Supplementary Information

Selectively doping pyridinic and pyrrolic nitrogen into 3D porous carbon matrix through template-induced edge engineering: enhanced catalytic activity towards oxygen reduction reaction

Ergui Luo,[abc] Meiling Xiao,[ac] Junjie Ge,*[ac] Changpeng Liu*[ac] and Wei Xing*[acd]

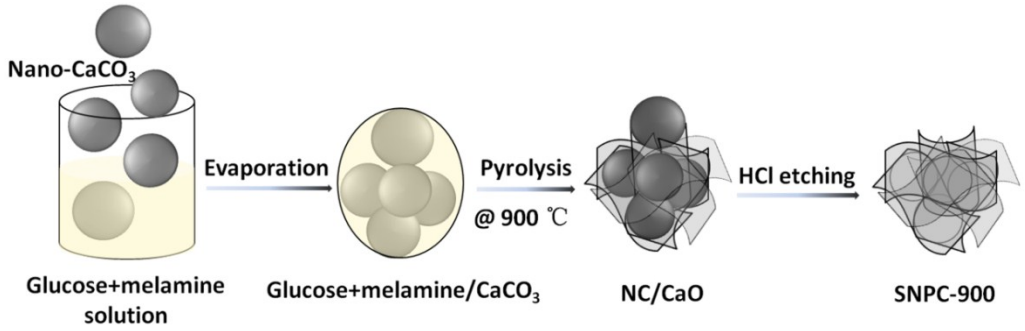
[a.] Laboratory of Advanced Power Sources, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun, Jilin, 130022, PR China.

[b.]University of Science and Technology of China, Hefei, Anhui, 230026, PR China

[c.] Jilin Province Key Laboratory of Low Carbon Chemical Power Sources, Changchun, Jilin, 130022, PR China

[d.] State Key Laboratory of Electroanalytical Chemistry, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun, Jilin, 130022, PR China.

Address: 5625 Renmin Street, Changchun 130022, PR China



Scheme S1 Schematic illustration of the synthetic strategy of the N-doped porous carbon.

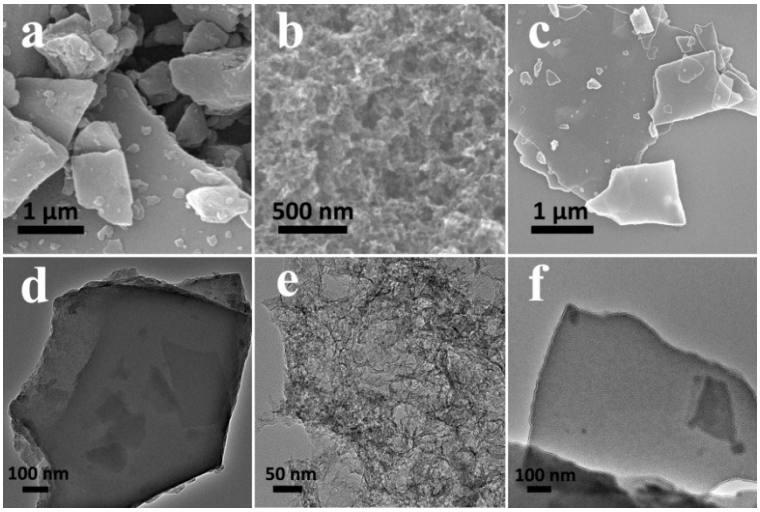


Fig. S1 SEM and TEM images of (a, d) C-900; (b, e) PC-900; (c, f) NC-900.

Table S1 The N atomic ratio, N species percentage (calculation from XPS analysis) and half-wave potential of all the samples.

	N atomic content / at%	Pyridinic N / %	Pyrrolic N / %	Quaternary N / %	Half-wave potential / V
SNPC-900	**5.39**	**38.5**	**55.5**	**6**	**0.853**
NC-900	**2.13**	**26.4**	**18.1**	**55.5**	**0.696**
SNPC-SiO_2	**2.4**	**18.1**	**6.9**	**68**	**0.712**
SNPC-900-0.2	**3**	**29.6**	**38.3**	**32.1**	**0.833**
SNPC-900-0.6	**5.06**	**36.1**	**47.3**	**16.6**	**0.837**
SNPC-700	**10.18**	**18.3**	**81.7**	**-**	**0.714**
SNPC-800	**7.29**	**30.4**	**66.8**	**2.8**	**0.811**
SNPC-1000	**2.22**	**65.3**	**9.9**	**16.8**	**0.801**

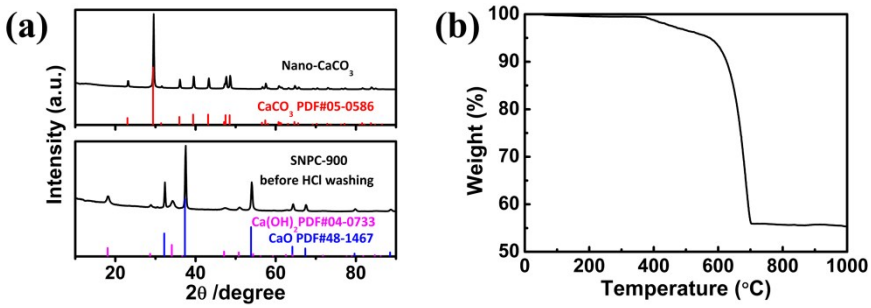


Fig. S2 (a) XRD patterns of nano-$CaCO_3$ and SNPC-900 before HCl washing; (b) TGA curve of nano-$CaCO_3$.

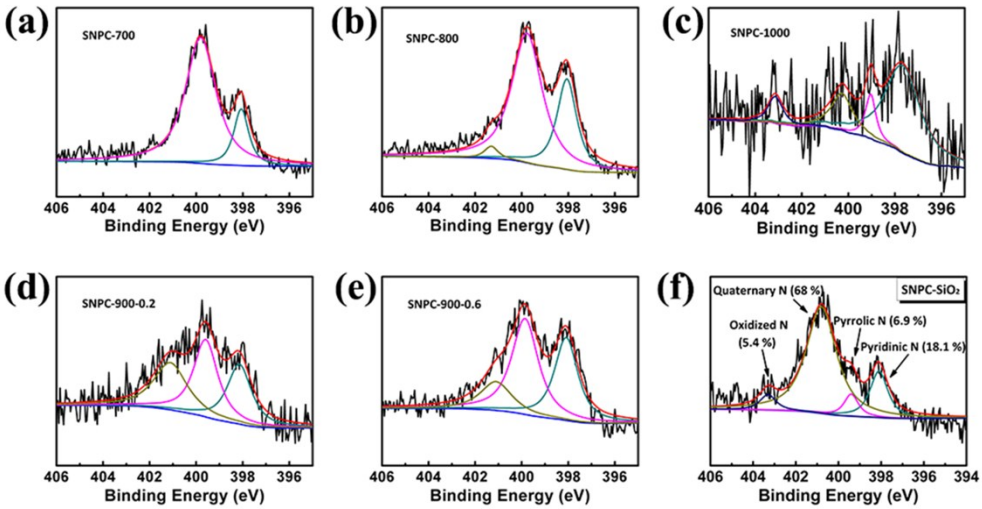


Fig. S3 High resolution N1s spectra of (a) SNPC-700, (b) SNPC-800, (c) SNPC-1000, (d) SNPC-900-0.2, (e) SNPC-900-0.6 and (f) SNPC-SiO_2.

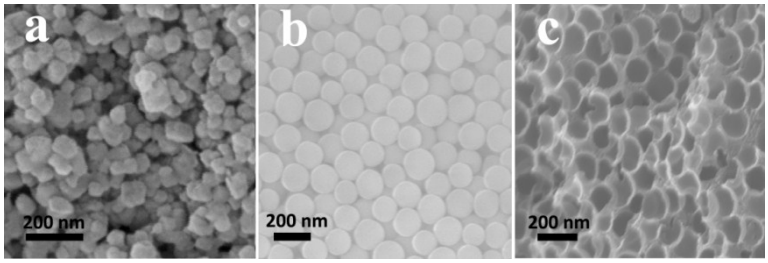


Fig. S4 SEM images of (a) nano-$CaCO_3$; (b) SiO_2 nanospheres and (c) SNPC-SiO_2.

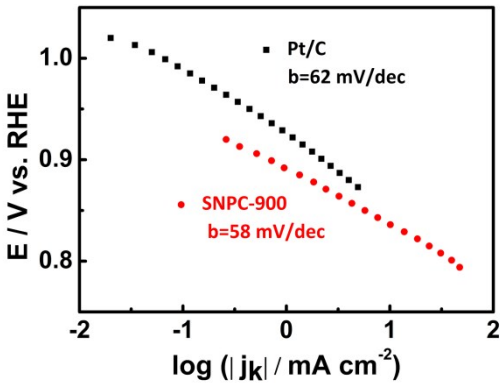


Fig. S5 Tafel plots for SNPC-900 and Pt/C extracted from Fig. 4(a).

Table S2 Comparison of ORR performance of SNPC-900 in this work and some recently reported heteroatom-doped carbon materials. All catalysts were tested in 0.1 M KOH at 1600rpm.

Materials	Loading (mg/cm^2)	Onset potential (V vs. RHE)	Half-wave potential (V vs. RHE)	Reference
N-doped porous carbon	0.5	0.97	0.853	This work
Carbon nanofiber @nitrogen-doped graphen blends	0.45	0.93	0.8	[1]
Carbon nanotubes/heteroatom-doped carbon core–sheath	0.6	0.92	0.82	[2]
N-doped carbon nanospheres	0.4	--	0.78	[3]
Hierarchically porous N-doped carbon	0.5	--	0.87	[4]
S,N dual-doped carbon nanosheets	--	0.95	0.83	[5]
N,P,S co-doped carbon nanosheets	0.6	0.938	0.8	[6]
B-N dual-doped porous carbon	0.4	0.894	0.793	[7]

1. T. N. Ye, L. B. Lv, X. H. Li, M. Xu and J. S. Chen, *Angew. Chem. Int. Ed.*, 2014, **53**, 6905-6909.
2. Y. J. Sa, C. Park, H. Y. Jeong, S. H. Park, Z. Lee, K. T. Kim, G. G. Park and S. H. Joo, *Angew. Chem. Int. Ed.*, 2014, **53**, 4102-4106.
3. G. Wang, Y. Sun, D. Li, H. W. Liang, R. Dong, X. Feng and K. Mullen, *Angew. Chem. Int. Ed.*, 2015, **54**, 15191-15196.
4. H. W. Liang, X. Zhuang, S. Bruller, X. Feng and K. Mullen, *Nat. Commun.*, 2014, **5**, 4973.
5. J. Li, Y. Zhang, X. Zhang, J. Huang, J. Han, Z. Zhang, X. Han, P. Xu and B. Song, *ACS Appl. Mater. Interfaces*, 2017, **9**, 398-405.
6. Y.-N. Zhu, C.-Y. Cao, W.-J. Jiang, S.-L. Yang, J.-S. Hu, W.-G. Song and L.-J. Wan, *J. Mater. Chem. A*, 2016, **4**, 18470-18477.
7. Y. Qian, Z. Hu, X. Ge, S. Yang, Y. Peng, Z. Kang, Z. Liu, J. Y. Lee and D. Zhao, *Carbon*, 2017, **111**, 641-650.