Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Al-coordination polymers-derived nanoporous nitrogen-doped carbon microfibers as metal-free catalysts for oxygen electroreduction and acetalization reaction

Zhen Han[a,b], Youyi Yu[a], Yongbo Zhang[a], Bing Dong[a], Aiguo Kong[a] and Yongkui Shan*[a]*

a, School of Chemistry and Molecular Engineering, East China Normal University, 500 Dongchuan Road, Shanghai 200241, P.R. China.

b, Shanghai Key Laboratory of Molecular Catalysts and Innovative Materials, Fudan University, Shanghai 200433, P.R. China.

Supporting information

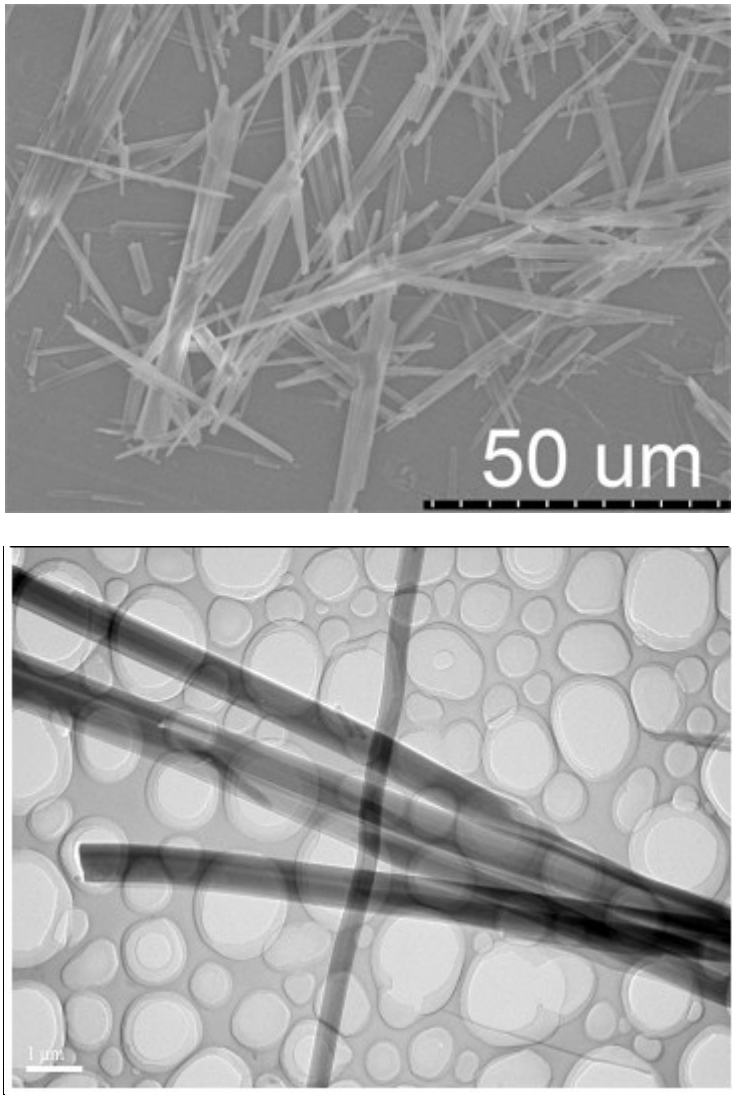


Figure S1 SEM and TEM images of Al-DTPA microfibers (80°C, DTPA and $Al(NO_3)_3 \cdot 9H_2O$ is 1:1)

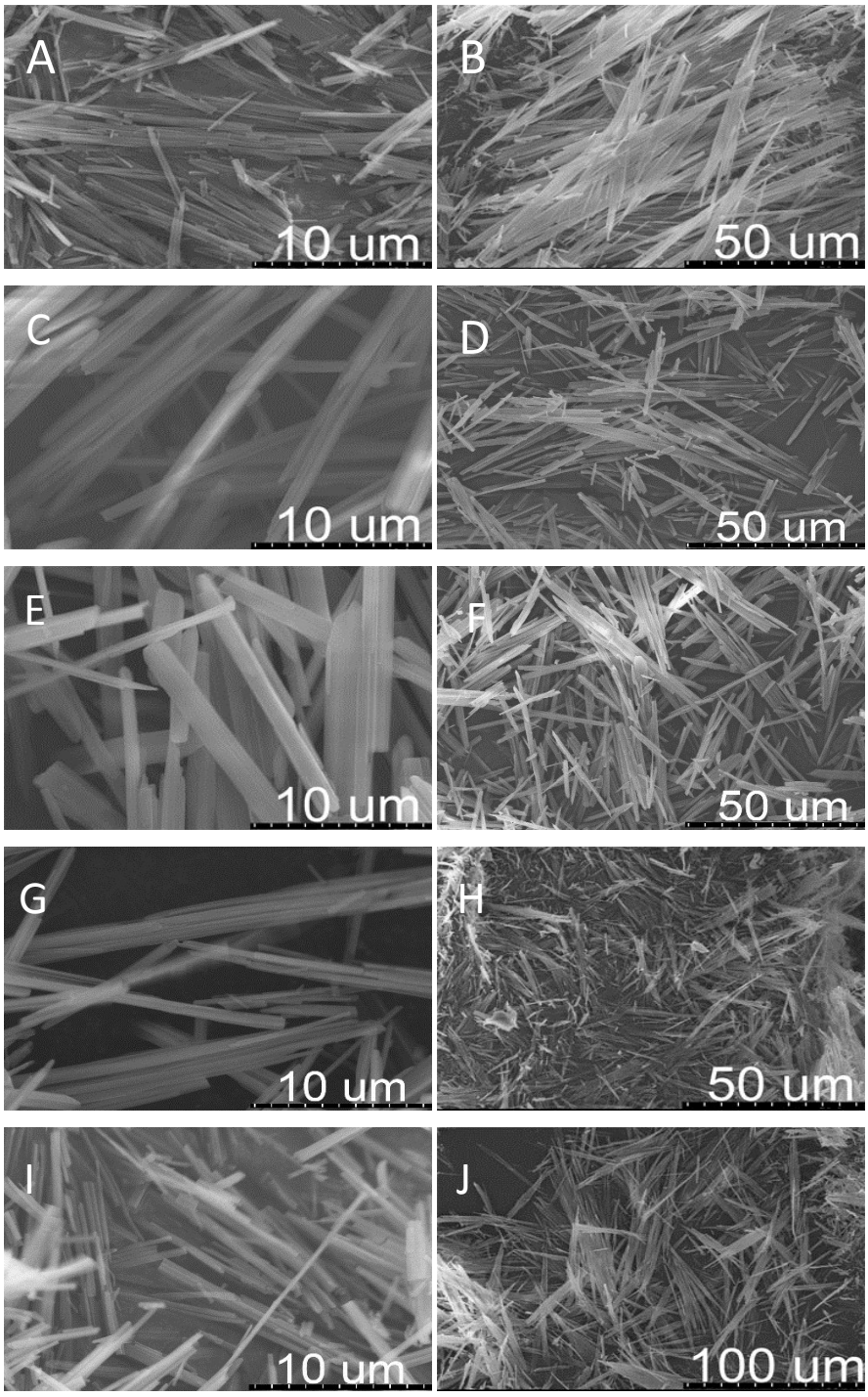


Figure S2 SEM images of Al-DTPA microfibers prepared at 60 (A and B), 80 (C and D) and 100 °C (E-F), respectively (the molar ratio of DTPA to $Al(NO_3)_3 \cdot 9H_2O$ is 1:1); SEM images of Al-DTPA microfibers prepare at 60 °C with different molar ratios of DTPA to $Al(NO_3)_3 \cdot 9H_2O$ (1:2, G and H; 2:1, I and J)

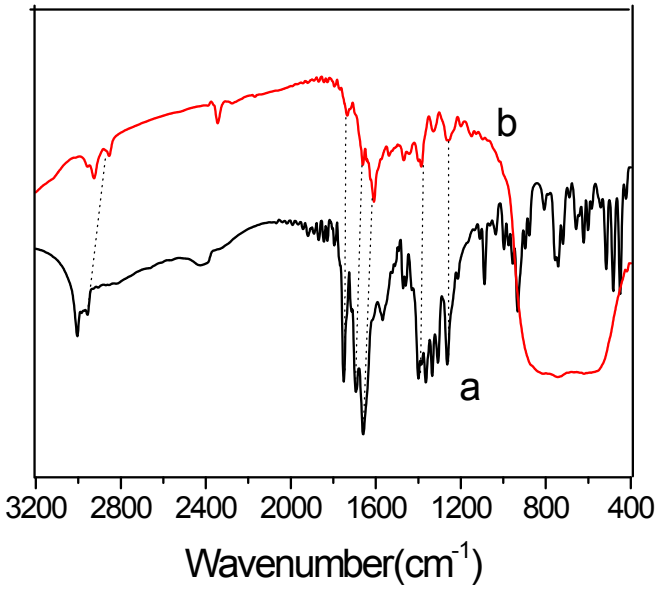


Figure S3 FT-IR spectra for DTPA (a) and Al-DTPA (b)

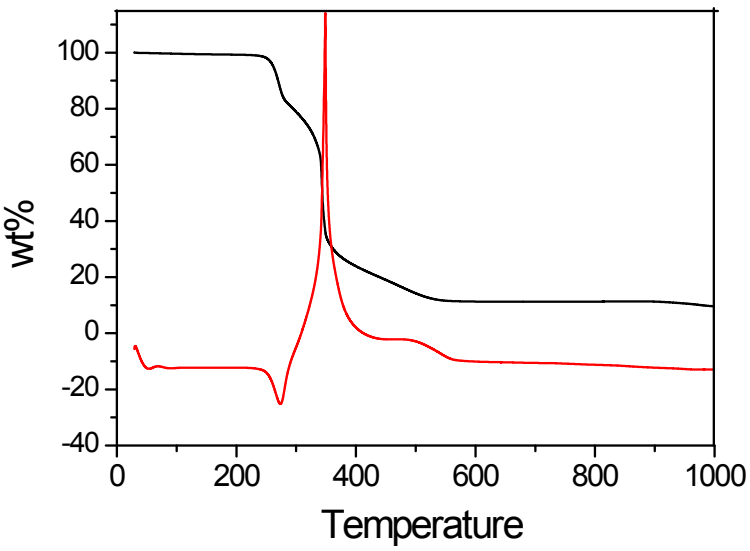


Figure S4 TG-DTA analysis for Al-DTPA microfiber in air

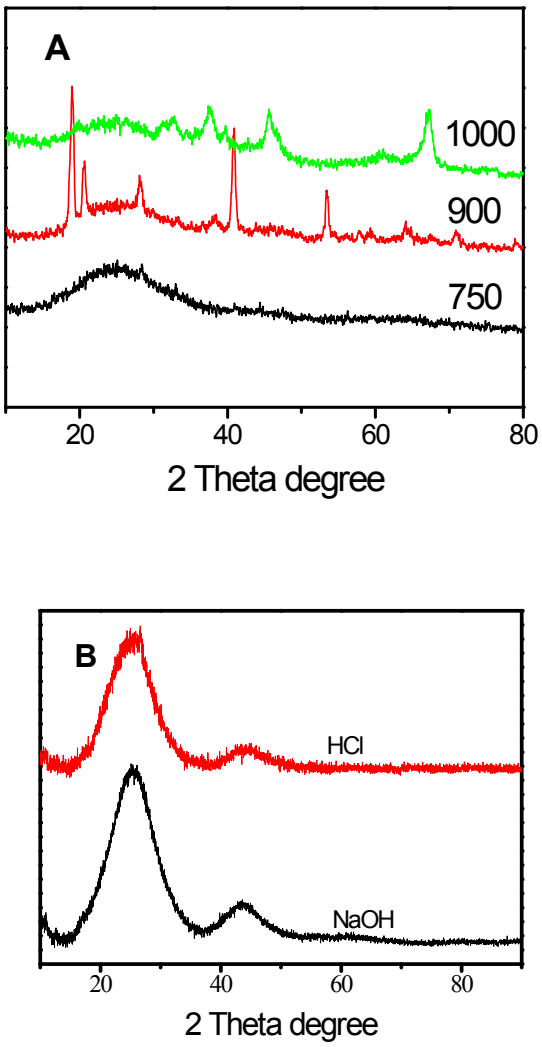


Figure S5 XRD patterns of the aluminium hydroxides or oxides-embedded carbon microfibers samples obtained by heating Al-DTPA at different temperatures (A). The NCF-900 obtained by etching off Al_2O_3 or $Al(OH)_3$ materials with an aqueous solution of HCl and NaOH (10 wt%)(B).

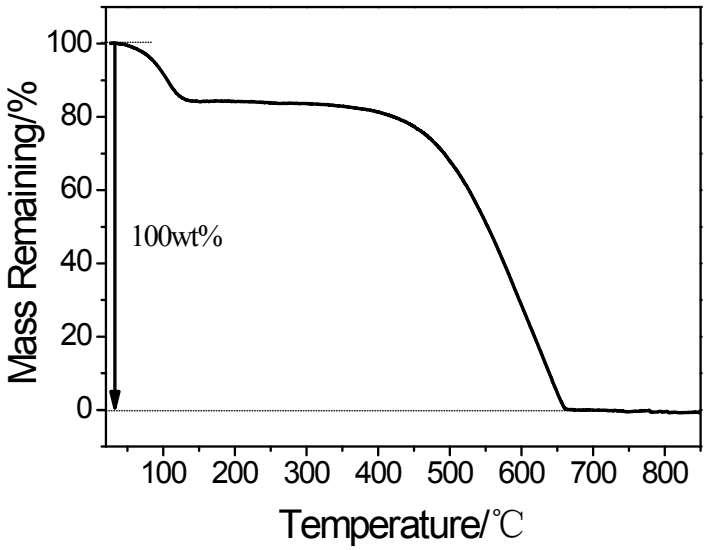


Figure S6 TGA analysis for NCF-900 in air

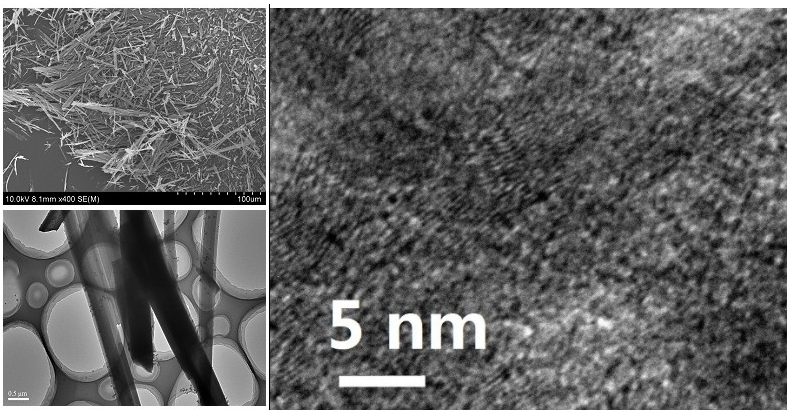


Figure S7 SEM,TEM and HRTEM images of NCFs obtained at 900 ℃

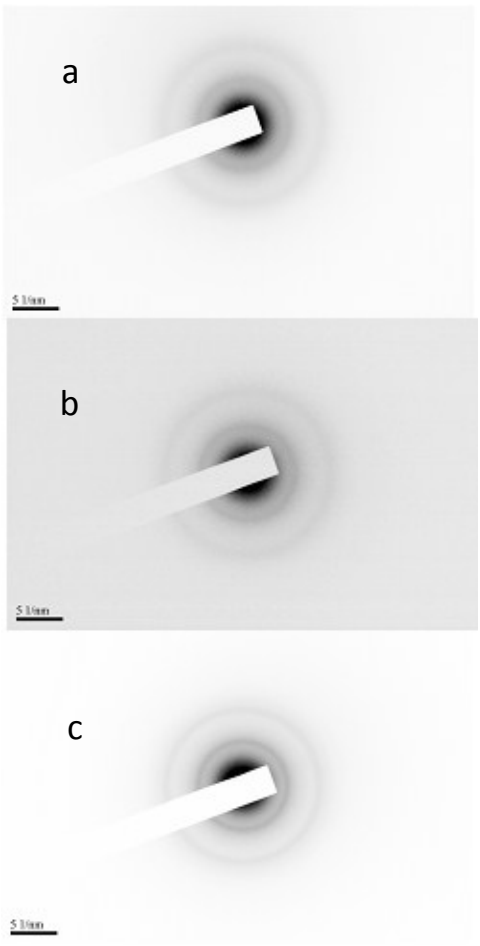


Figure S8 SAED images of NCFs obtained at (a) 750, (b) 900 and (c) 1000 °C in nitrogen atmosphere

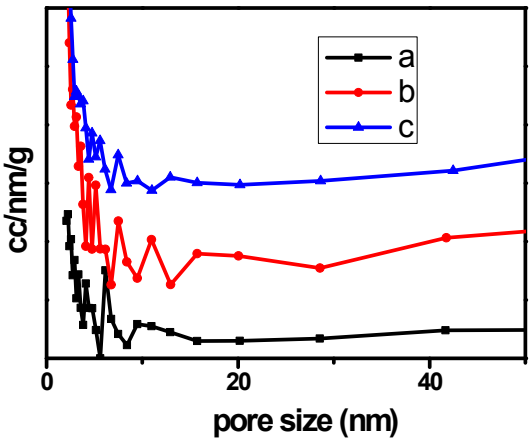
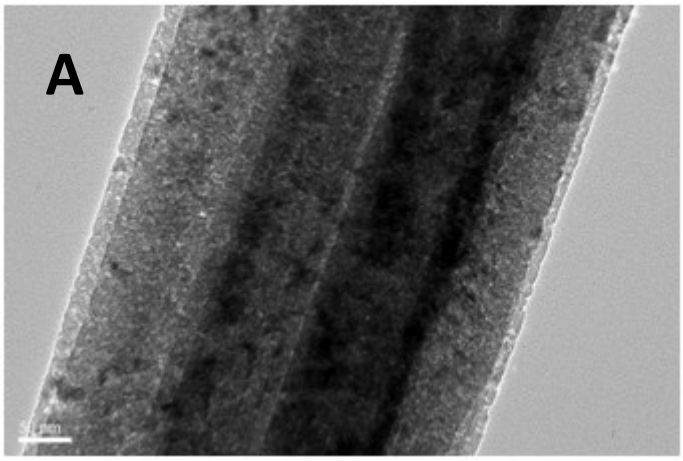


Figure S9 The pore size distribution curves for NCFs obtained at (a) 750, (b) 900 and (c) 1000 °C



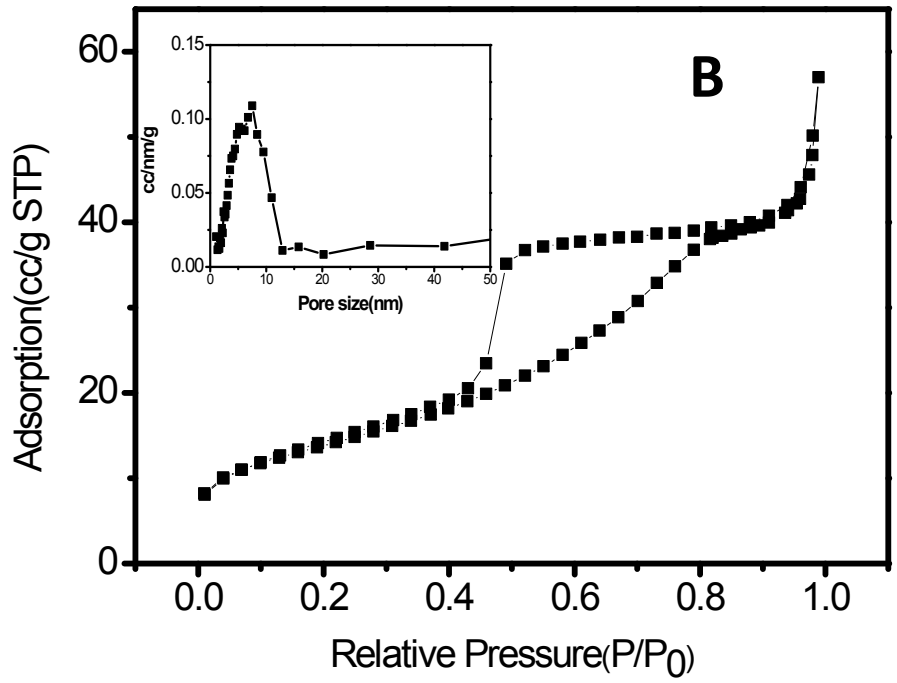


Figure S10 TEM (A) and N_2-adsorption analysis (B) result for γ-Al_2O_3 obtained by heating Al-DTPA at 800 °C in air

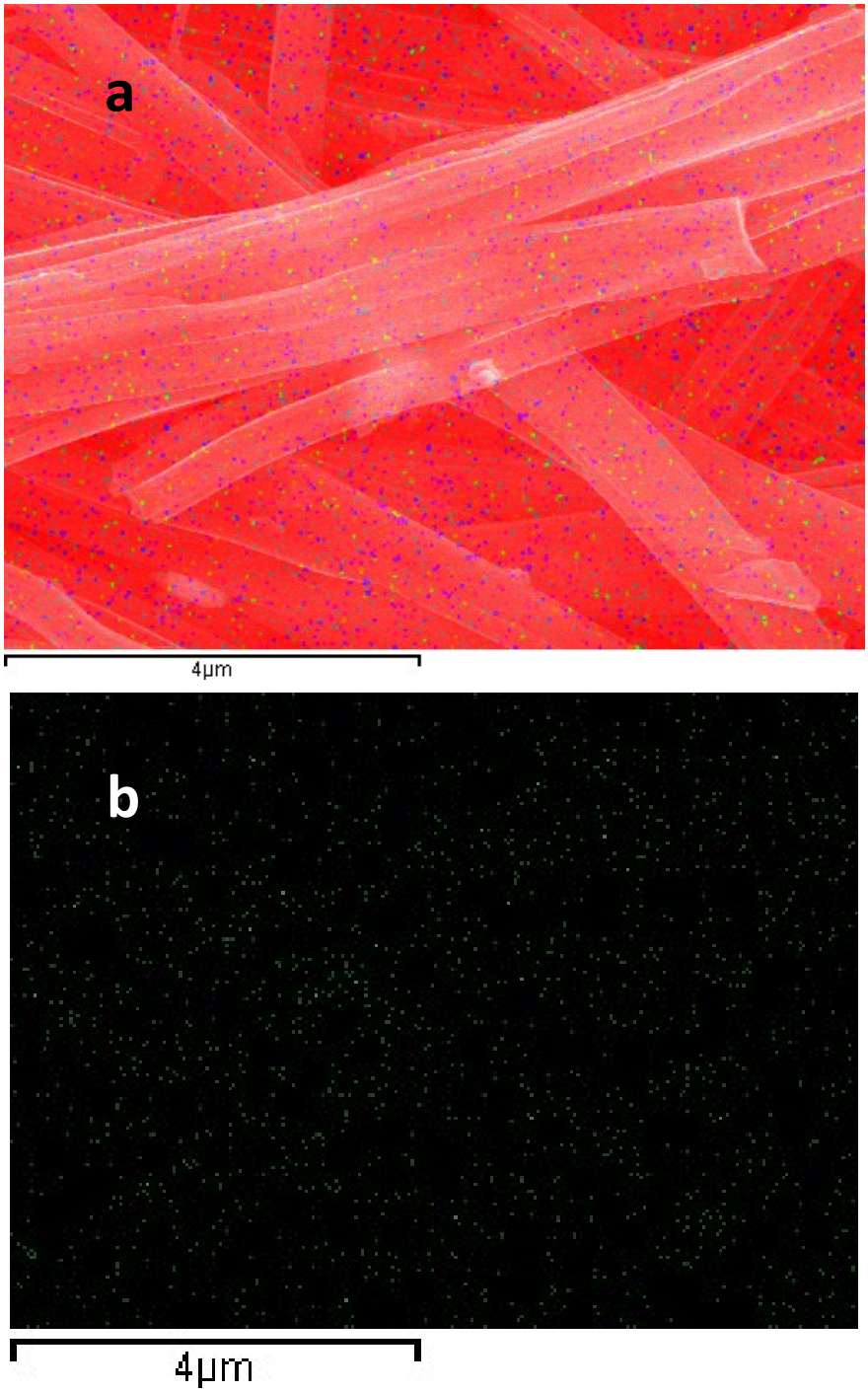


Figure S11 (a) SEM EDS element mapping images of NCF-900 for nitrogen, carbon and oxygen; (b) individual EDS element mapping image for nitrogen

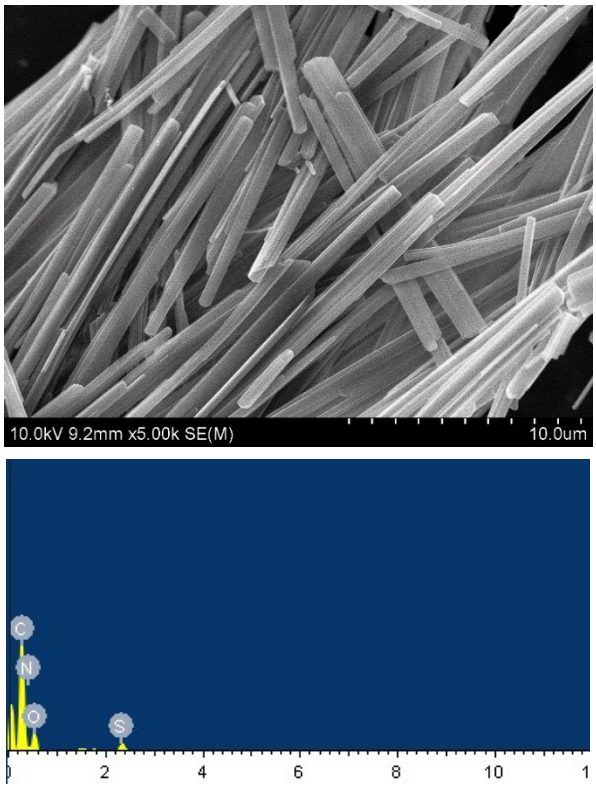


Figure S12 SEM and EDS spectrum of SO_3H/NCF-600

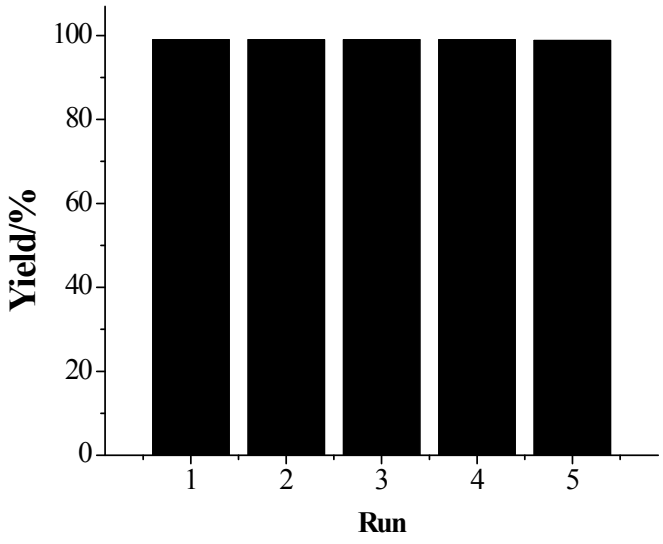


Fig.S13 The recycles of the SO_3H/NCF-600 catalyst for the acetalization reaction of benzaldehyde with 1,2-ethanediol

Table S1 The surface species of N-doped carbon fibers and the content of deconvoluted N-type determined by XPS (at %) and the nitrogen contents determined by elemental analysis (wt %)

Samples	C (at%)	N (at %)	N[a] (wt%)	Py-N^+-O^- (%)	Py-like (%)	G-like (%)	Pyr-N-H (%)
750	83.1	7.9	8.5	9.7	50.8	11.1	28.4
900	83.7	6.7	7.0	7.8	52.2	21.5	18.6
1000	84.0	3.6	3.9	12.0	34.9	50.0	3.2

[a] determined by elemental analysis

Table S2 The surface species and nitrogen content of deconvoluted N-type determined by XPS for Al-DTPA -600 and SO_3H/NCF-600

Samples	C (at %)	N (at %)	Py-N+-O- (%)	Py-like (%)	G-like (%)	Pyr-N-H (%)
Al-DTPA -600	51.08	4.84	10.1	51.3	10.4	28.2
SO3H/NCF-600	68.40	11.03	12.6	21.6	25.8	40.0