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Supporting Information

H_2O-Induced Self-Propagating Synthesis of Hierarchical Porous Carbon: A Promising Lithium Storage Material with Superior Rate Capability and Ultralong Cycling Life

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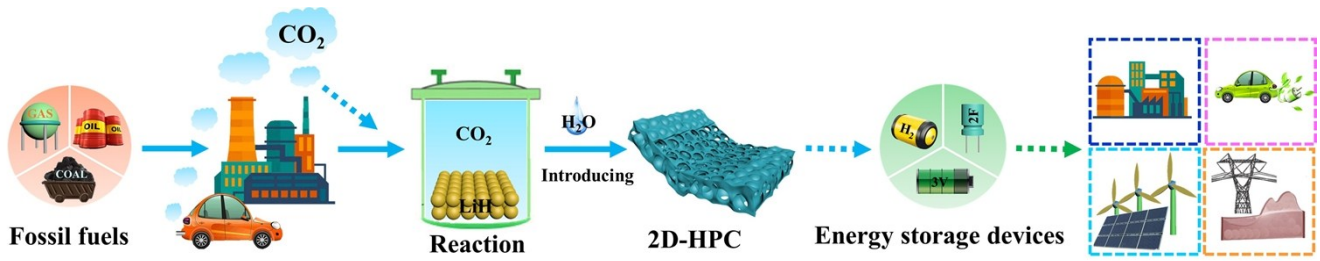
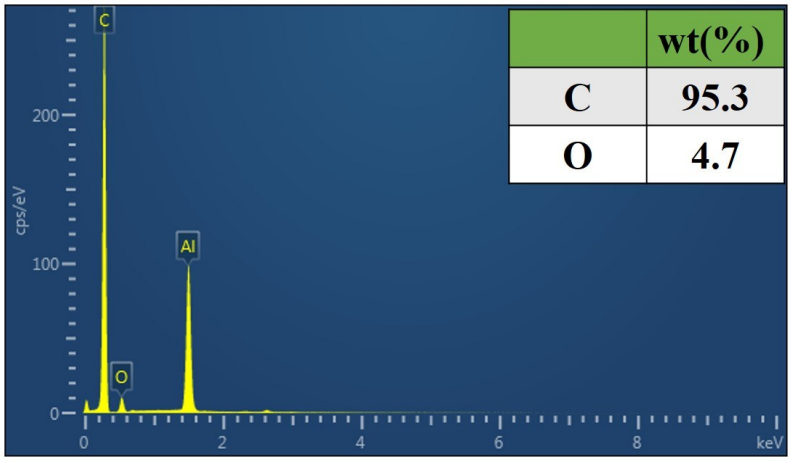


Fig. S1 Schematic illustration of the synthesis procedure of HPC from CO_2 and its proposed applications.



	wt(%)
C	95.3
O	4.7

Fig. S2 EDS spectrum of the as-synthesized carbon powder (HPC). The HPC powder was coated onto aluminum foil in the EDS measurement.

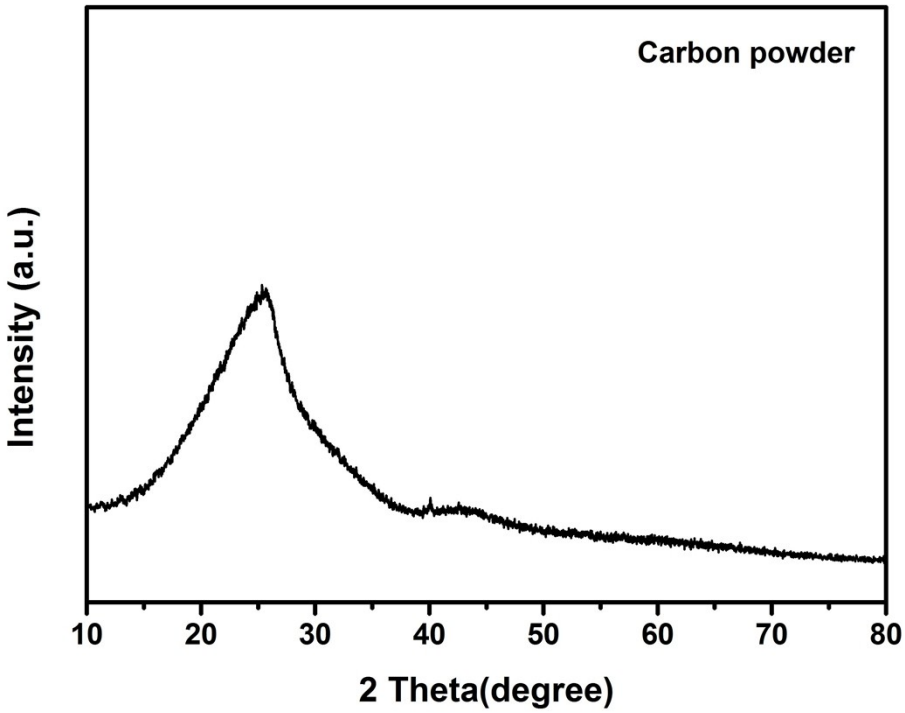


Fig. S3 XRD pattern of the as-synthesized carbon powder (HPC).

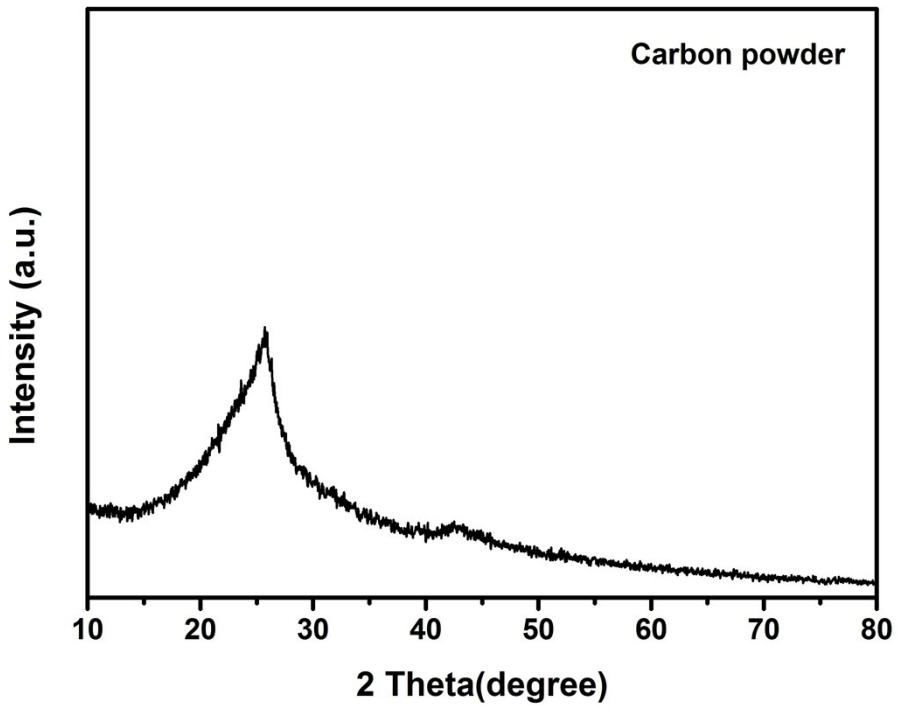
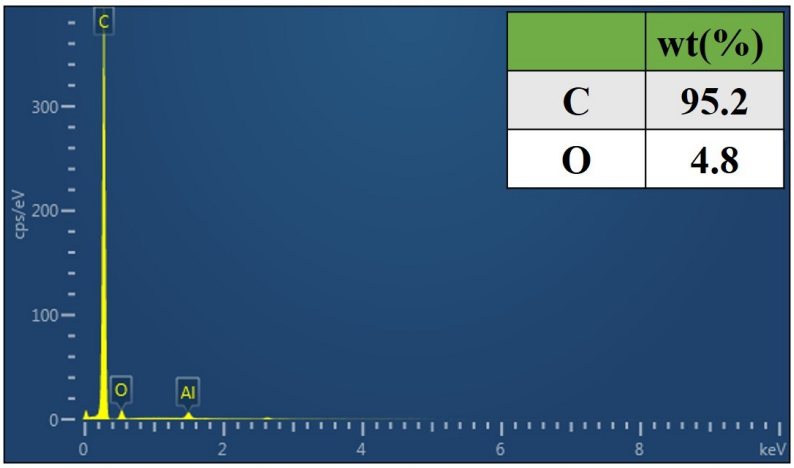


Fig. S4 XRD pattern of the as-synthesized carbon derived from the LiH–CO_2 mixture heated to 212 °C.



	wt(%)
C	95.2
O	4.8

Fig. S5 EDS spectrum of the as-synthesized carbon derived from the LiH–CO_2 mixture heated to 212 °C. The as-synthesized carbon was coated onto aluminum foil in the EDS measurement.

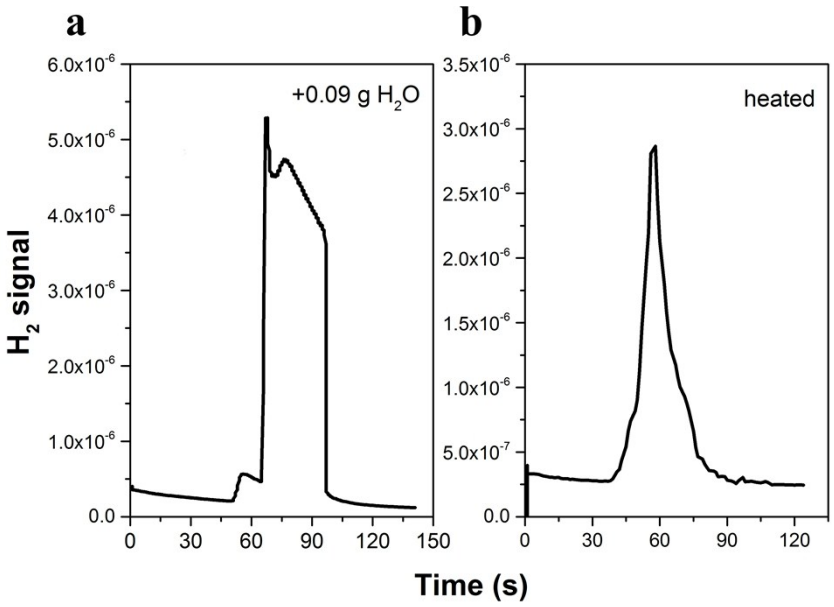


Fig. S6 Hydrogen signal of the gaseous products of the reaction between LiH and CO_2. The gaseous composition was analyzed on a mass spectrometer in the offline mode. The H_2 signal was recorded after the conversion reaction. (a) The LiH–CO_2 mixture with 0.09 g H_2O, (b) The LiH–CO_2 mixture without H_2O.

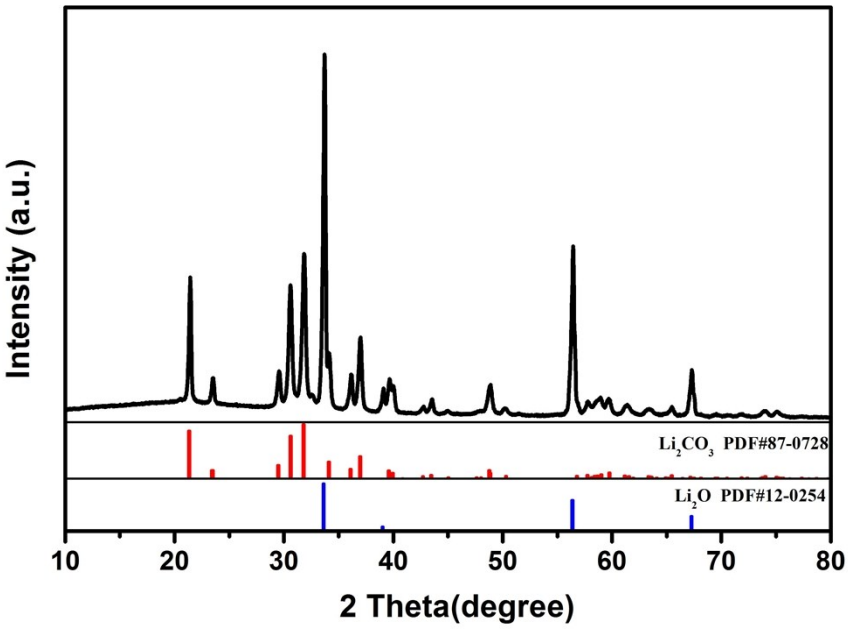


Fig. S7 XRD pattern of the solid products of Li_2O powder heated at 310 ^oC under an initial CO_2 pressure of 6.5 bar.

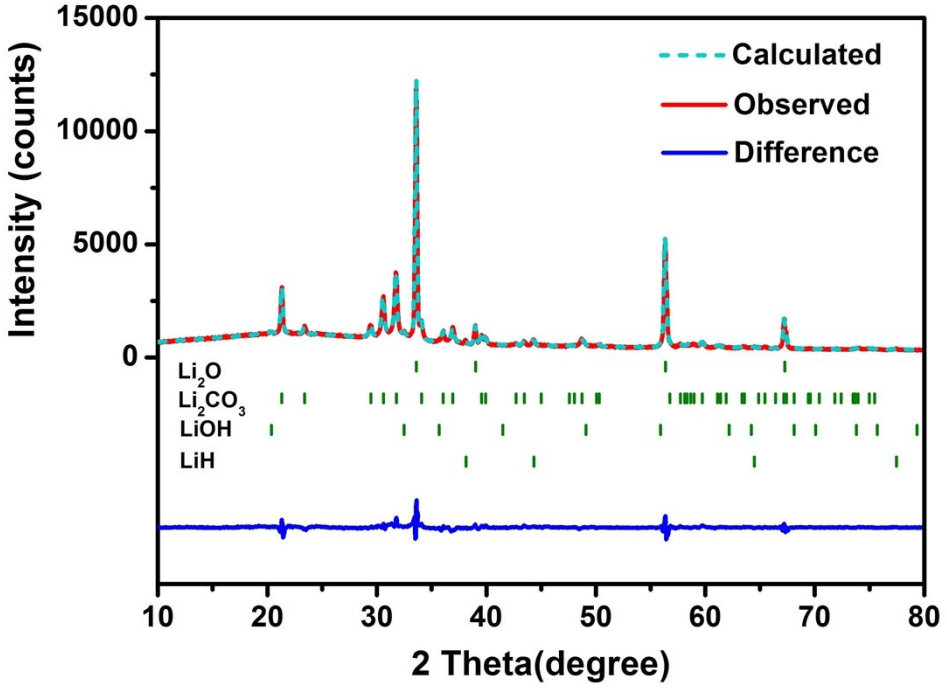


Fig. S8 Rietveld refinement of the XRD pattern for the as-obtained solid products of the LiH–CO_2 mixture with 0.18 g H_2O.

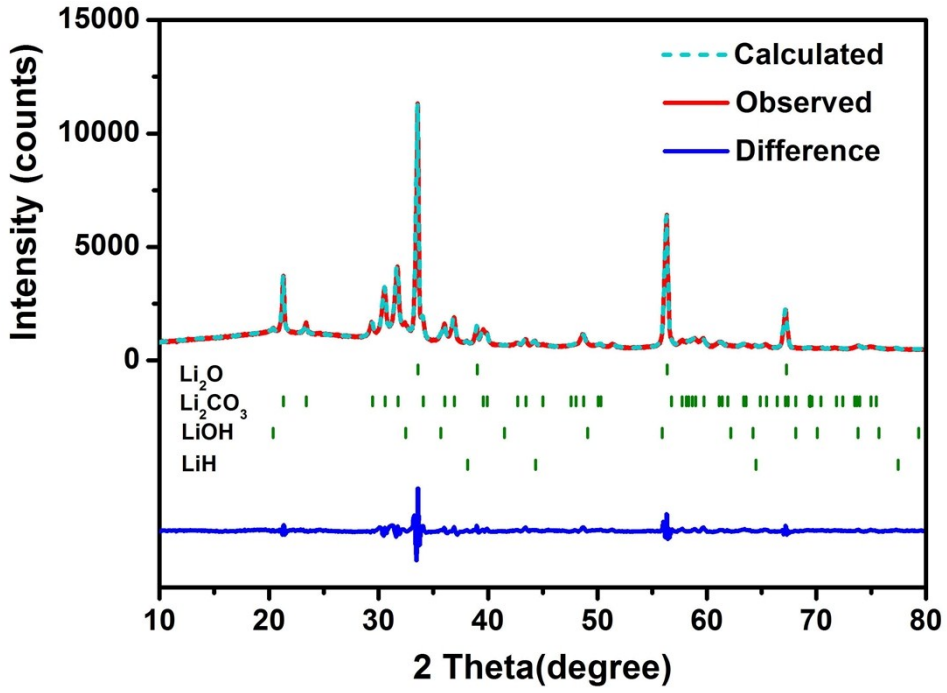


Fig. S9 Rietveld refinement of the XRD pattern for the as-obtained solid products of the LiH–CO_2 mixture with 0.27 g H_2O.

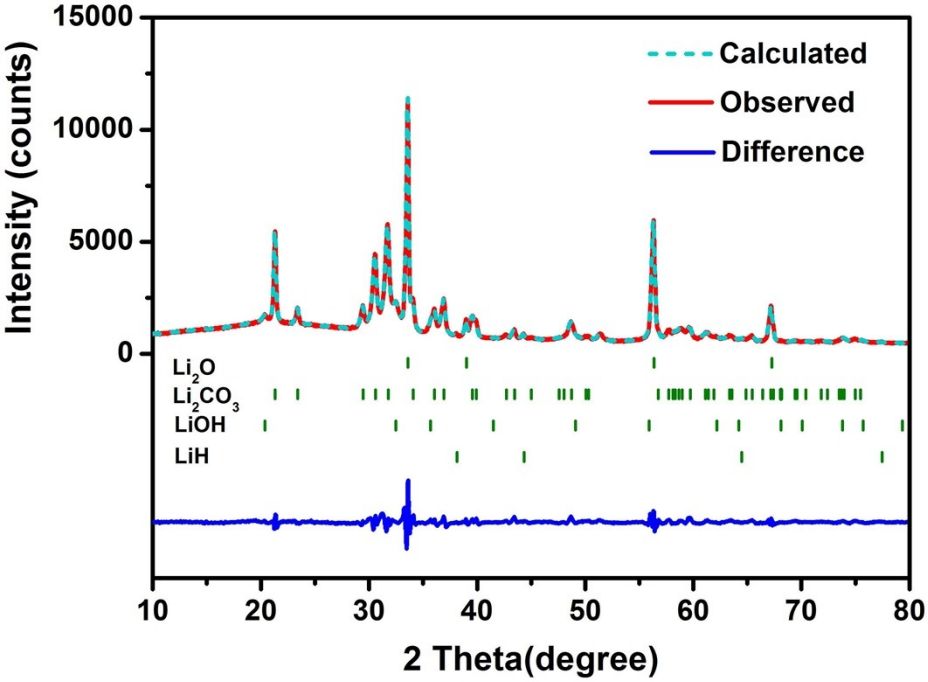


Fig. S10 Rietveld refinement of the XRD pattern for the as-obtained solid products of the LiH–CO_2 mixture with 0.36 g H_2O.

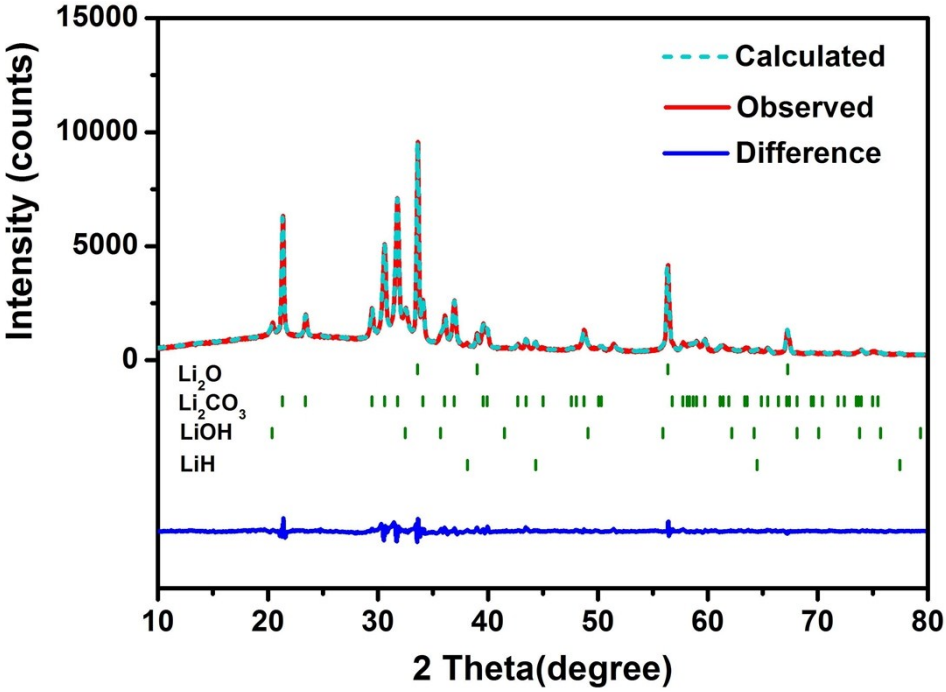


Fig. S11 Rietveld refinement of the XRD pattern for the as-obtained solid products of the LiH–CO_2 mixture with 0.45 g H_2O.

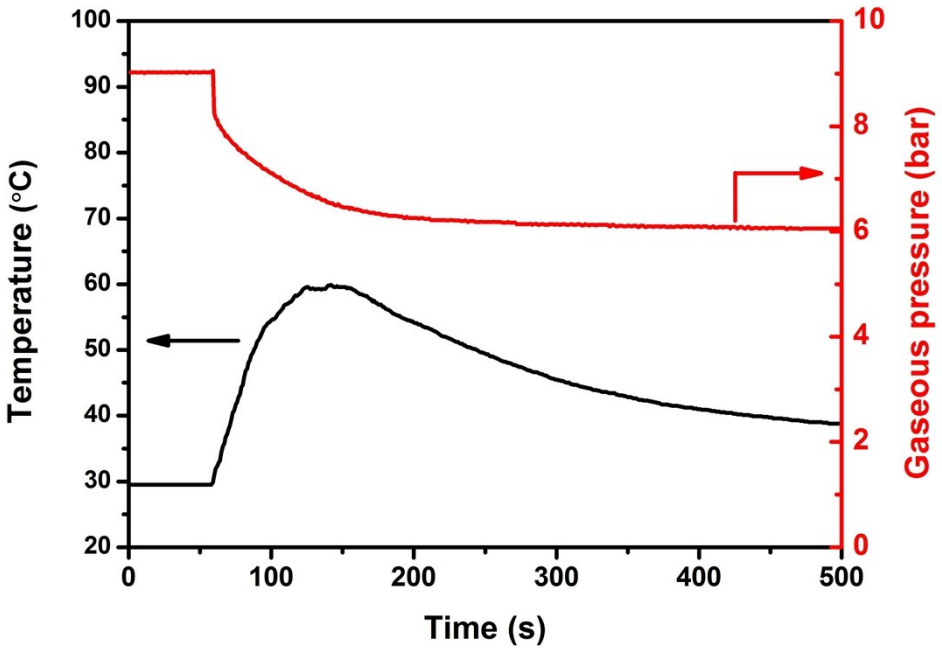


Fig. S12 Time dependence of temperatures and gaseous pressures curves of the LiOH–CO_2 mixture at room temperature.

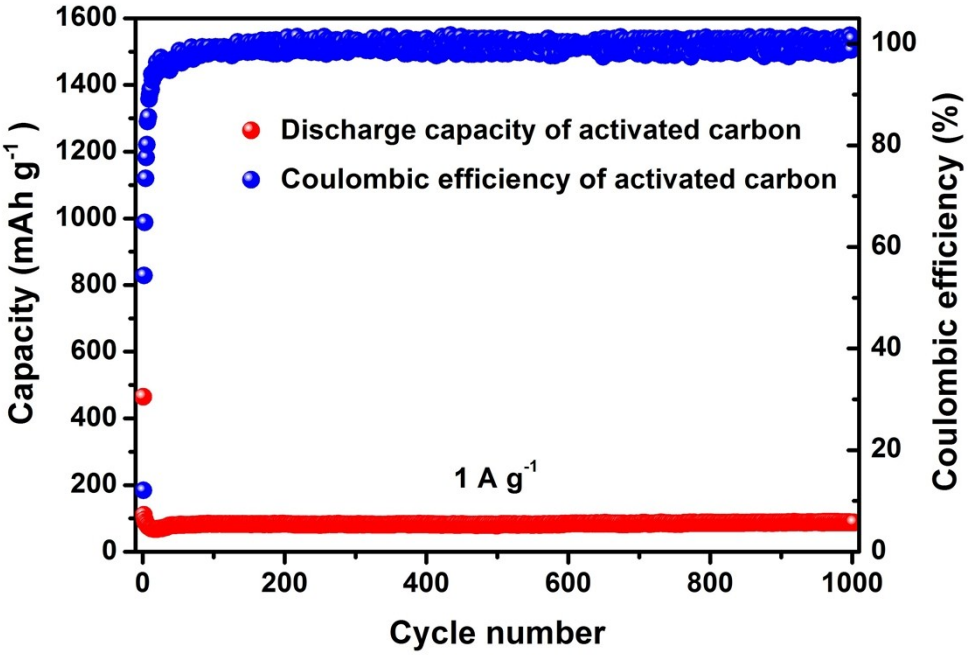


Fig. S13 Cycling properties and Coulombic efficiency of activated carbon at a current density of 1 A g^{-1}.

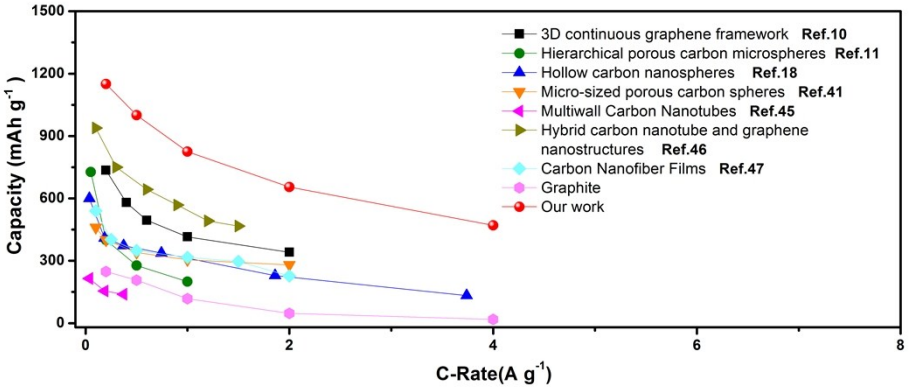


Fig. S14 Comparison of the rate capabilities of HPC and various nanocarbons.

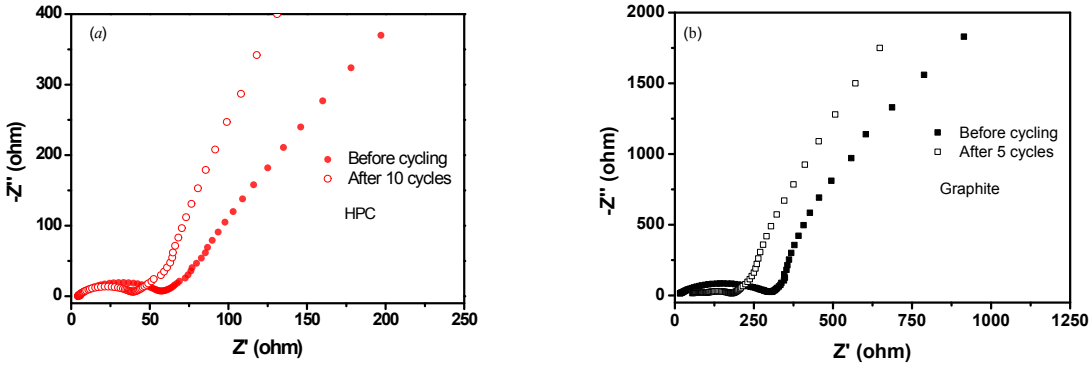


Fig. S15 EIS spectra of graphite and HPC at fresh state and after forming stable SEI layers.

Table S1. The abundance of Li_2CO_3 and Li_2O phases obtained by the Rietveld refinements of XRD patterns

H_2O	Li_2CO_3		Li_2O	
(g)	mol %	wt %	mol %	wt %
0	13.8	28.4	86.2	71.6
0.09	21.2	40.0	78.8	60.0
0.18	24.1	44.0	75.9	56.0
0.27	30.2	51.7	69.8	48.3
0.36	40.0	62.2	60.0	37.8
0.45	49.6	70.9	50.4	29.1

Table S2. The values of standard enthalpy of formation for related compounds from the elements

Related compounds	LiH (s)	LiOH (s)	Li_2CO_3 (s)	Li_2O (s)	LiCl (s)	$H_2O(l)$	CO_2 (g)	HCl (g)
Standard enthalpy of formation (kJ mol^{-1})	–90.5	–487.5	–1215.9	–597.9	–408.6	–285.8	–393.5	–92.3

Reference:

1. Standard Thermodynamic Properties of Chemical Substances, CRC Press LLC, 2000.

Table S3. Comparison of the electrochemical properties of various nanocarbons used as anode materials for lithium ion batteries.

Various Nanocarbons	Current ($mA\ g^{-1}$)	Capacity ($mAh\ g^{-1}$) @ cycles number	References
Hierarchical porous carbon monolith	100	669@50	7
3D continuous graphene framework	2000	318@600	10
Hierarchical porous carbon microspheres	50	480@70	11
Hollow carbon nanospheres	37.2	630@50	18
Micro-sized porous carbon spheres	100	507@100	41
Multiwall carbon nanotubes	372	460@1200	45
Hybrid carbon nanotube and graphene nanostructures	600	588@250	46
Carbon nanofiber films	500	333@500	47
Hollow graphitic carbon nanospheres	818.4	410@300	48
Nitrogen-doped core–sheath carbon nanotube Films	1488	320@400	49
Hierarchical porous carbon	1000 2000	830@1000 555@2000	Our work