Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

China Rose-Derived Tri-heteroatom Co-doped Porous Carbon as an Efficient Electrocatalysts for Oxygen Reduction Reaction

Table S1. The XPS elemental analyses of RPC-D, RPC-A and RPC-M.

	Fresh rose	RPC-D	RPC-A	RPC-M
C1s	69.39	89.62	93.67	88.64
N1s	2.96	1.19	0.49	3.80
O1s	23.4	7.69	4.86	7.40
S2p	0.95	0.7	0.09	0.06
Metal	3.3	0	0	0

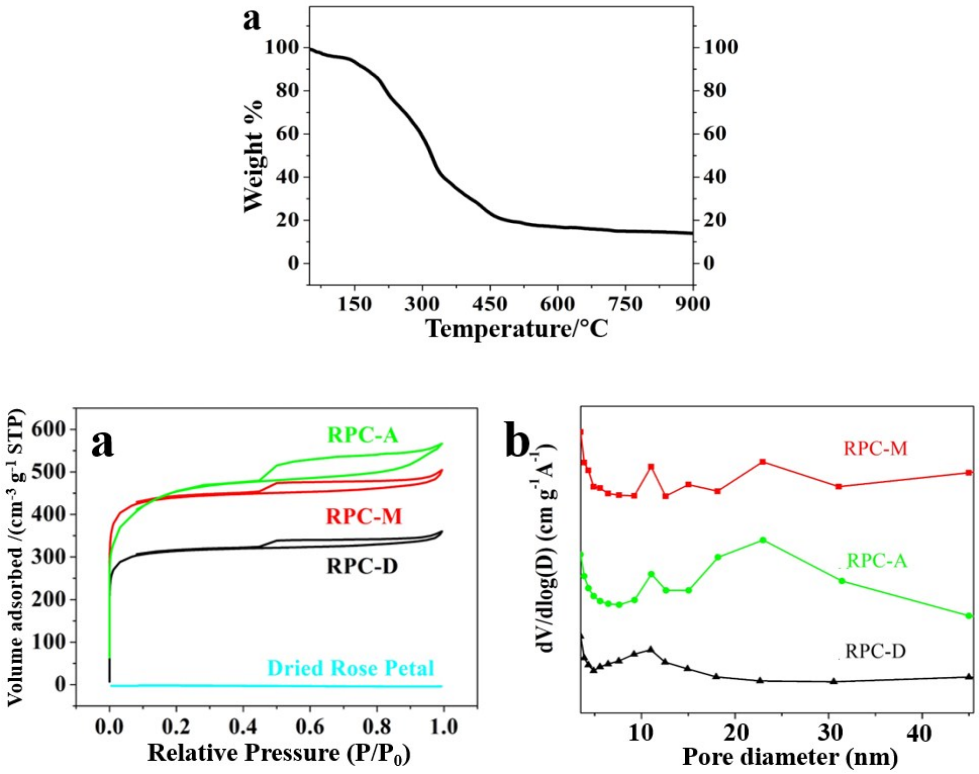

Figure S1. (a) Thermogravimetric analysis of the dried rose petal. (b)The Nitrogen adsorption-desorption isotherms of RPC-D, RPC-A, RPC-M and dried rose petal. (c)The corresponding pore-size distribution ofRPC-D, RPC-A and RPC-M by analysis of adsorption branch using Barrett-Joyner-Halenda (BJH) method.

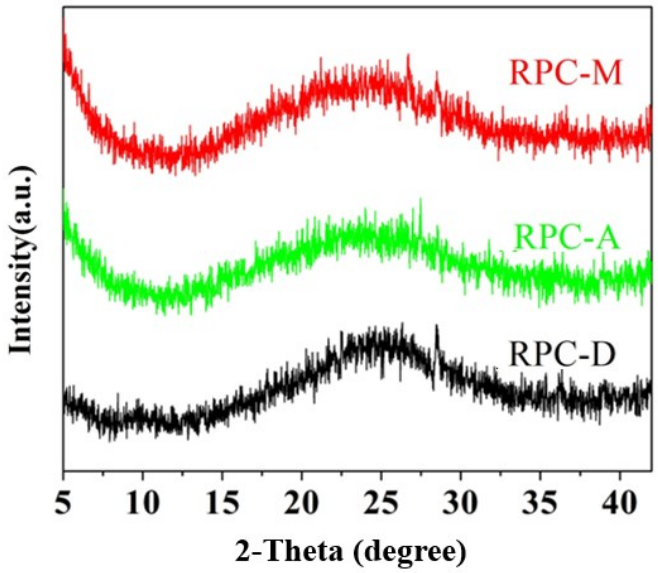

Figure S2. XRD patterns of RPC-D, RPC-A and RPC-M.

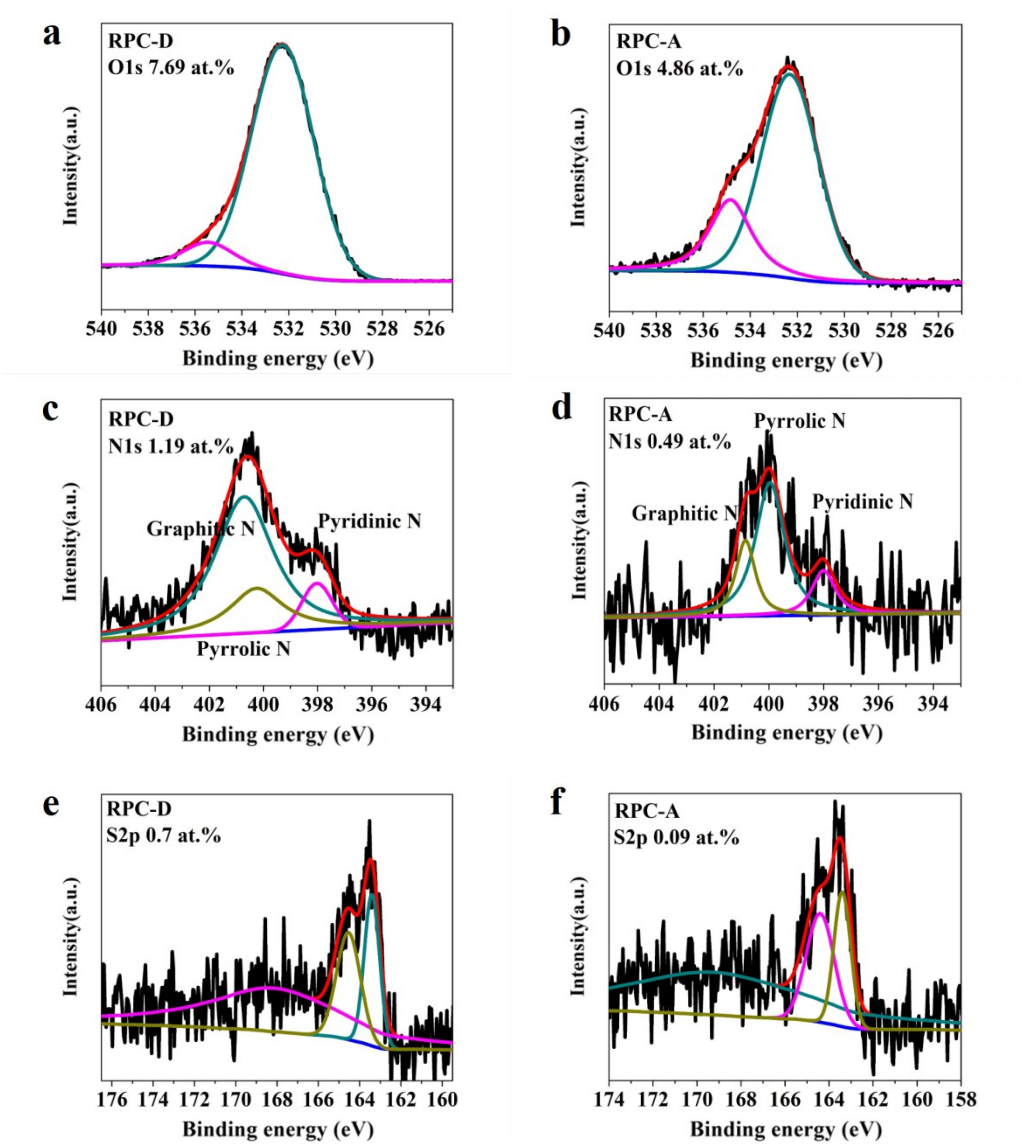

Figure S3.(a-f) The high resolution XPS O1s, N1s and S2p core level spectra of RPC-D and PRC-A.

Table S2. The contents of different types of nitrogen in RPC-D, RPC-A and RPC-M.

	RPC-D	RPC-A	RPC-M
Pyridinic N	28.45	16.35	8.76
Pyrrolic N	0	60.56	22.38
Graphitic N	66.48	23.09	68.86
Oxidized N	5.07	0	0

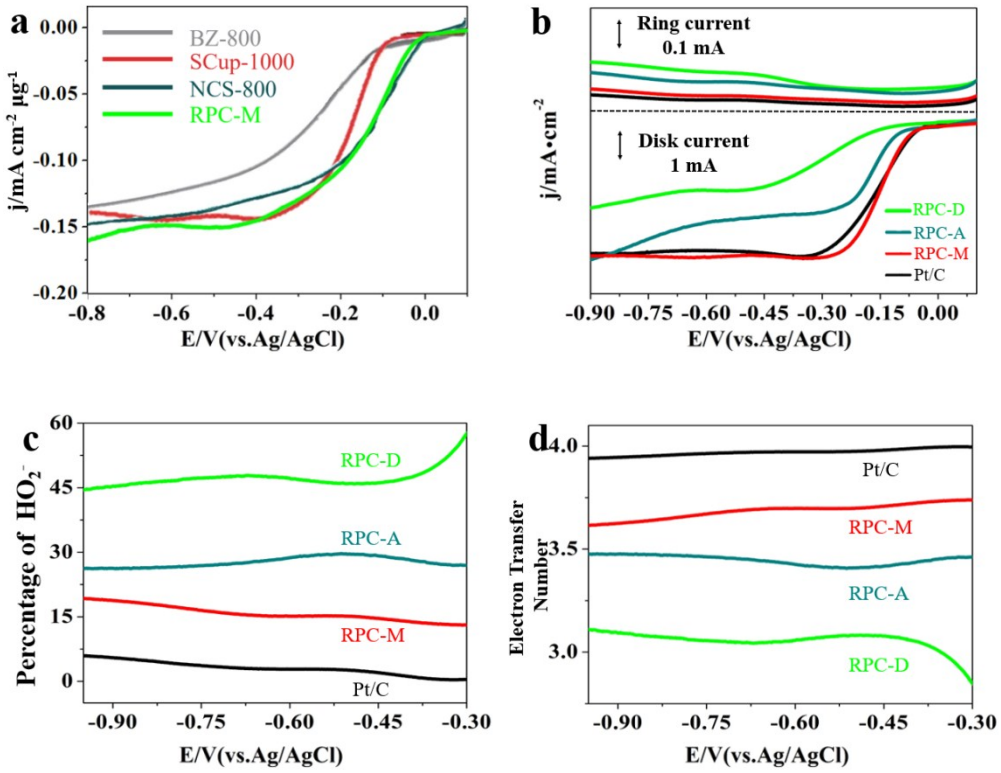

Figure S4. (a) The comparison of LSV curves for RPC-M and other biomass-derived catalysts[30, 41, 44] on a glassy carbon rotating disk electrode (RDE) in O_2 saturated 0.1 M KOH solution at the sweep rate of 10 mVs^{-1} with the rotation speed of 1600 rpm. (b) RRDE voltammograms for ORR of RPC-D, RPC-A, RPC-M and commercial Pt/C in O_2-saturated 0.1 M KOH solution, with the rotation speed of 1600 rpm and sweep rate of 10 mV s^{-1}. (c) The HO_2^- yield and (d) electron transfer number obtained from RRDE curves for RPC-D, RPC-A, RPC-M and commercial Pt/C.

Table S3. The half-wave potentials and limit current densities per loading mass for NCS-800[30], Scup-1000[41], BZ-800[44] and RPC-M.

	half-wave potential V (vs. Ag/AgCl)	current density mA cm^{-2} μg^{-1}
NCS-800	-0.26	0.131
Scup-1000	-0.19	0.137
NCS-800	-0.16	0.146
RPC-M	-0.15	0.161

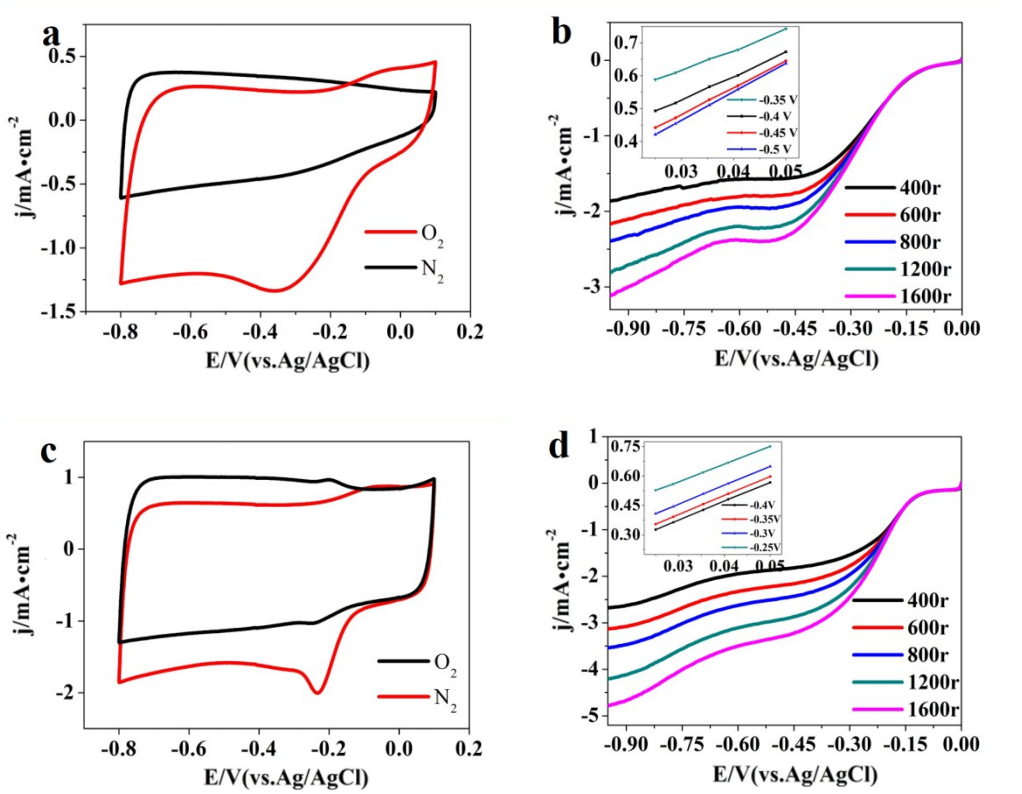

Figure S5. The CV and LSV curves of RPC-D (a, b) and RPC-A (c, d) in N_2 (black lines) or O_2-saturated (red lines) 0.1 M KOH solutions. The sweep rate of CV is 50 mV s^{-1} and LSV is 10 mV s^{-1}. Inset: K-L plots.