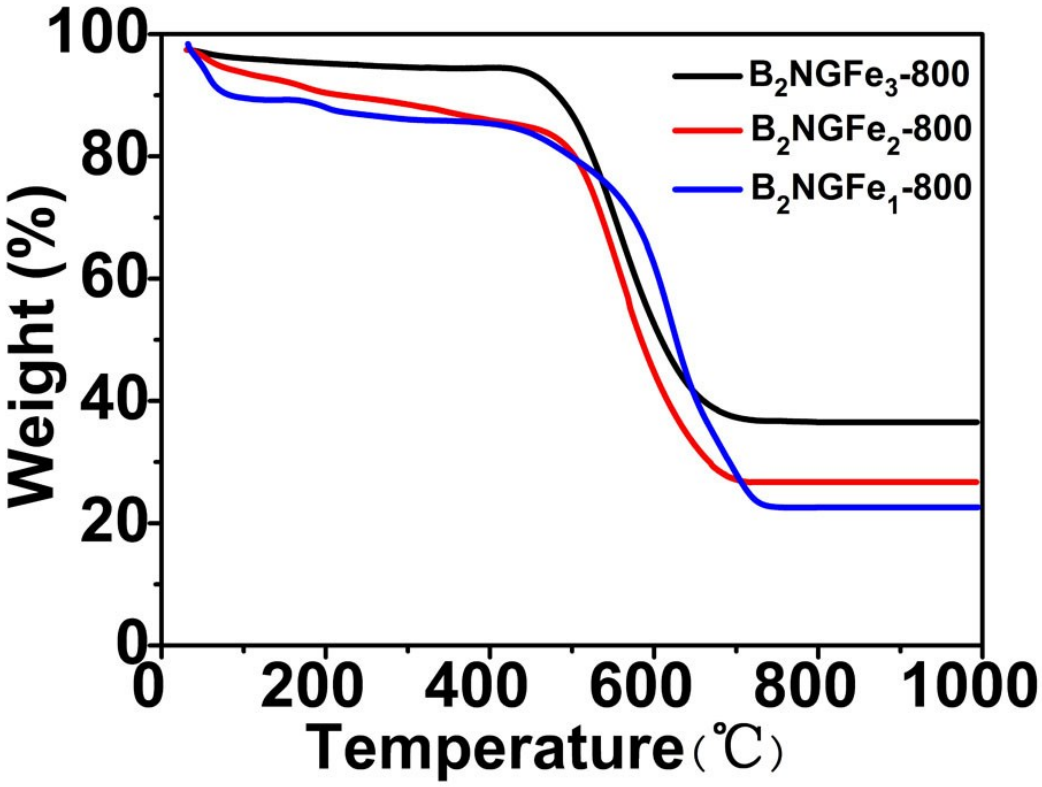

Fig. S5TGA curves of B_2NGFe_1-800, B_2NGFe_2-800 and B_2NGFe_3-800 composites.

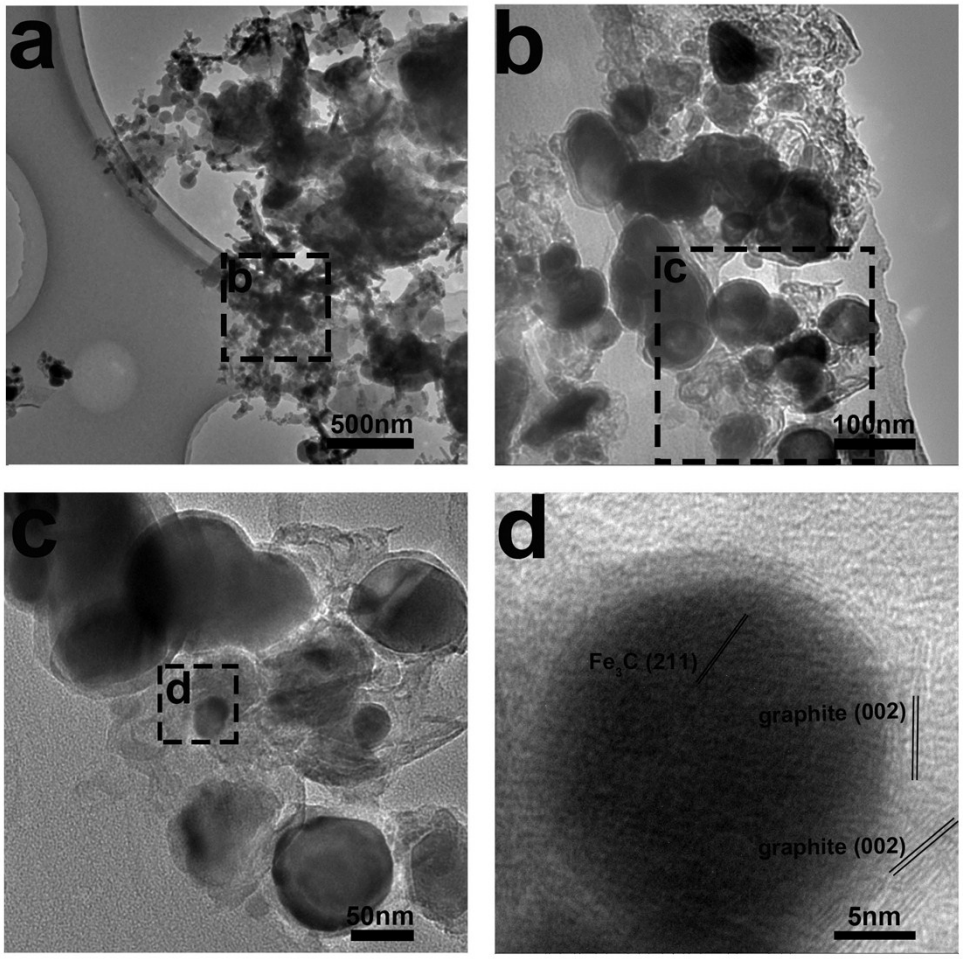

Fig. S6 TEM and HRTEM images of B_2NGFe_2-800-Fe composite without treating by HCl.

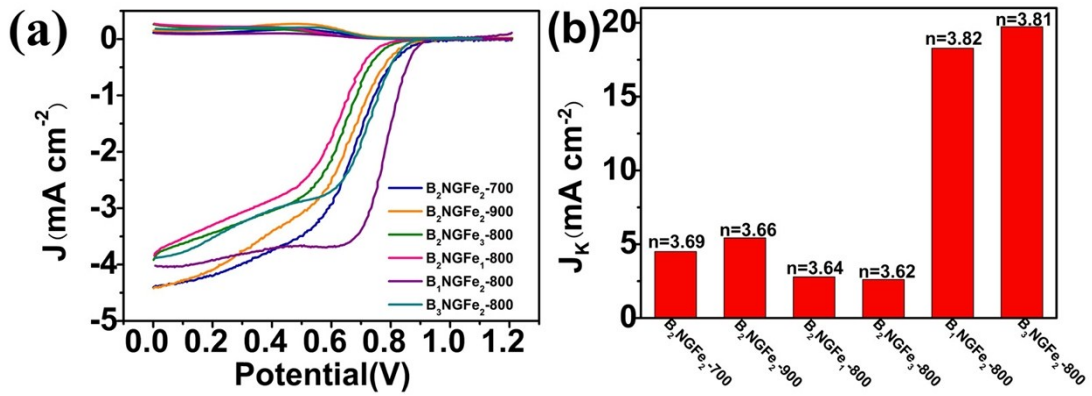

Fig. S7 (a) RRDE voltammetric response in O_2-saturated 0.1 M KOH electrolyte at a scan rate of 5 mV s^{-1} and (b) electrochemical activity given as the kinetic current density (JK) at 0.6 V for compared electrodes; The electrode rotation rate was 1600 rpm, and the Pt ring electrode was polarized at 1.2 V.

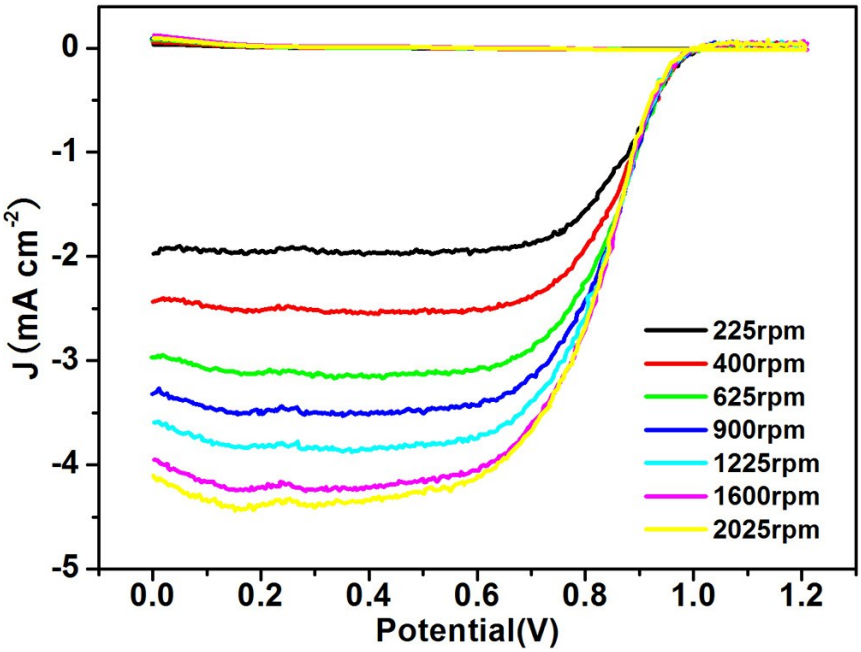

Fig. S8 RRDE curves of Pt/C on a RRDE in an O_2-saturated 0.1 M KOH electrolyte with various rotating speeds at scan rates of 5 mV s^{-1}.

Table S3. Current densities of B_2NGFe_2-800 and Pt/C for ORR at different potentials.

Current density (m A cm^{-2})	0.1V	0.2V	0.3V	0.4V	0.5V	0.6V	0.7V	0.8V	0.9V
B_2NGFe_2-800	4.8	4.9	4.9	4.9	4.9	4.8	4.6	2.9	0.5
Pt/C	4.2	4.2	4.2	4.2	4.2	4.1	3.7	2.6	0.4

Table S4. The comparison of ORR performance of B_2NGFe_2-800 with other Pt-free ORR electrocatalysts (vs. RHE)

Catalysts	Loading (mg cm^{-2})	electrolyte	$E_{1/2}$ (V)	E_{Onset} (V)	J_K (mA cm^{-2})	Ref
B_2NGFe_2-800	0.3 mg cm^{-2}	0.1M KOH	0.83	0.98	72.7	This work
Fe@C-FeNCs	0.7 mg cm^{-2}	0.1M KOH	0.899	1.0	41.6 A/g at 0.80 V	1
Fe−N/C-800	0.1 mg cm^{-2}	0.1M KOH	0.809	0.923	Not mentioned	2
Fe_3C/C hollow spheres	0.6 mg cm^{-2}	0.1M KOH	0.83	1.05	Not mentioned	3
Fe@N-C/SiC@N-C	1.0 mg cm^{-2}	0.1M KOH	0.84	0.88	Not mentioned	4
Fe−N-Doped Carbon Capsules	0.1 mg cm^{-2}	0.1M KOH	0.83	0.94	18.3 mA cm^{-2}	5
N-doped mesoporous carbons with a trace amount of Fe	0.08 mg cm^{-2}	0.1M KOH	Not mentioned	0.98	Not mentioned	6
B and N isolate-doped graphitic nanosheets	0.2 mg cm^{-2}	0.1M KOH	Not mentioned	0.95	11.9 mA cm^{-2}@0.7V	7

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