Supporting Information

Hierarchical porous nitrogen-rich carbon monoliths *via* ice-templating: high capacity and high-rate performance as lithium-ion battery anode materials

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Table S1. Characterization data for the PAN50 and CPAN50 samples by Hg intrusion porosimetry

	Total Intrusion Volume (cm^3/g)	**Total Pore Area (m^2/g)**	**Average Pore Diameter (4V/A) (µm)**
PAN50	8.01	3.56	9.0
CPAN50	1.13	0.82	5.6

Table S2. Summary of the conductivity and elemental content of the carbonized PAN monoliths

PAN concentration ($mg\ cm^{-3}$)	**Conductivity (Scm^{-1})**	**C (%)**	**H (%)**	**N (%)**	**O (%) (inferred)**
25	1.53×10^{-3}	72.0	1.04	16.4	10.56
50	2.03×10^{-2}	74.9	1.31	15.7	8.09
100	3.06×10^{-2}	70.9	1.05	16.7	11.35
150	4.29×10^{-2}	73.2	0.84	17.3	8.66
200	5.73×10^{-2}	75.9	0.77	16.0	8.03

Table S3. Comparison of reversible (C_{rev}) and irreversible (C_{irr}) capacity values of a number of templated porous carbons described in the literature**.**

Template	Carbon precursor	C_{irr} (mAh g^{-1})	C_{rev} (mAh g^{-1})	C_{rev} after N cycles (mAh g^{-1})	N cycles	Ref.
Silica monolith	Mesophase pitch	680	900	500	40	[1]
Silica SBA-15	Sucrose	2000	1100	800	20	[2]
Silica particles & PS spheres	Furfurylalcohol	671	903	799	80	[3]
SBA-15	Furfurylalcohol	N/A	714	583	80	[3]
Inverse silica opal	Benzene (CVD)	N/A	326	320	60	[4]
PMMA	Recorcinol Formaldehyde	400	300	150	150	[5]
Ice crystals	Polyacrylonitrile	450	702	570	50	This work

Table S4. Comparison of some of the best high-rate performance carbon-based anode materials described in the literature

Description	C_{rev} at current density X (mAh g^{-1})	Current density X (A g^{-1})	Ref.
Carbon templated by silica and PS spheres	750	1	[3]
Nitrogen-doped pristine graphene	250	10	[6]
Boron-doped pristine graphene	300	10	[6]
N-rich porous carbon derived from protein	210	4	[7]
N-doped activated carbon nanofiber web	320	10	[8]
N-doped carbon spheres (<100nm)	200	3	[9]
CPAN50	320	1	This work
CPAN50 - Melamine & graphene doped	300	10	This work

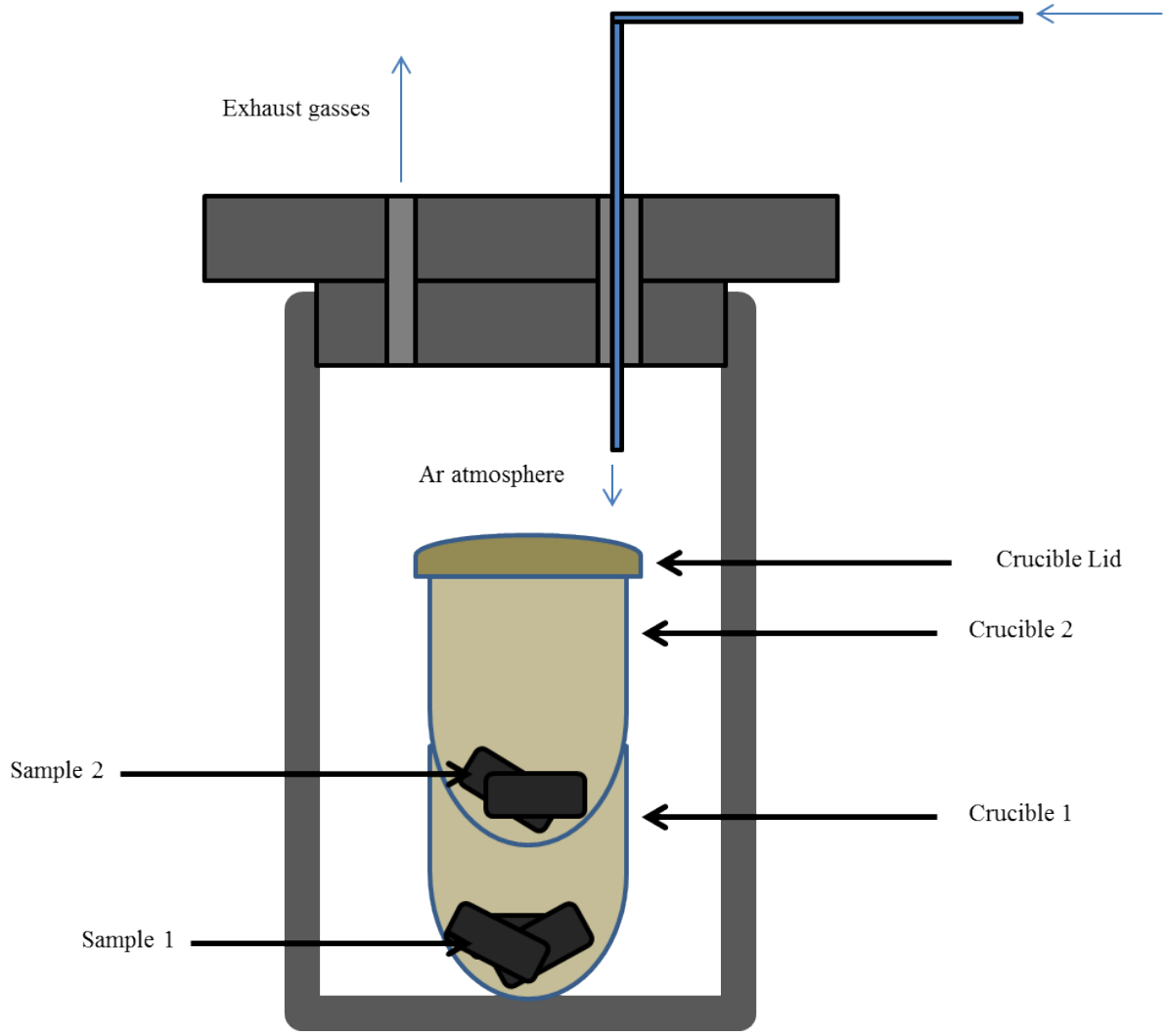

Figure S1. Schematic representation of the 'home-made' pyrolysis setup.

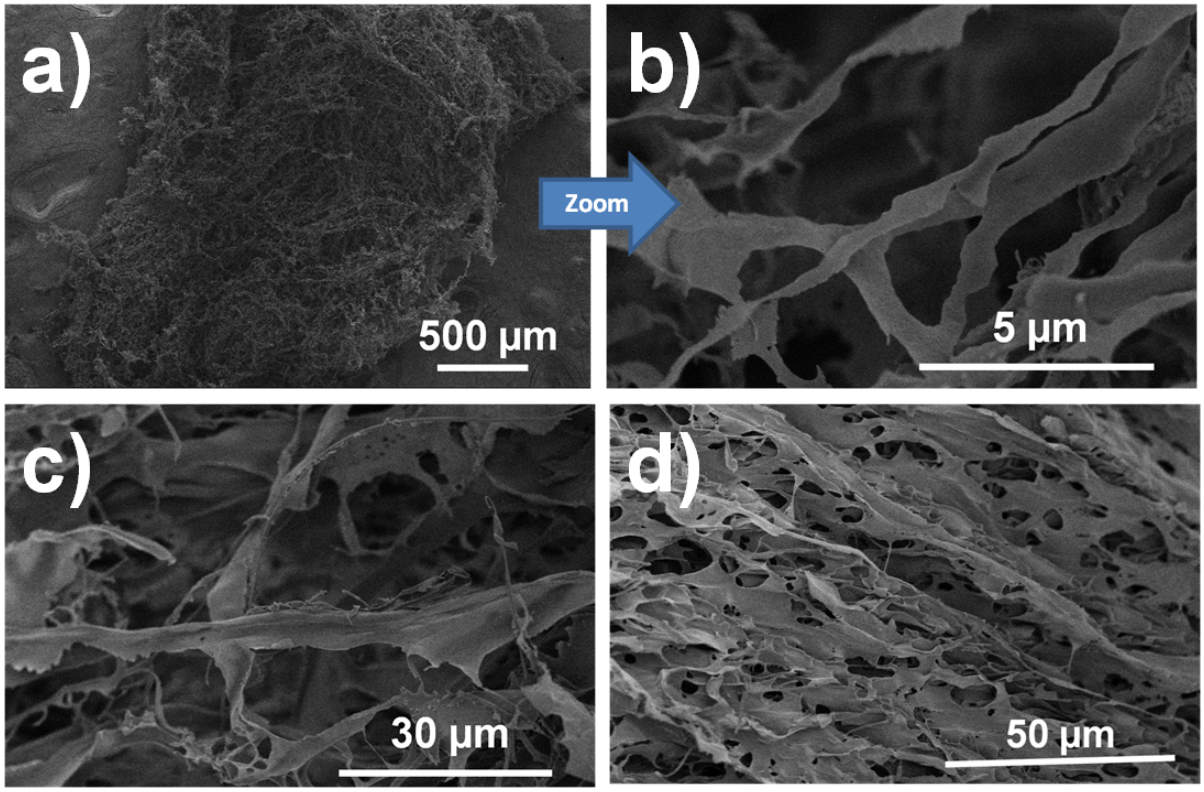

Figure S2. SEM images of PAN monoliths prepared from the relatively low concentrations of a) & b) 1 mg cm^{-3}, c) 2.5 mg cm^{-3} and d) 10 mg cm^{-3}

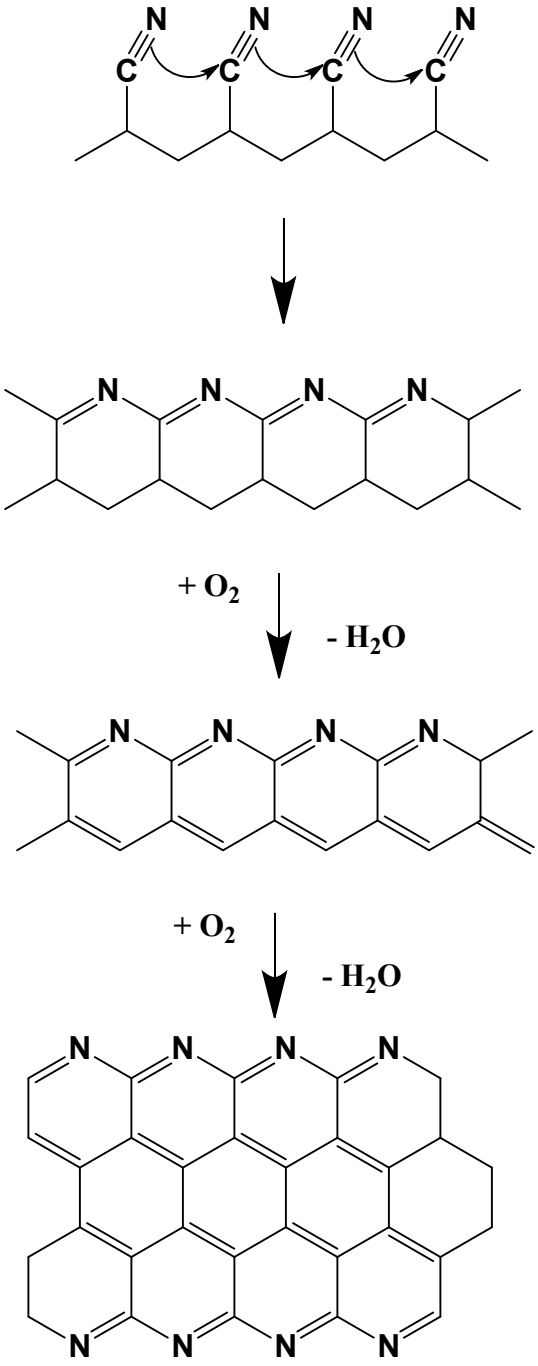

Figure S3. Schematic representation of the oxidative annealing (crosslinking) process of PAN.

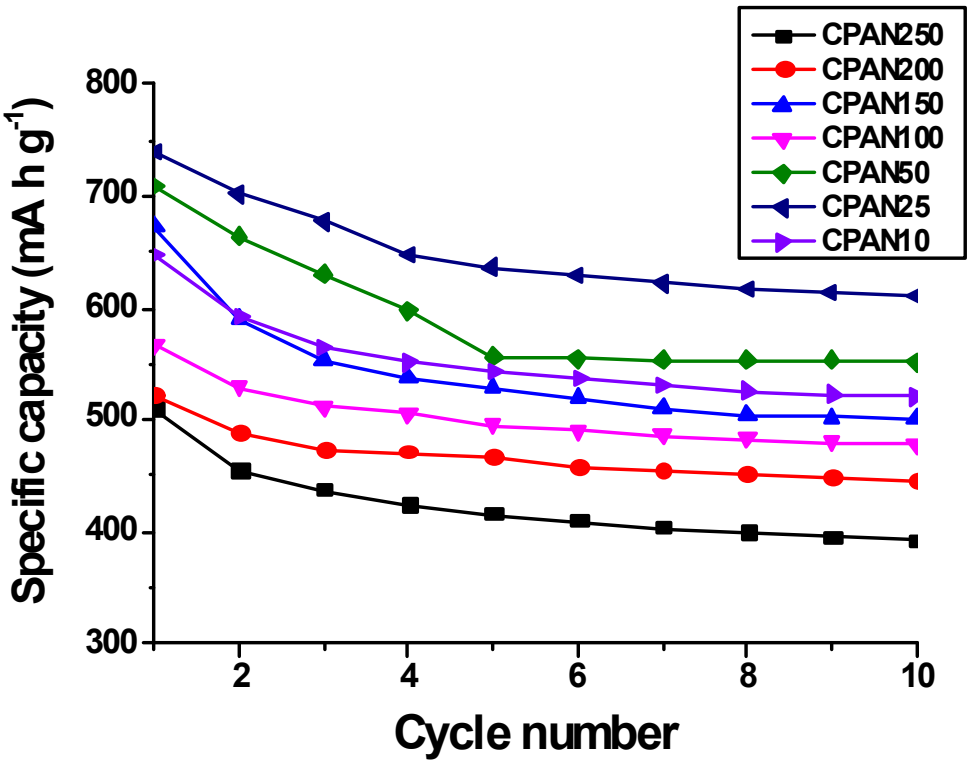

Figure S4. Comparison of the specific capacity values of the porous carbons prepared at different initial PAN/DMSO concentrations, over 10 charge/discharge cycles.

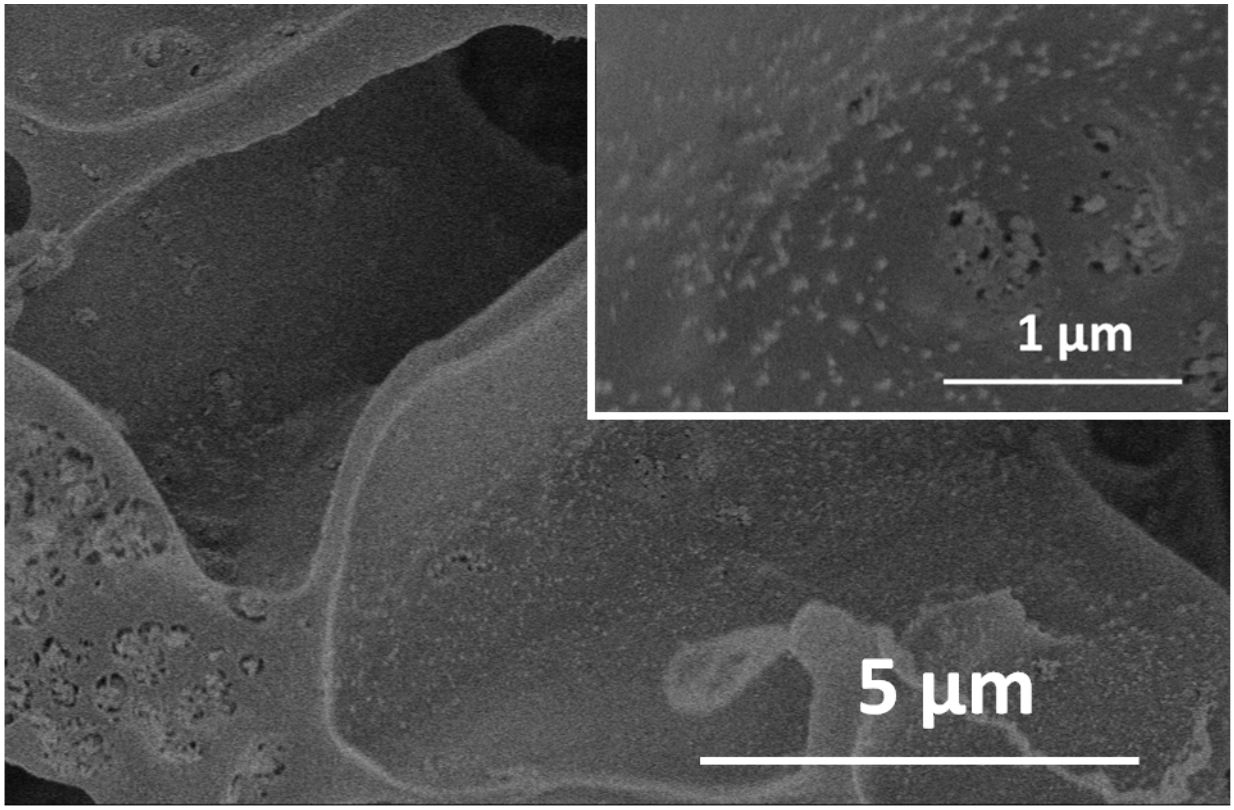

Figure S5. SEM images of the silicon nanoparticle-carbon composite prepared by ice-templating started from a suspension of silicon nanoparticles in a PAN in DMSO solution. The PAN concentration was 50 mg cm^{-3} and the ratio of silicon nanoparticles to PAN was 1:1.

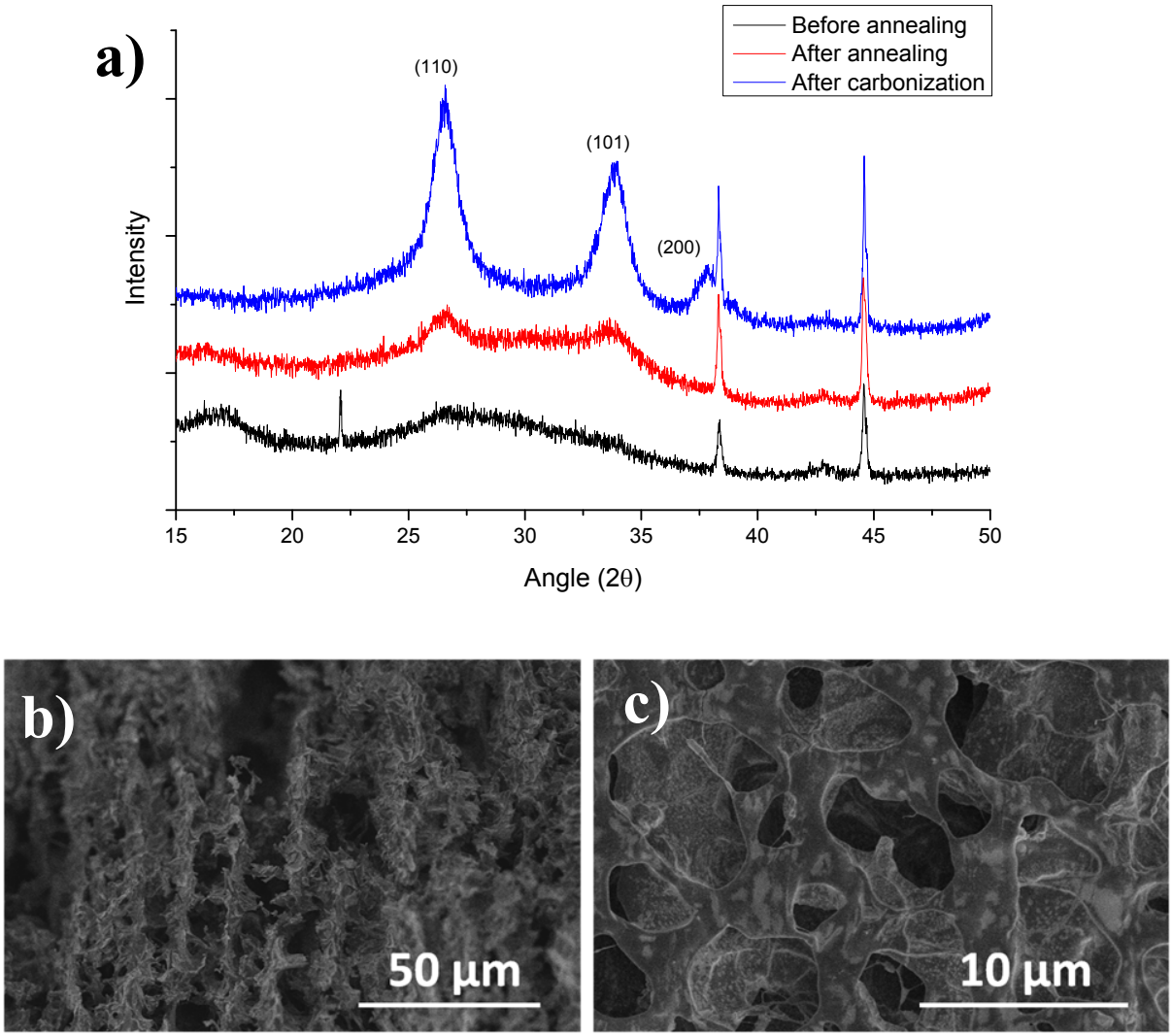

Figure S6. a) XRD patterns of a PAN-$Sn(OAc)_2$ composite before and after carbonization at 550 °C. The appearance of the associated (110), (101) and (200) diffraction peaks indicates the conversion of $Sn(OAc)_2$ to SnO_2. The concentration of PAN was 50 mg cm^{-3} and the ratio of PAN to $Sn(OAc)_2$ was 1:1. b) SEM images of the carbon-SnO_2 composites.

References

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