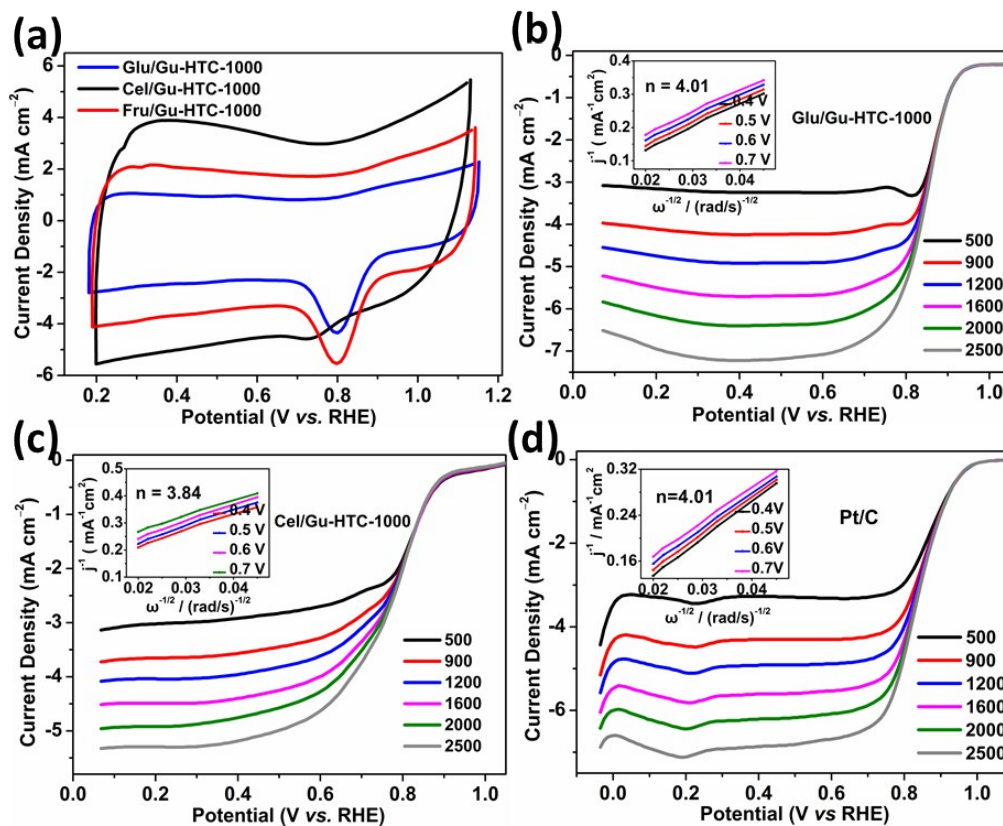# Supporting information

Fig. S1 (a) CVs with 50 mV s^{-1}; (b), (c) and (d) RDE polarisation curves at various rpms for different catalysts in O$_2$-saturated 0.1M KOH solution.

Table S1 Elemental analysis (wt. %)

Samples	C	H	N	O ^{a}
Fru/Gu-HTC-1000	87.26	<0.30	2.43	10.01
Glu/Gu-HTC-1000	81.71	<0.30	2.84	15.15
Cel/Gu-HTC-1000	84.64	<0.30	3.26	11.80

^{a} calculated.

Table S2 The relative contents of different nitrogen species determined by XPS

Samples	Pyridinic-N (%) 398.4 eV	Graphitic-N (%) 401.1 eV	Oxidized-N (%) 403.1 eV	Total (%) ^{a}
Fru/Gu-HTC-1000	18.3	60.8	20.9	79.1
Glu/Gu-HTC-1000	22.2	46.4	31.4	68.6
Cel/Gu-HTC-1000	28.5	43.2	28.2	71.7

^{a} The relative total content of graphitic N and pyridinic N.

Catalyst	E$_{onset}$ (V $vs.$ RHE)	E$_{j=-10}$ (V $vs.$ RHE)	Tafel slope (mV dec^{-1})	Electrolyte	Reference
Table S3 Comparison of carbon-based HER catalysts					
g-C$_3$N$_4$@N-doped graphene	0.35	> 0.6	-	0.1 M KOH	Nat. Commun. 2014, 5, 3783
N, P-doped porous graphene	0.35	> 0.6	-	0.1 M KOH	ACS Nano 2014, 8, 5290
N, P-doped porous graphene	0.25	0.42	91	0.5 M H$_2$SO$_4$	ACS Nano 2014, 8, 5290
N-doped holely graphene	0.30	0.51	157	0.1 M KOH	Nano Energy 2015, 15, 567
N, P-doped carbon	0.29	0.47	-	0.1 M KOH	Angew. Chem. Int. Ed. 2016, 128, 2270
N, P, F-doped graphene	0.4	0.52	-	0.1 M KOH	Angew. Chem. Int. Ed. 2016, 55, 13296
Defect graphene	0.1	0.32	118	1 M KOH	Adv. Mater. 2016, 28, 9532
N-doped graphene microtubes	0.30	0.43	117	1 M KOH	Nano Research 2016, 9, 2606
N, P, O-doped porous graphitic carbon@oxidized carbon cloth	0.25	0.45	154	1 M KOH	Energy Environ. Sci. 2016, 9, 1210
N, S-doped carbon nanofiber	0.23	0.33	99	0.5 M H$_2$SO$_4$	Nano Energy 2017, 32, 336
N -doped Fru/Gu-HTC-1000	0.12	0.35	108	1 M KOH	**This work**