Experimental

Materials

Guanine (99%), furfuryl alcohol (FFA, 98%), 1, 4-benzoquinone (BQ, 99%), dimethyl sulfoxide (DMSO, 99%) and sodium persulfate ($Na_2S_2O_8$, PDS, 99%) were supplied by Aladdin Reagent Co. Ltd., Shanghai, China. Methanol (99.5%), ethanol (99.9%) and zinc nitrate hexahydrate ($Zn(NO_3)_2 \cdot 6H_2O$, 99%) were purchased from China Medicine Group Shanghai Chemical Reagent Company. Rhodamine B (RhB, AR) was obtained from Wenzhou Huaqiao Chemical Reagent Co., Ltd.. All the reagents were directly used without further purification.

Synthesis of N-doped porous carbon

The N-doped porous carbon was synthesized by carbonization of guanine as both C and N source, during which $Zn(NO_3)_2$ was employed as activator. Specifically, 6 g of guanine and 2.0 g of $Zn(NO_3)_2$ were dispersed in 50mL of ethanol in a beaker. Then the mixture was heated at 70^{o}C in an oil bath with magnetic stirring to remove the solvent, followed by drying in a 100^{o}C oven. Subsequently, the solid mixture was charged to a quartz boat with a cover, and then transfer to a tube furnace equipped with a quartz tube. Next the precursor was heated to 1000^{o}C with a heating rate of 5^{o}C/min under the protection of N_2 atmosphere and kept for 1h. The obtained black powder was taken out after the furnace cooled down to ambient temperature, followed by washing with ethanol. Next, the product was dried at 110^{o}C and labelled as NC1000. NC900 and NC1100 were fabricated under the same condition, except that the carbonization temperature was 900^{o}C and 1100^{o}C, respectively. To mask the Zn species, 0.1g of NC1000 was firstly dispersed in 100 mL of water in a flask. Then, 1.0g of KSCN was added to the above mixture and stirred at 25^{o}C overnight. Next, the mixture was filtrated and the black powder was washed with water to remove residual KSCN. Finally, the obtained product was transferred into a 110^{o}C oven for drying and denoted as NC1000(SCN)

Characterization

The X-ray diffraction (XRD) patterns were recorded on a Rigaku D/Max-2500PC diffractometer with a Cu Kα radiation source operating at 50 kV, 300 mA. The Raman spectra were collected using a Renishaw inVia with a 532 nm laser excitation. The nitrogen adsorption-desorption isotherms were obtained from Micromeritics ASAP 2060 at 77 K. The specific surface area was calculated by Brunauer-Emmett-Teller (BET) method. The X-ray photoelectron spectroscopy (XPS) study was performed on an ESCALAB 250 XPS system with a monochromatized Al Kα X-ray source (1486.6 eV) with correction for cross sections and escape depths. To detect the composition of each N species, shirley type is used for background and four peaks are set during fitting. However, no constrains (such as position and FWHM) are employed during data processing. The morphology was observed by a FEI Talos F200S G2 microscope (operated at 200 kV) combined with an energy dispersive spectroscopy (EDS) spectrometer. Besides, the morphology was also investigated by a ZEISS Sigma 300 scanning electron microscope operated at 3-10 kV.

Catalytic degradation of RhB

The catalytic activity of each material was evaluated using RhB degradation via PDS activation as a model reaction. Typically, 5 mg of catalyst and 10 mg of PDS were added into a 100 mL bottom rounded flask in sequence, followed by the addition of 50 mL of RhB solution (20 mg/L) to start the reaction. At certain reaction interval, about 2 mL of solution was withdrawn and filtrated using a 0.22 μm Millipore syringe filter, and then the filtration was immediately analyzed with the assistance of a UV-vis spectrophotometer. The procedure for the assessment of adsorption capability was the same to the catalytic process except the addition of PDS.

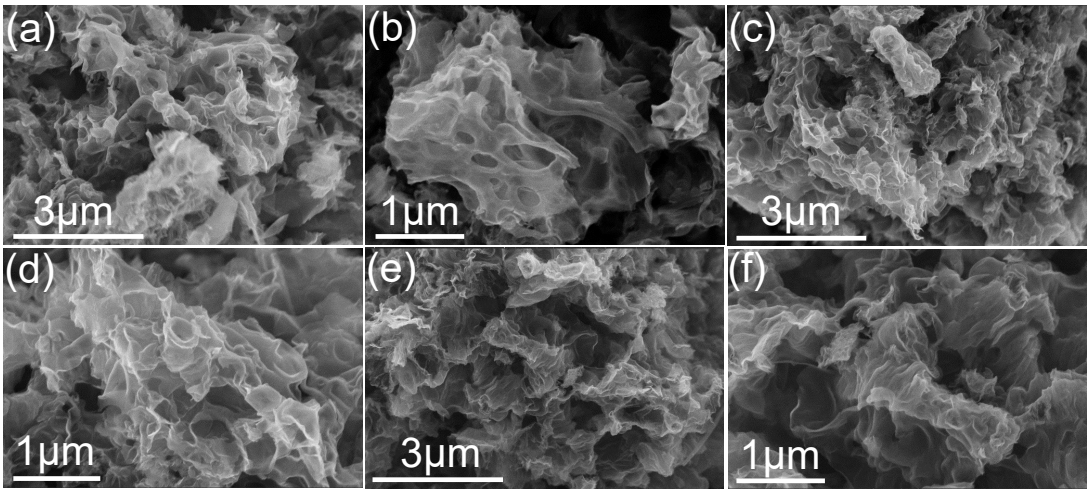

Fig. S1. SEM figures of NC900 (a, b), NC1000 (c, d) and NC1100 (e, f)

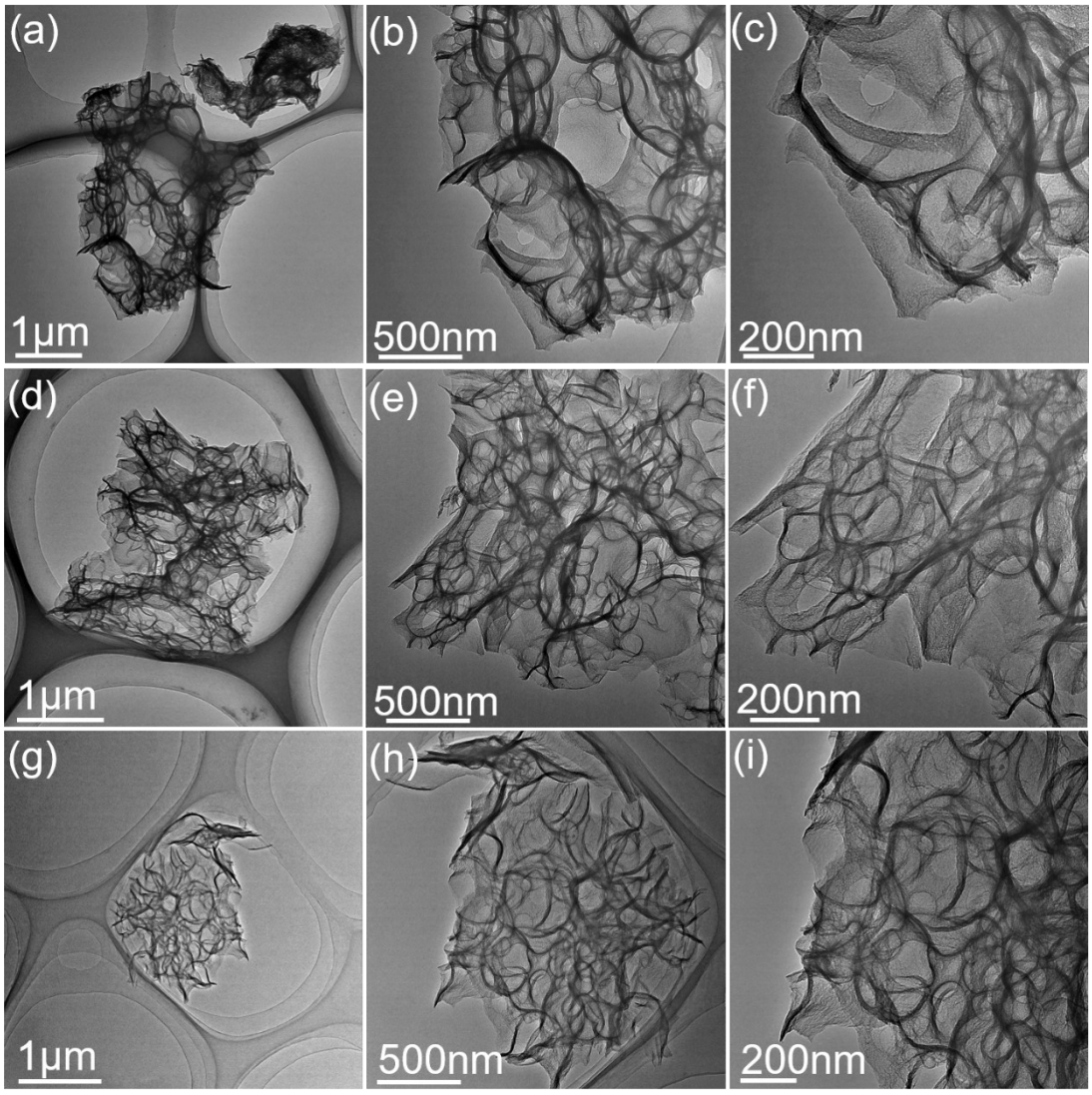

Fig. S2. TEM images of NC900 (a-c), NC1000 (d-f) and NC1100 (g-i)

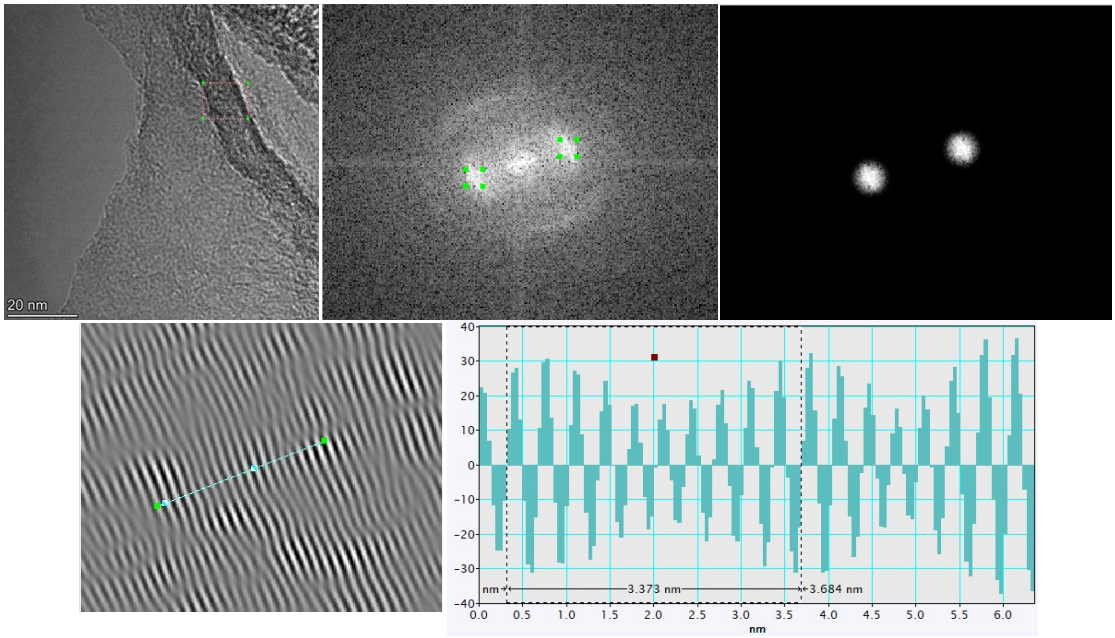

Fig. S3. HRTEM of NC1000

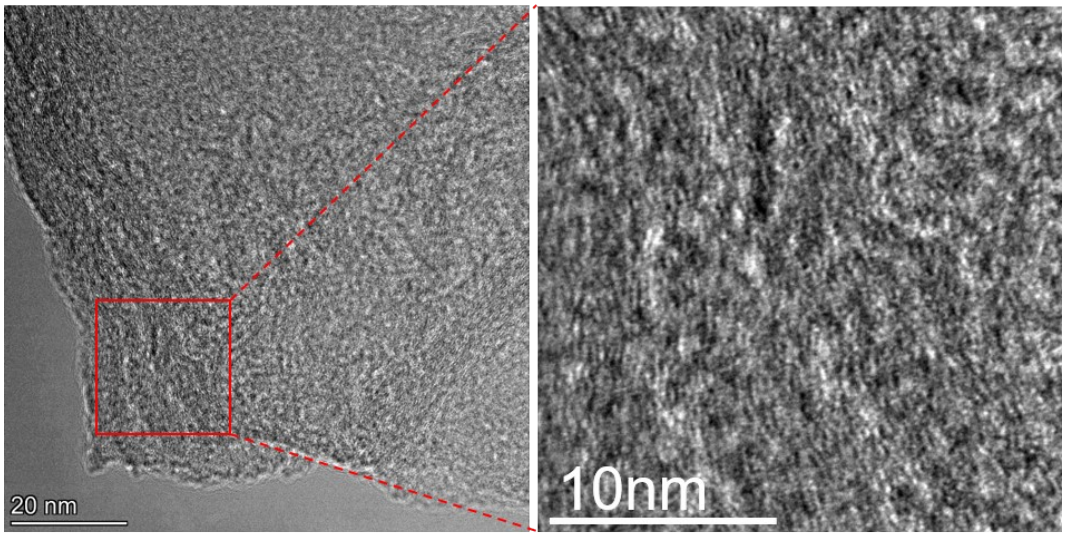

Fig. S4. HRTEM of NC900

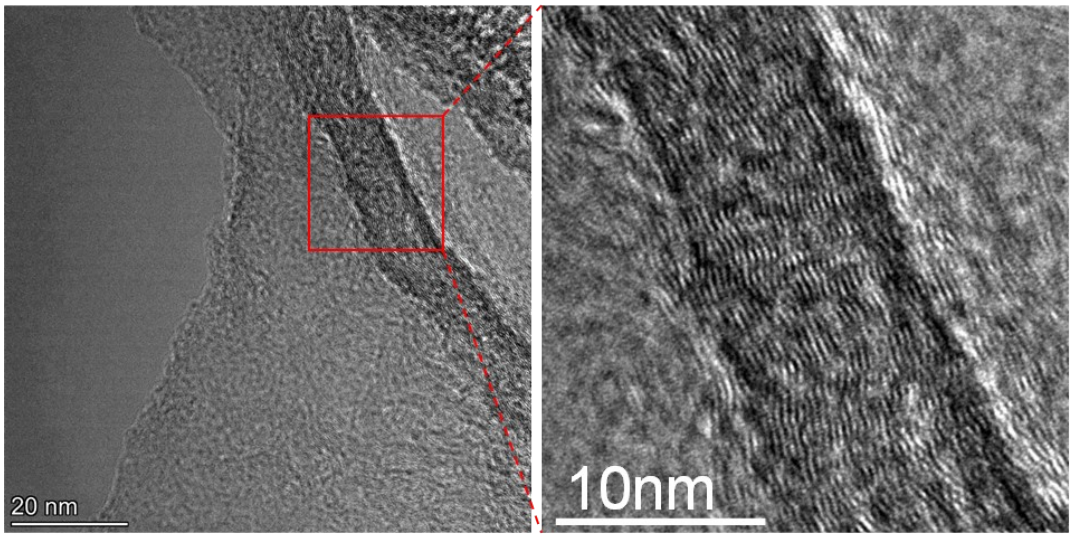

Fig. S5. HRTEM of NC1000

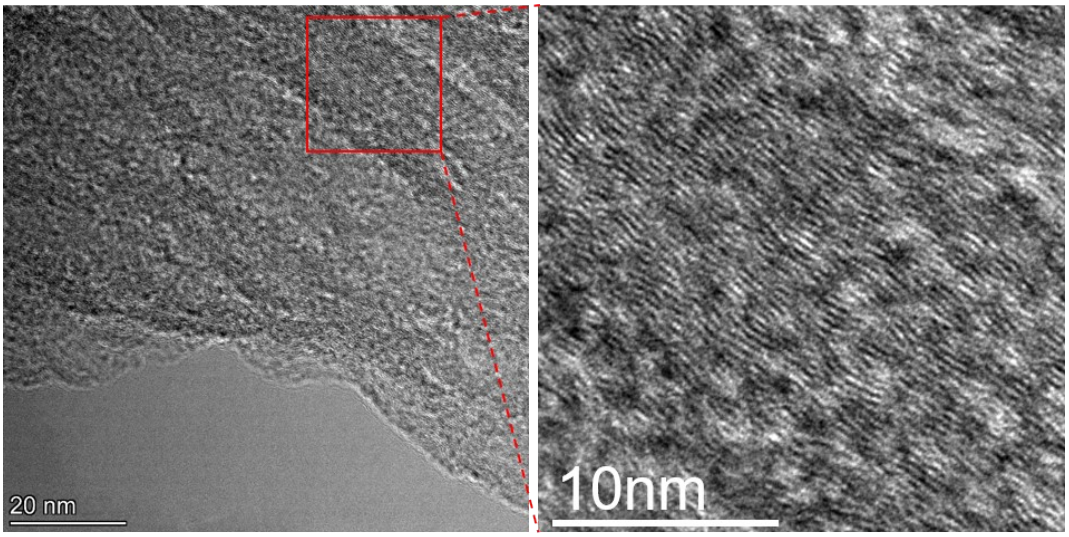

Fig. S6. HRTEM of NC1100

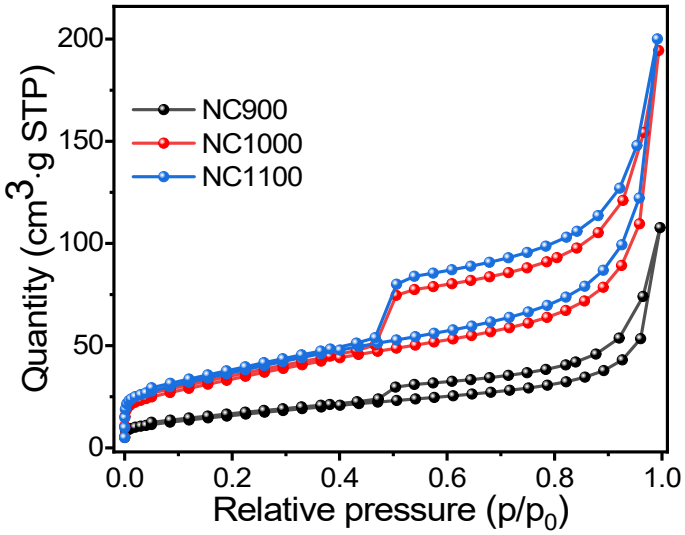

Fig. S7. N_2 adsorption-desorption isotherms of the catalysts

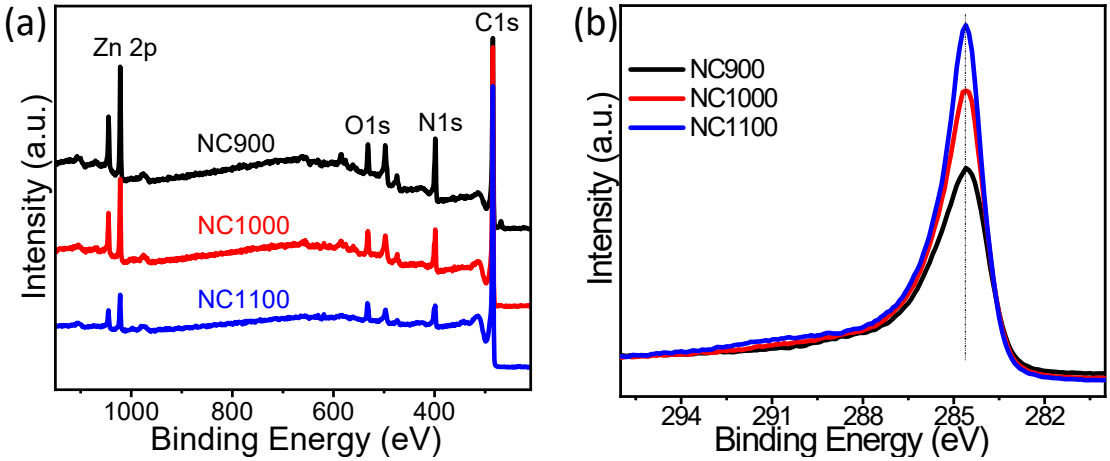

Fig. S8. XPS scan spectra (a) and C1s spectra (b) of the materials

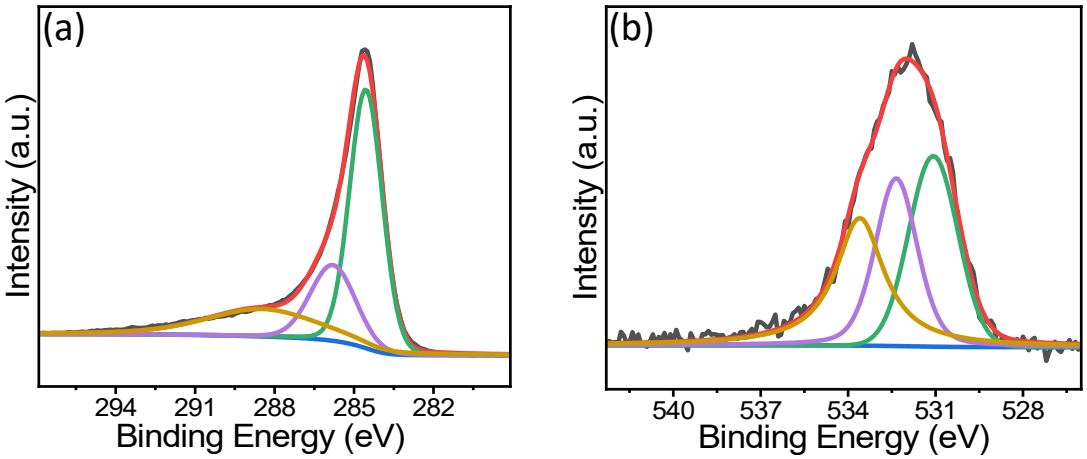

Fig. S9. High resolution N 1s (a) and O 1s (b) spectra of NC1000

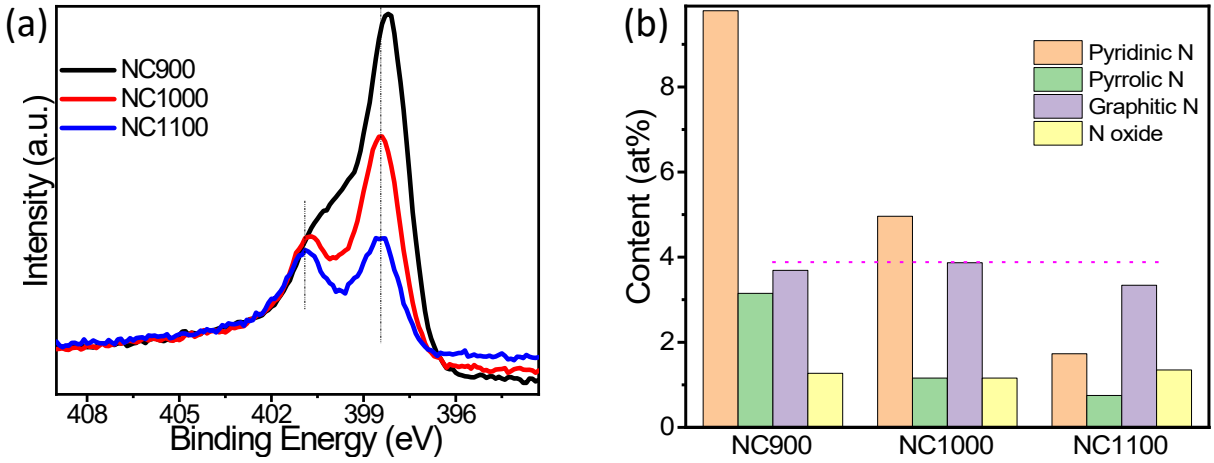

Fig. S10. Comparison of N 1s spectrum (a) and the content of each N species (b)

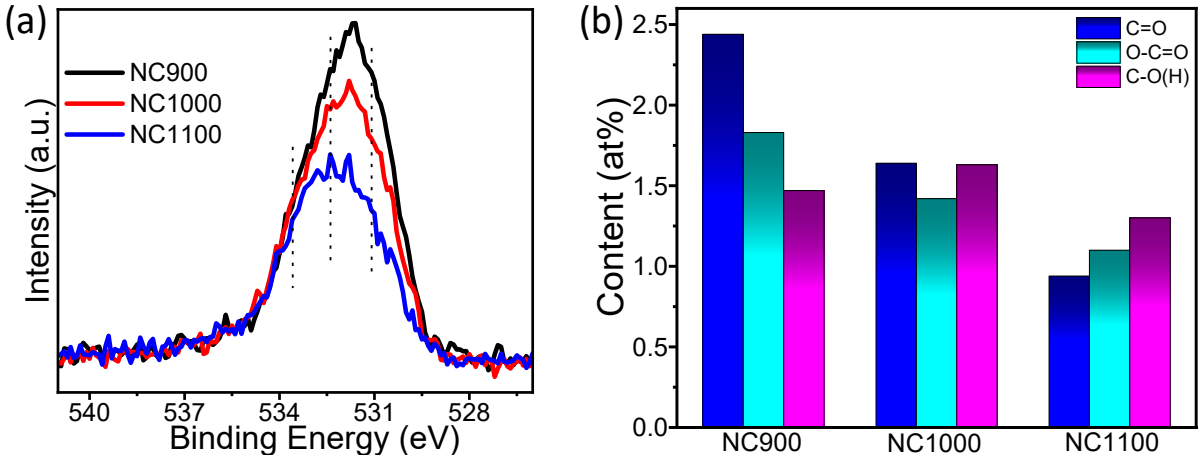

Fig. S11. Comparison of O 1s spectrum (a) and the content of each O species (b)

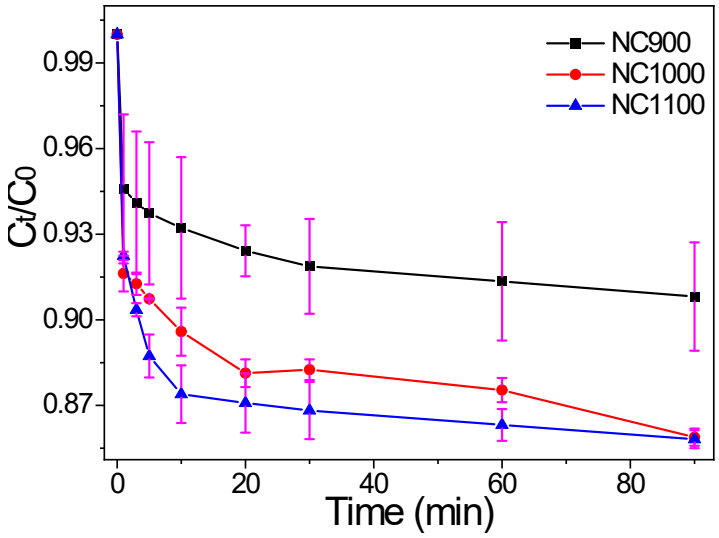

Fig. S12. The adsorption of RhB on each catalyst

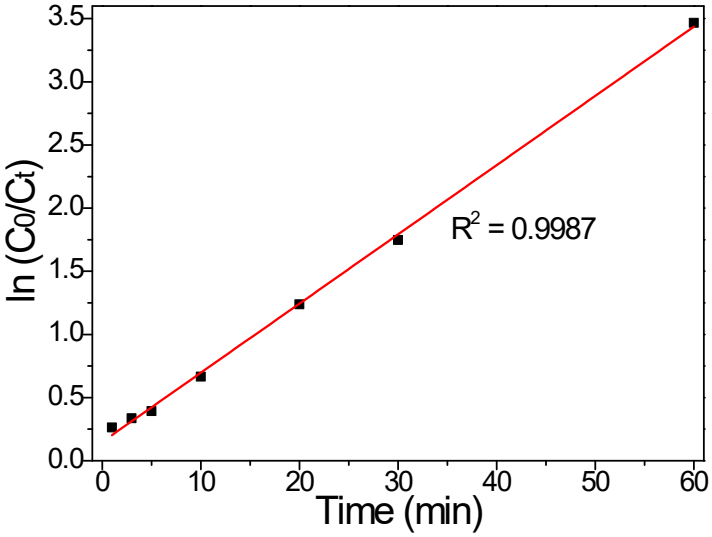

Fig. S13. The RhB degradation catalyzed by NC1000

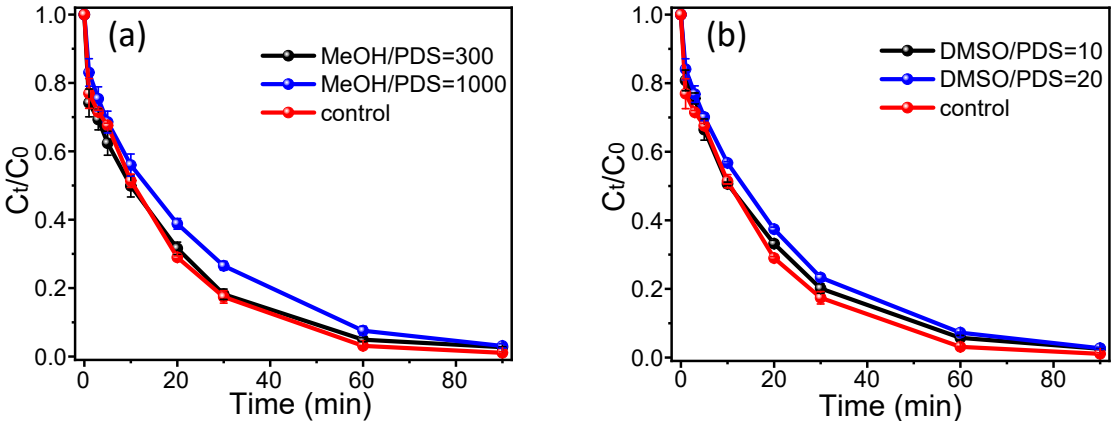

Fig. S14. The effect of methanol and DMSO on degradation of RhB

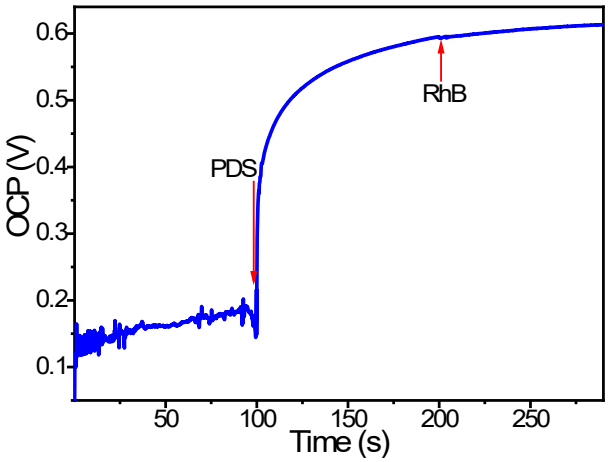

Fig. S15. The open circuit potential curve

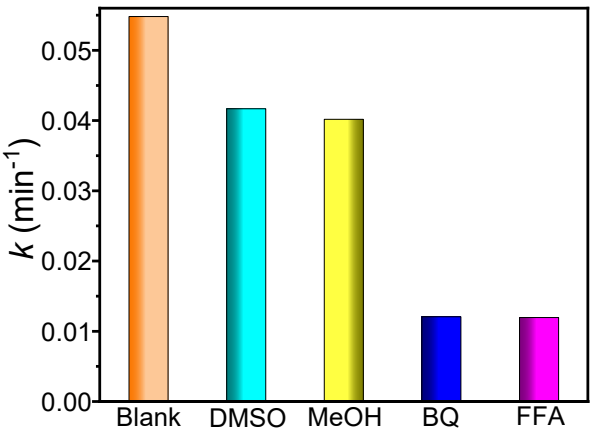

Fig. S16. The reaction constant in the presence of each quenching reagent

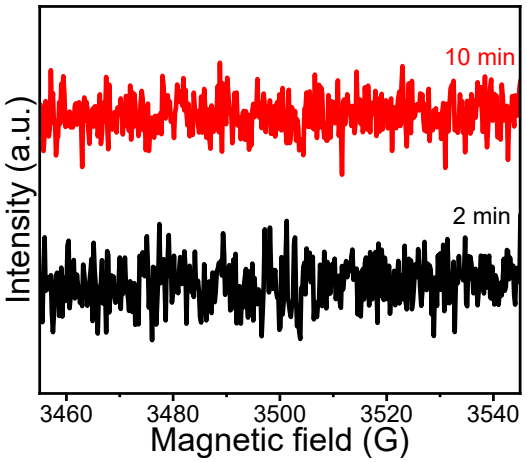

Fig. S17. EPR spectra for DMPO-trapped hydroxyl and sulfate radicals

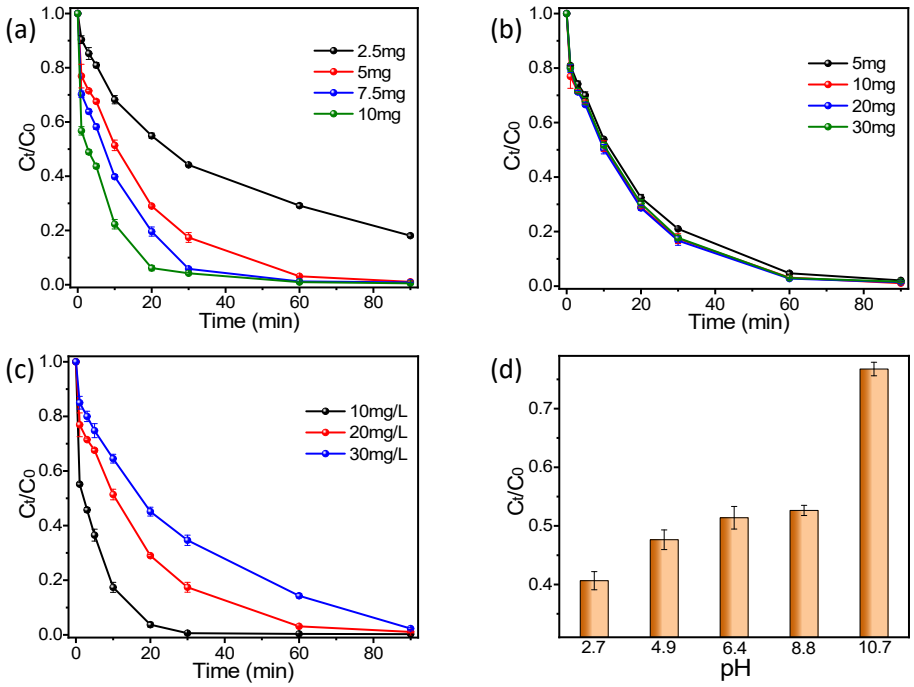

Fig. S18. The effect of catalyst amount (a), PDS dosage (b), RhB concentration (c) and initial pH (d) on the reaction.

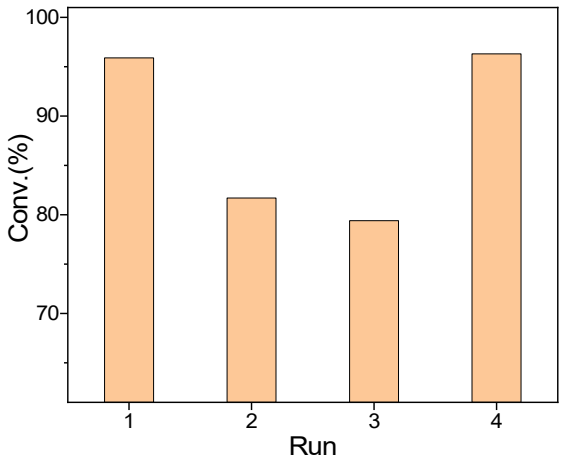

Fig. S19. The recycling test of NC1000 (The 4th run was performed after the spent catalyst was regenerated at 800^{o}C)

Table S1. The content of N species on the surface of each catalyst

Catalyst	Total N (at%)	Pyridinic N (at%)	Pyrrolic N (at%)	Graphitic N (at%)	N oxide (at%)
NC900	17.90	9.79	3.15	3.69	1.27
NC1000	11.15	4.96	1.16	3.87	1.16
NC1100	7.17	1.73	0.75	3.34	1.35

Table S2. Comparison of the reaction parameters with literature

Catalyst	Loading (g/L)	PDS (g/L)	PMS (g/L)	RhB (mg/L)	k (min^{-1})	Ref.
ABC-800	1.5	2.4		20	0.2622	[1]
CA	0.2	0.27		20	0.070	[2]
NPC-800	0.2		1.4	100	0.0427	[3]
N,P-HC	0.3	0.95		50	0.055	[4]
PS800	2.0	2.4		20	0.1644	[5]
MBC	0.8	2.2		10	0.0143	[6]
N-HCS	0.1		0.4	20	0.0566	[7]
Co/N-CNTs	0.025		0.20	10	0.094	[8]
0.5-Mn/ZIF-120	0.1		0.3	10	0.0367	[9]
NAPY	1		0.6	10	0.0513	[10]
NC1000	0.1	0.2		20	0.0548	This work

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