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Supplementary Materials

$Li_2(BH_4)(NH_2)$ Nanoconfined in SBA-15 as Solid-State Electrolyte for Lithium Batteries

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The Nyquist plot of $Li_2(BH_4)(NH_2)$@SBA-15 can be well fitted using the equivalent circuit model shown in the inset. In the equivalent circuit, R represents the resistance of ionic transformation and W represents Warburg resistance generated by Li-ion diffusion. They are in series connection and then in parallel connection with a constant phase element (CPE).

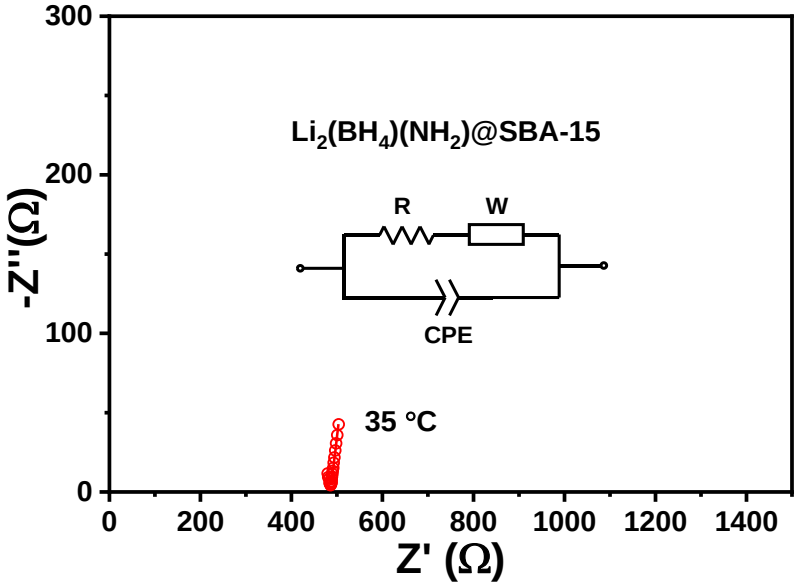

Figure 1. A representative Nyquist plot of $Li_2(BH_4)(NH_2)$@SBA-15 derived from the electrochemical impedance spectroscopy (EIS) tests with an equivalent circuit.

The thermogravimetric (TG) curve of $Li_2(BH_4)(NH_2)$@SBA-15 presents a marked weight loss occurred near 75 °C, and then a 9 wt% weight loss is observed in the temperature range of 75 to 500 °C, corresponding a hydrogen desorption at these high temperatures.

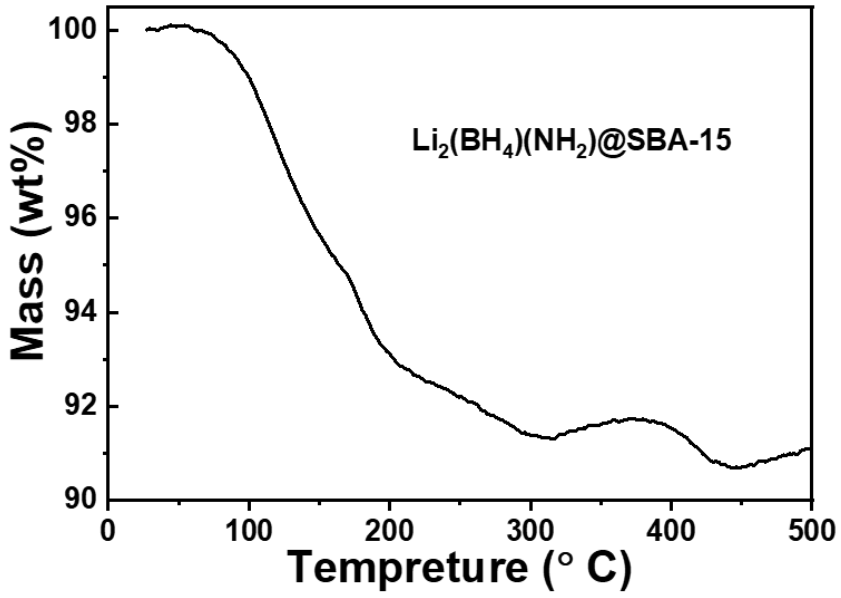

Figure 2. Thermogravimetric (TG) curve of $Li_2(BH_4)(NH_2)$@SBA-15.

Temperature-dependent conductivities of $Li_2(BH_4)(NH_2)$@SBA-15 with different loading contents show the 70 wt% loading content improves the conductivities most significantly, because lower loading contents renders isolating empty mesopores of SBA-15 to a large extent, and higher loading contents leads to mesopores of SBA-15 blocked by $Li_2(BH_4)(NH_2)$.

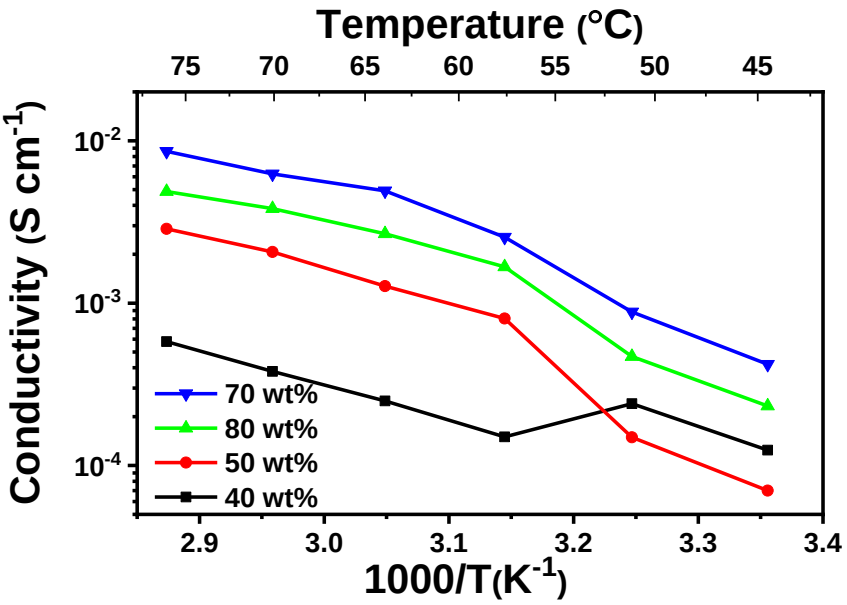

Figure 3. Conductivities of $Li_2(BH_4)(NH_2)$@SBA-15 with different loading contents of 40 wt%, 50 wt%, 70 wt% and 80 wt% at various temperature.

The pore parameters show that both surface area and pore volume decrease considerably with increasing loading contents of $Li_2(BH_4)(NH_2)$. For instance, a 90% reduction in the Brunauer-Emmett-Teller (BET) surface area and Barrett-Joyner-Halenda (BHJ) pore volume are found in the 70 wt% loading sample, while the pore parameters do not change in the mixture sample.

Table 1. Pore parameters of SBA-15, $Li_2(BH_4)(NH_2)$@SBA-15 samples and $Li_2(BH_4)(NH_2)$/SBA-15 mixtures.

sample	BET surface area ($m^2\ g^{-1}$)	BJH pore volume ($cm^3\ g^{-1}$)
SBA-15	541	1.13
$Li_2(BH_4)(NH_2)$@SBA-15 40 wt% loading	300	0.52
$Li_2(BH_4)(NH_2)$@SBA-15 70 wt% loading	54	0.11
$Li_2(BH_4)(NH_2)$@SBA-15 70 wt% mixture	508	1.09