Electronic Supplementary Material (ESI) for RSC Advances.

Nitrogen self-doped carbon with super high-rate and long cycle life as anode materials for lithium-ion batteries

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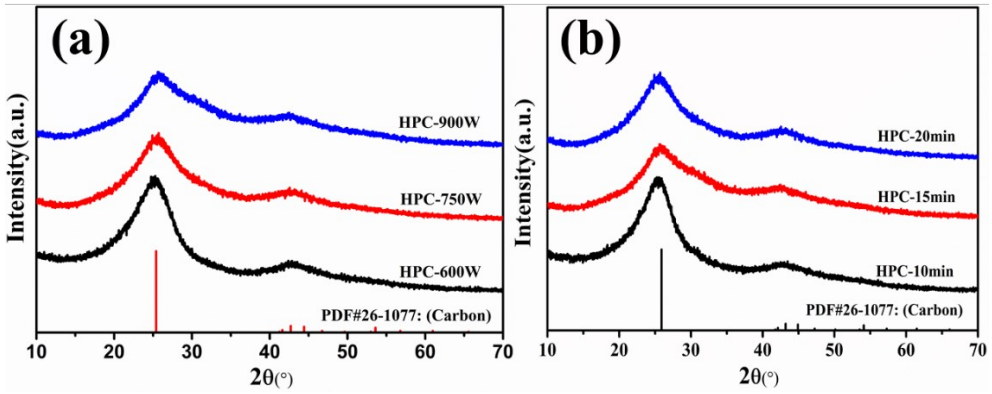

Fig. S1(a) XRD of HPC at different power (b) XRD of HPC at different time

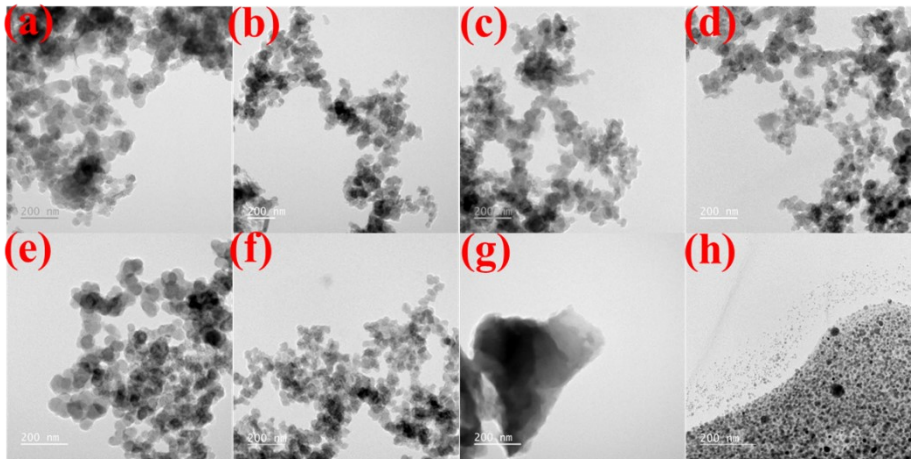

Fig. S2 TEM of (a) PC, (b) HPC-1:1, (c) HPC-1:3, (d) HPC-1:5, (e) HPC-1:7, (f) HPC-1:9 ,(g) HPC-1:11,(h) HPC-1:13.

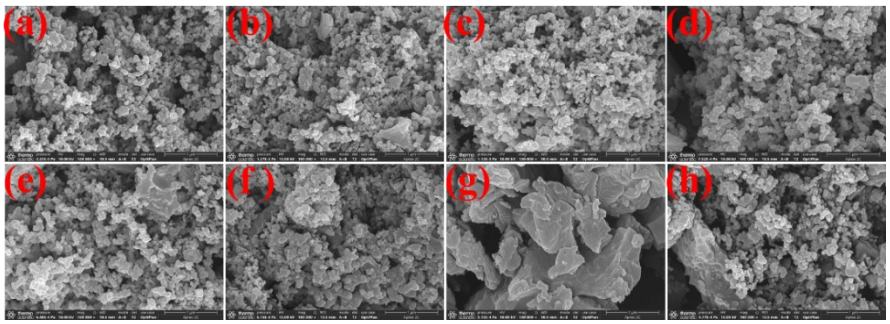

Fig. S3 SEM of (a) PC, (b) HPC-1:1, (c) HPC-1:3,(d) HPC-1:5, (e) HPC-1:7, (f) HPC-1:9 ,(g) HPC-1:11,(h) HPC-1:13.

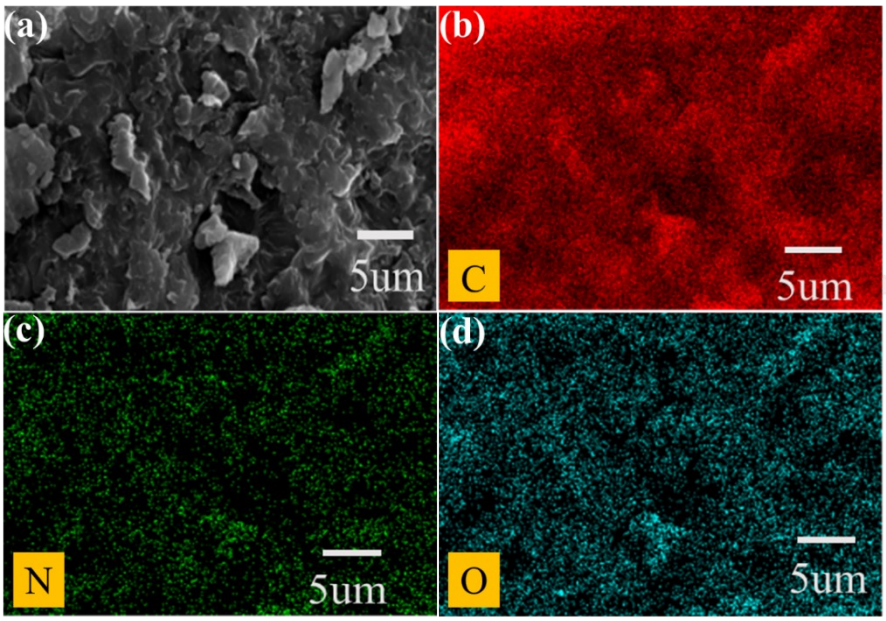

Fig. S4(a-d) SEM and mapping images of HPC.

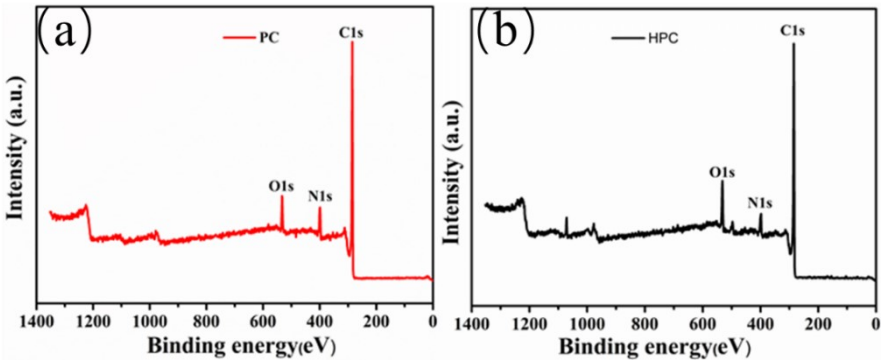

Fig. S5 XPS spectra of (a) PC and (b) HPC

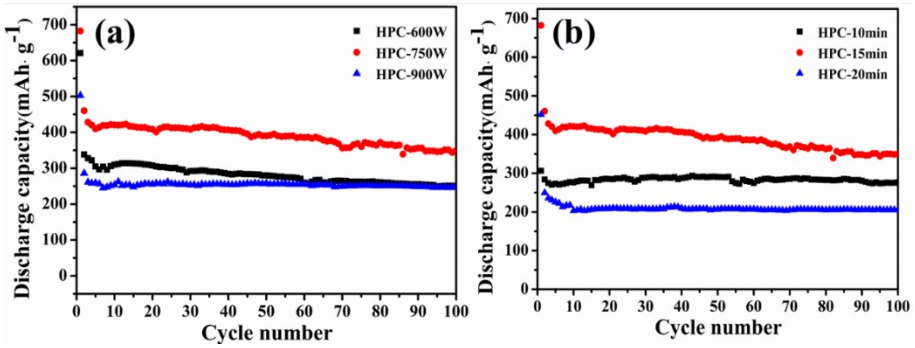

Fig. S6 cycle performance of HPC (a) at different power (b) at different time.

We conducted cyclic voltammetry tests on prepared materials at different sweep rates, as is shown in Fig. S7(a) and 7(b). From the observed peak patterns, the lithium ion diffusion rate of HPC 1:11 is significantly higher than that of PC. In addition, galvanostatic intermittent titration technique (GITT) was used to test the lithium ion diffusion rate of the as-prepared samples. The lithium ion diffusion was calculated based on the following equations :

$$D=\frac{4}{\pi\tau}(m_B V_m/M_B S)^2(\Delta E_s/\Delta E_\tau)^2$$

Where m_B and M_B are the active mass and molar mass of PC and HPC-1:11, respectively; V_m is the molar volume; and S is the active surface area of the PC and HPC-1:11. Detailed descriptions of the other parameters, i.e..τ, ΔE_s and ΔE_τ, could be obtained from the GITT curves in Fig. S7(c) and 7(d). The Li-ion diffusion value of HPC-1:11 and PC is range from 1.96×10^{-8} to 2.73×10^{-7}, and 8.06×10^{-11} to 1.57×10^{-7}, except for the first point, during the charge and discharge processes. The Li-ion diffusion value of HPC-1:11 is higher than PC. Two different test methods (CV, GITT) have proved that the Li-ion diffusion rate of HPC-1:11 is better than that of PC. Therefore, we attribute the reason for the lithium ion diffusion rate accelerates when the diagonal part is greater than 45° to the pseudo capacitive behavior of the HPC-1:11.

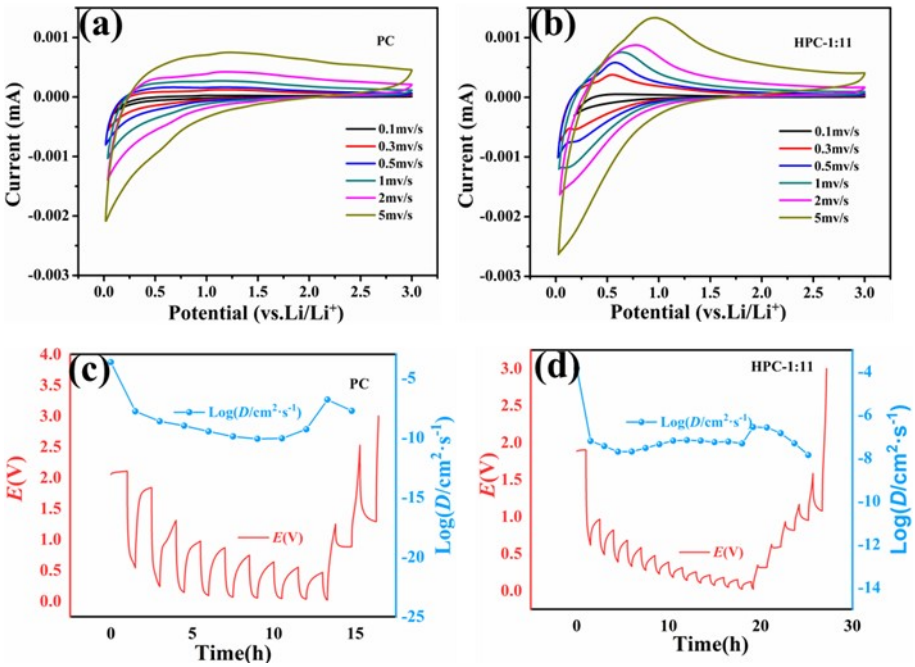

Fig. S7 Cyclic voltammograms at different sweep rates of (a) PC and (b) HPC-1:11; GITT spectrum of (c) PC and (d) HPC-1:11

Table S1 Element content analysis table based on XPS spectrum

Sample	C%	O%	N%	PyridinieN%	PyrrolicN%	GraphitizedN%	NO_X
HPC	82.39	9.04	8.57	50.5	49.5	0	0
PC	83.44	7.49	9.07	38.8	36.2	16.4	8.6

Table S2.Fitting impedance equivalent circuit diagram parameters

Samples	Rs(Ω)	Rct(Ω)	R_{sei}(Ω)	CPE1-P	Wo-R	Wo-T	Wo-P
HPC	0.40	152.00	126.00	0.67	100.00	0.05	0.43

PC	0.60	176.00	135.50	0.74	102.40	0.02	0.35