Supporting Information

Nitrogen, Phosphorus and Sulfur co-doped Ultrathin Carbon Nanosheet as a Metal-free Catalyst for Selective Oxidation of Aromatic Alkanes and Oxygen Reduction Reaction

Ya-Nan Zhu,[ab] Chang-Yan Cao,*[ab] Wen-Jie Jiang,[ab] Shu-Liang Yang,[ab] Jin-Song Hu,[a] Wei-Guo Song*[ab] and Li-Jun Wan*[a]

[a]Beijing National Laboratory for Molecular Sciences, Laboratory of Molecular Nanostructures and Nanotechnology, Institute of Chemistry, Chinese Academy of Sciences, Beijing, 100190, China.
*E-mail: cycao@iccas.ac.cn, wsong@iccas.ac.cn, wanlijun@iccas.ac.cn
[b]University of Chinese Academy of Sciences, Beijing, 100049, P.R.China.

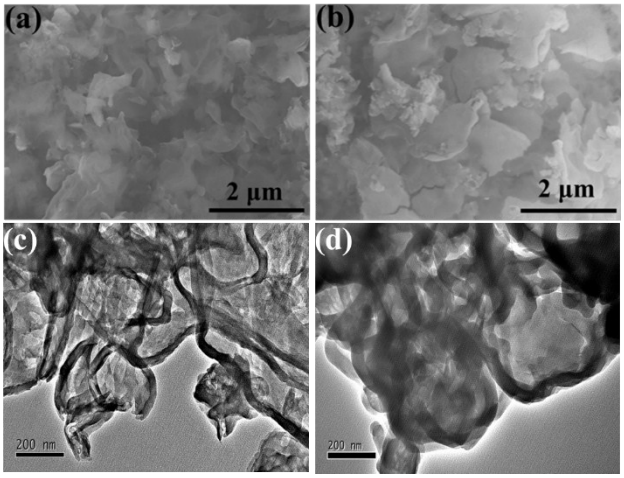

Fig. S1 (a, c) SEM and TEM images of g-C_3N_4, (b, d) SEM and TEM images of g-C_3N_4@PZS.

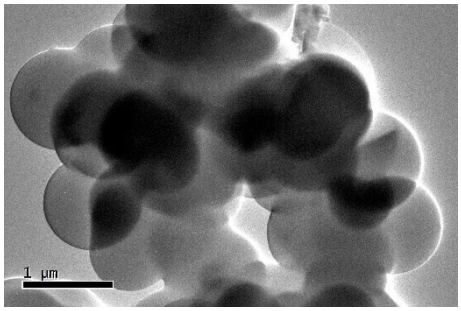

Fig. S2 TEM image of pure PZS

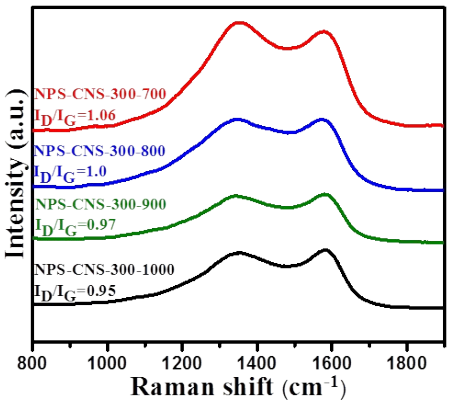

Fig. S3 Raman spectra of NPS-CNS-300-Y

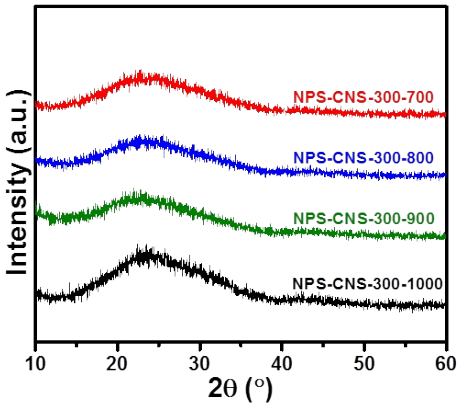

Fig. S4 XRD patterns of NPS-CNS-300-Y

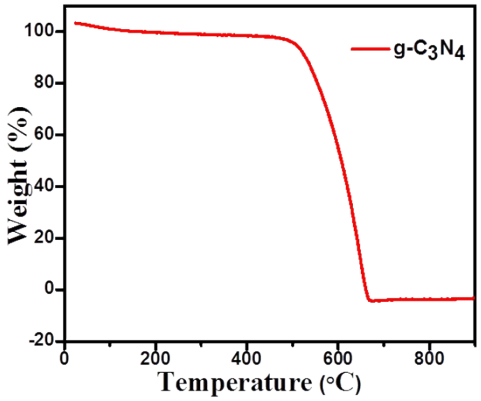

Fig. S5 TGA curve of g-C_3N_4 nanosheets

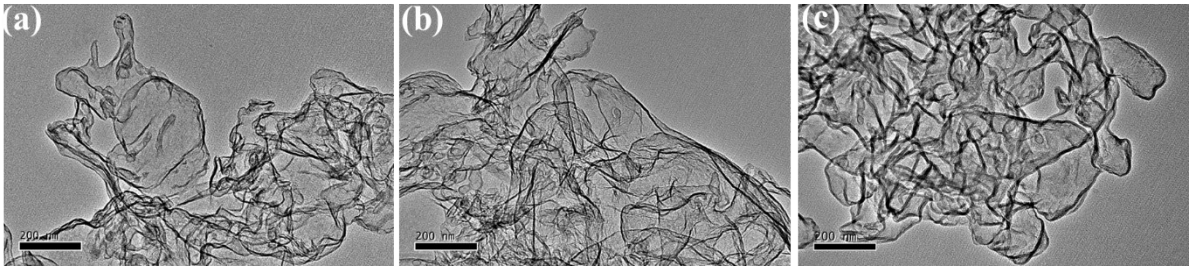

Fig. S6 TEM images of (a) NPS-CNS-300-700, (b) NPS-CNS-300-800 and (c) NPS-CNS-300-900

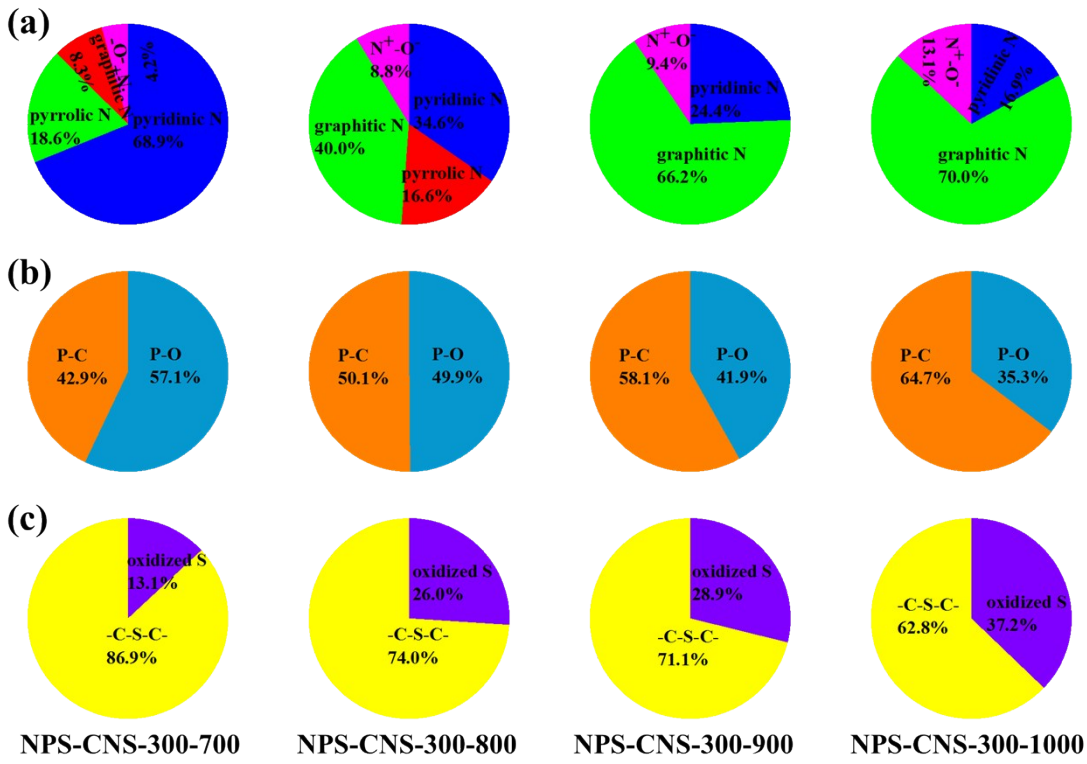

Fig. S7 The relative contents of (a) nitrogen species, (b) phosphorus species and (c) sulphur species in NPS-CNS-300-Y

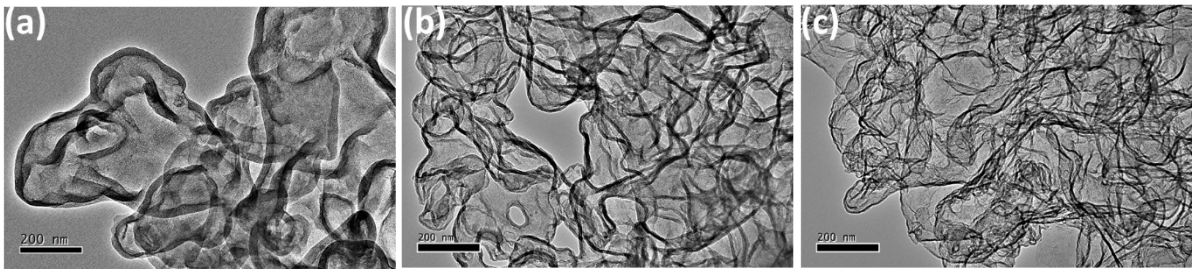

Fig. S8 TEM images of (a) NPS-CNS-100-1000, (b) NPS-CNS-200-1000, (c) NPS-CNS-400-1000

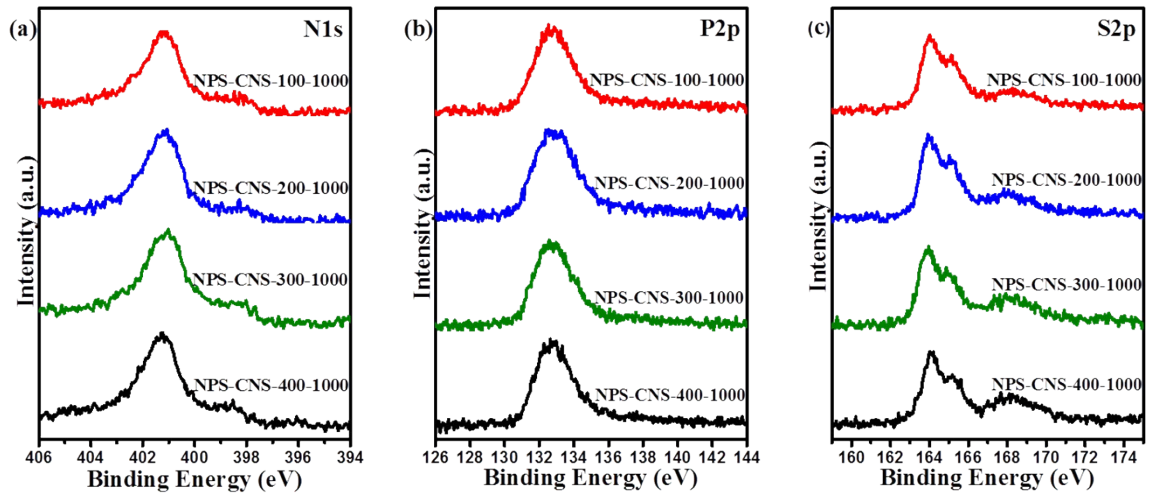

Fig. S9 XPS spectra of NPS-CNS-X-1000: (a) N1s, (b) P2p, and (c) S2p.

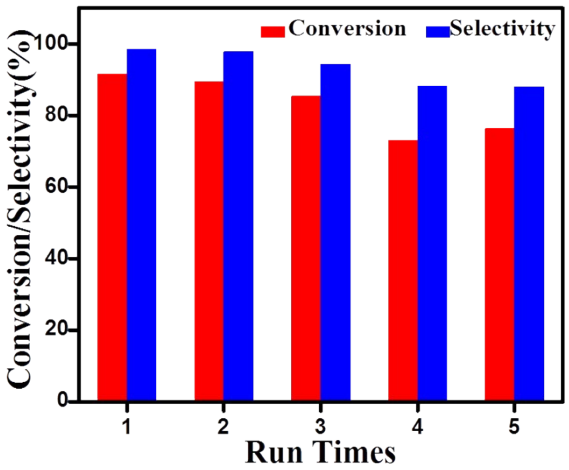

Fig. S10 Reusability of NPS-CNS-300-1000 for ethylbenzene oxidation. Reaction conditions: catalyst (8mg), ethylbenzene (0.5mmol), TBHP (0.5mL,70wt% in water), H_2O (1mL), 80 ºC, 6h.

Table S1 The atomic ratio (calculation from XPS analysis) and BET surface areas of all the samples

Sample	C(%)	N(%)	P(%)	S(%)	O(%)	Surface area ($m^2 g^{-1}$)
PZS-1000	91.25	1.18	0.74	0.70	6.13	562
NPS-CNS-300-700	53.20	29.12	6.81	0.32	10.56	330
NPS-CNS-300-800	76.48	9.09	2.85	0.53	11.06	755
NPS-CNS-300-900	84.34	4.75	1.60	0.59	8.72	807
NPS-CNS-300-1000	89.10	2.32	0.68	0.49	7.41	1198
NPS-CNS-100-1000	91.30	1.70	0.62	0.59	5.81	873
NPS-CNS-200-1000	89.77	2.12	0.69	0.58	6.85	915
NPS-CNS-400-1000	89.15	2.48	0.69	0.49	7.20	1031