Electronic Supplementary Material (ESI) for Green Chemistry.

Supplementary Information

Preparation of high-quality lithium sulfide by reducing lithium sulfate with hydrogen: a green and cost-effective method

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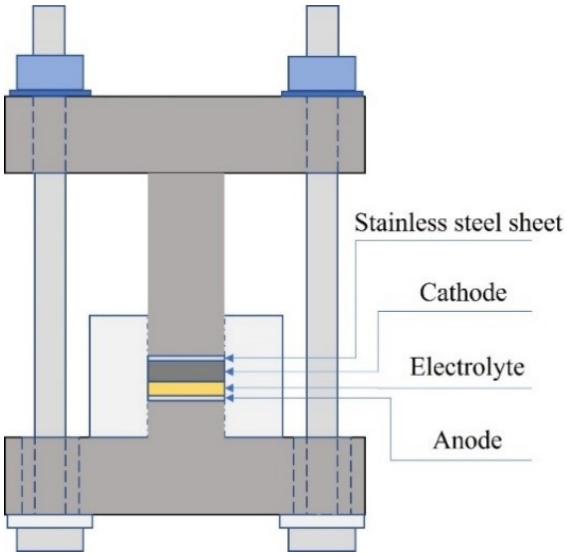

Fig. S1. Structure diagram of the ASSLB in this work.

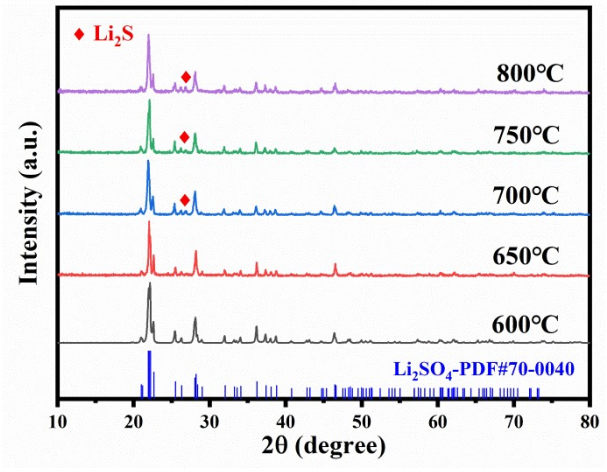

Fig. S2. XRD patterns of calcined products at different temperature.

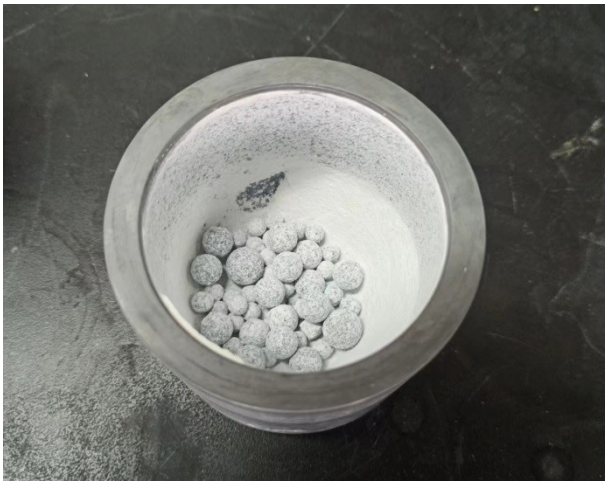

Fig. S3. Photograph of low ball milling efficiency caused by Li_2SO_4 sticky wall (ball spinning over material) in dry ball milling.

Fig. S4. Color comparison of products of carbothermal reduction (left) and H_2 reduction (right) dissolved in anhydrous ethanol.

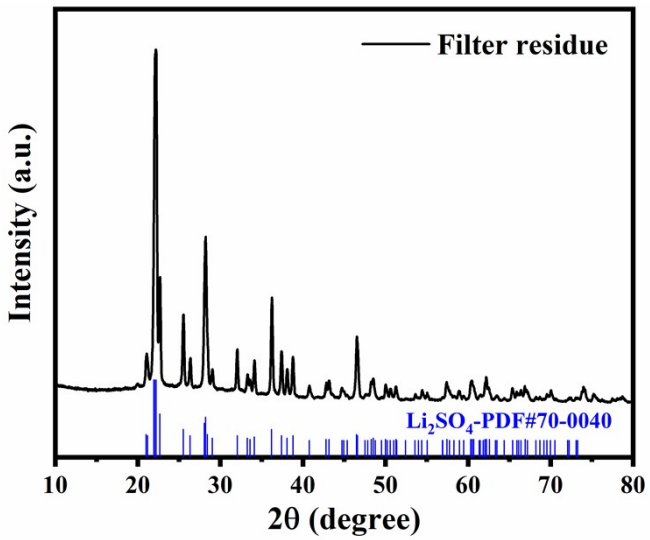

Fig. S5 XRD pattern of filter residue after purification of calcined products.

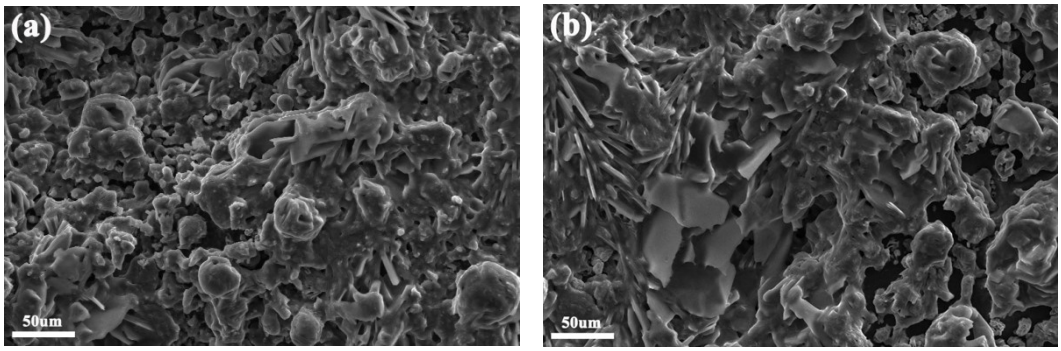

Fig. S6 SEM images of (a) N-Li_2S and (b) H-Li_2S.

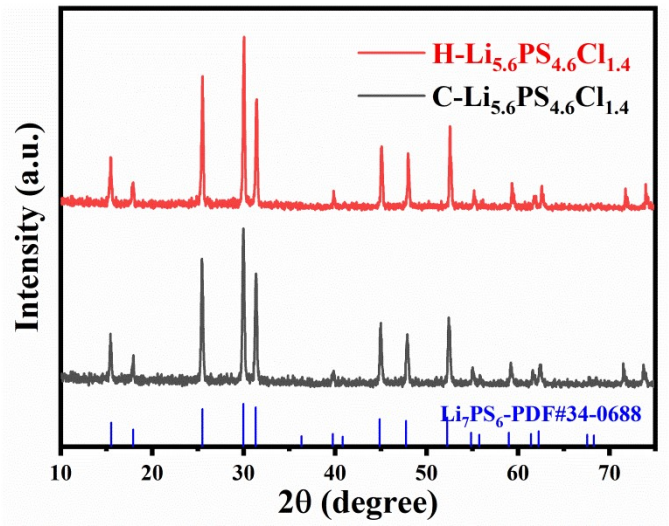

Fig. S7 XRD patterns of H-$Li_{5.6}PS_{4.6}Cl_{1.4}$ and C-$Li_{5.6}PS_{4.6}Cl_{1.4}$.

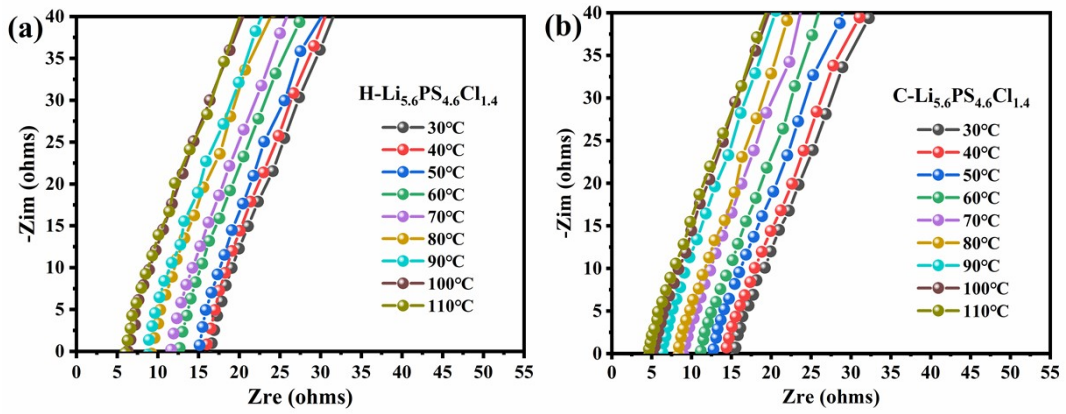

Fig. S8 Nyquist plots of (a) H-$Li_{5.6}PS_{4.6}Cl_{1.4}$ and (b) C-$Li_{5.6}PS_{4.6}Cl_{1.4}$ at different temperature.

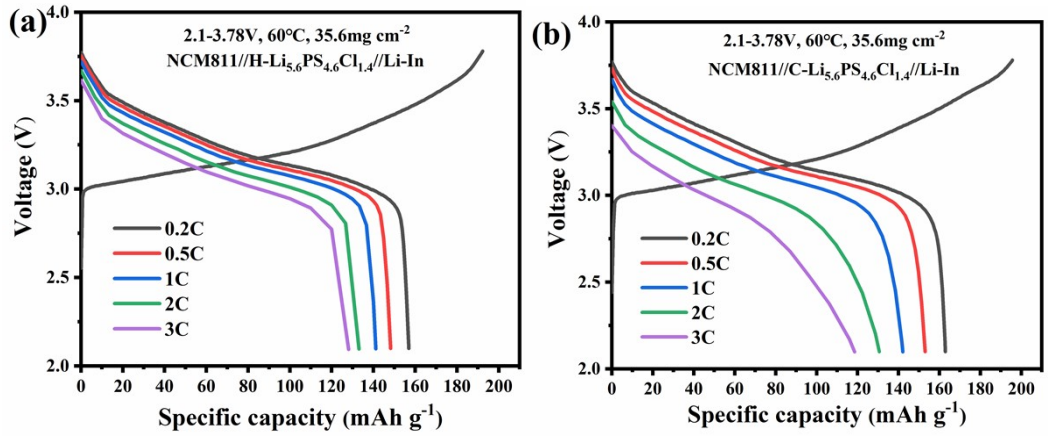

Fig. S9 Rate performance discharge capacity comparison chart of (a) H-$Li_{5.6}PS_{4.6}Cl_{1.4}$ and (b) C-$Li_{5.6}PS_{4.6}Cl_{1.4}$.

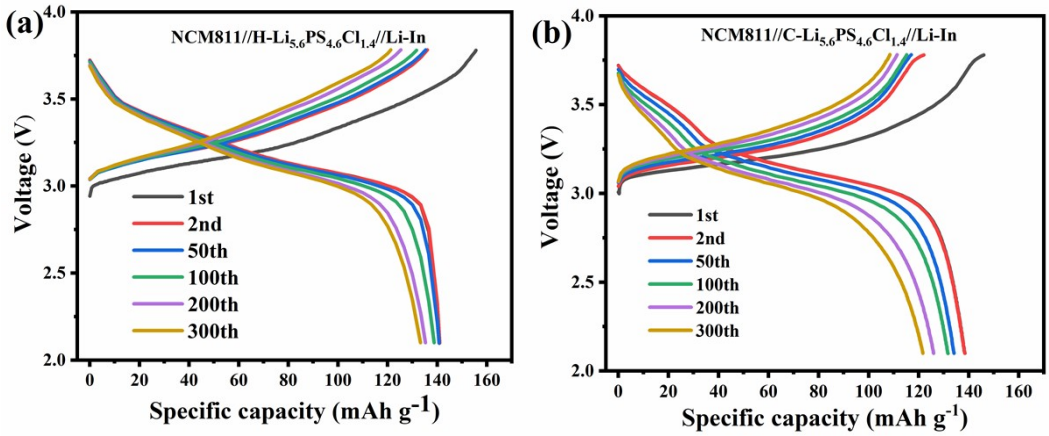

Fig. S10 Comparison of discharge capacities of (a) H-$Li_{5.6}PS_{4.6}Cl_{1.4}$ and (b) C-$Li_{5.6}PS_{4.6}Cl_{1.4}$ with different cycles.

Table S1 C-Li_2S determination of elements (ICP-OES method).

Elements	Ag	Al	As	B	Ba	Be
Element content (mg/kg)	0.6453	17.59	ND	8.728	6.536	ND
Elements	Bi	Ca	Cd	Co	Cr	Cu
Element content (mg/kg)	4.794	3.553	ND	3.181	ND	25.34
Elements	Fe	K	Li	Mg	Mn	Mo
Element content (mg/kg)	ND	0.6862	3.065×10^5	7.548	15.99	0.3532
Elements	Na	Ni	P	Pb	S	Sb
Element content (mg/kg)	693.1	3.472	16.14	ND	7.742×10^5	ND
Elements	Se	Si	Sn	Sr	Ti	Tl
Element content (mg/kg)	ND	21.64	ND	3.803×10^{-2}	0.8224	0.1799
Elements	V	Zn	Zr			
Element content (mg/kg)	2.217	5.476	0.1734			

Table S2 H-Li_2S determination of elements (ICP-OES method).

Elements	Ag	Al	As	B	Ba	Be
Element content (mg/kg)	0.5678	20.789	ND	4.578	8.984	5.554
Elements	Bi	Ca	Cd	Co	Cr	Cu
Element content (mg/kg)	ND	4.895	ND	15.489	ND	40.549
Elements	Fe	K	Li	Mg	Mn	Mo
Element content (mg/kg)	60.145	0.895	3.066×10^5	15.786	8.685	2.2548
Elements	Na	Ni	P	Pb	S	Sb
Element content (mg/kg)	154.89	3.1456	20.458	ND	7.744×10^5	ND
Elements	Se	Si	Sn	Sr	Ti	Tl
Element content (mg/kg)	ND	40.578	ND	0.458	0.4789	0.1458
Elements	V	Zn	Zr			
Element content (mg/kg)	5.1489	6.4581	0.1789			