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ARTICLE

Title: Rechargeable Li//Br battery: A promising platform for post lithium ion batteries
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Electronic supporting information (ESI)

1. Ionic conductivity of aqueous positive electrode (LiBr aqueous solution added with Br_2)

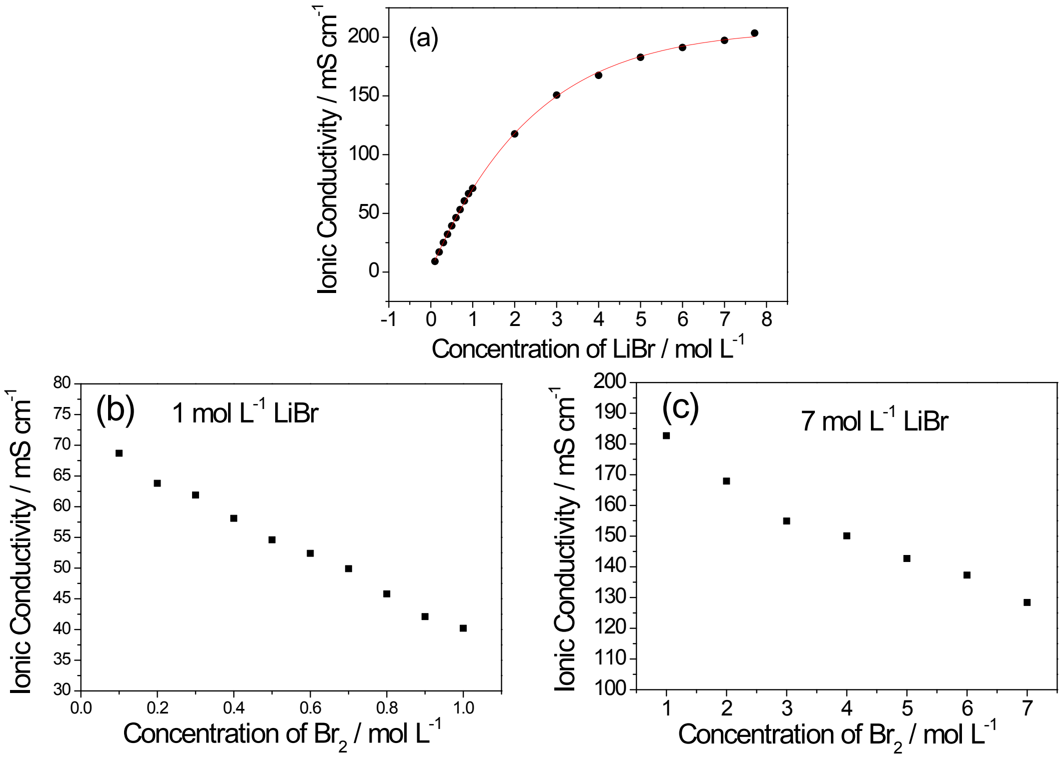

Figure S1. (a) Ionic conductivity of LiBr aqueous solution of different concentration, (b) and (c) ionic conductivities of 1 and 7 mol L^{-1} LiBr aqueous solutions adding with different concentration of Br_2.

The ionic conductivity at room temperature increases with the concentration of LiBr, and arrives at the highest, 197.3 mS cm^{-1}, for 7.76 mol L^{-1}.

After adding Br_2 in the LiBr aqueous solution, the ionic conductivity decreases with the concentration of Br_2 due to the transformation of Br^- into Br^{3-} or Br^{5-}.

2. Changes of LiBr solution acting as electrolyte before and after charge

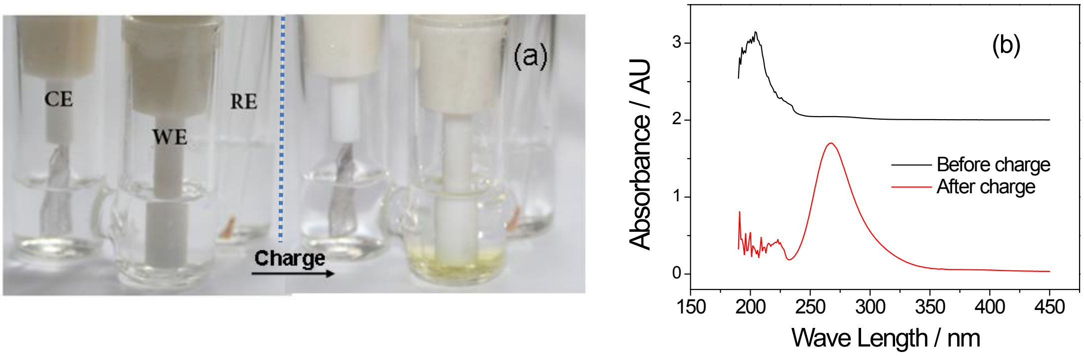

Figure S2. (a) Optical images of the solution around the GC electrode surface before and after a charge in 3 mol L^{-1} LiBr aqueous solution, and (b) UV-Vis spectra of the solution before (black) and after (red) charge.

In Fig.S2a, it was found that the color of the solution after a charge was turned into yellowish, proving the formation of Br_3^-. After the charge, the characteristic absorption peak at 274 nm in the UV-Vis spectra was observed, also evidencing the generation of Br_3^-.

3. Electrochemical window of GC electrode

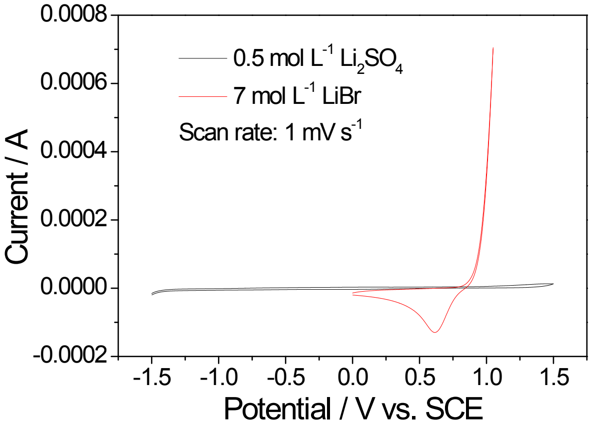

Figure S3. CV curves of the GC electrode in the aqueous solutions at the scan rate of 1 mV s^{-1}.

It suggests that the electrochemical window in 0.5 mol L^{-1} Li_2SO_4 (black) is very wide, and there are no evident redox reactions between -1.5 and 1.5 V (vs. SCE). In the case of 7 mol L^{-1} LiBr, there is no oxygen evolution, and only the redox for Br^-/Br_3^- can be observed.

4. Stability of Br electrode

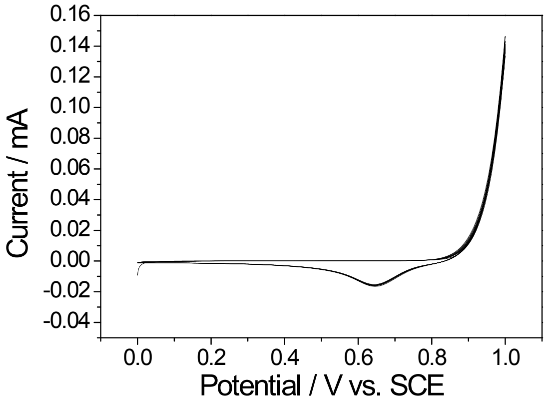

Figure S4. CV curves of 7mol L^{-1} LiBr aqueous solution at the scan rate of 0.5 mV s^{-1} for the first 10 scans.

The good overlapping of the CV curves demonstrates the excellent stability of Br electrode during the electrochemical reaction.

5. A promising platform of charge and discharge

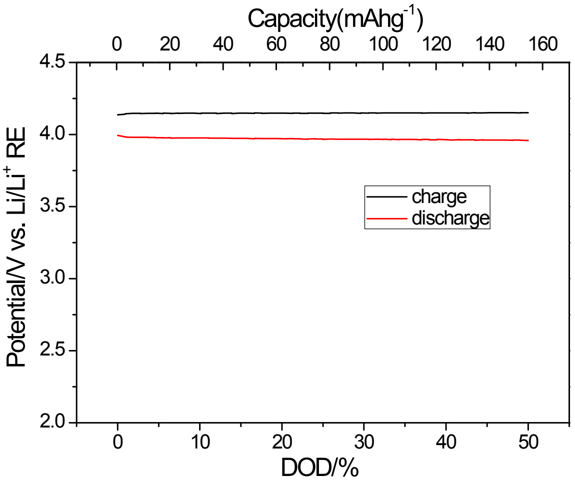

Figure S5. The charge /discharge curves for 100% DOD of the Li//Br battery in which aqueous positive electrode is 1 mol L^{-1} LiBr with 0.1 mol L^{-1} Br_2.

6. Discharge voltage curves in different current density

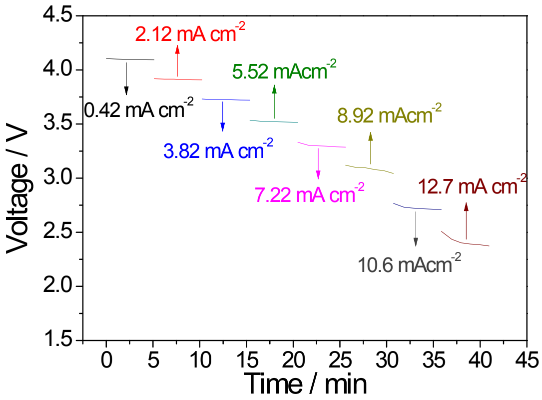

Figure S5. Discharge voltage curves in the current density range of 0.42 to 12.7 mA cm^{-2}. At each current density, the test was carried out for 5 mins instead of several seconds.

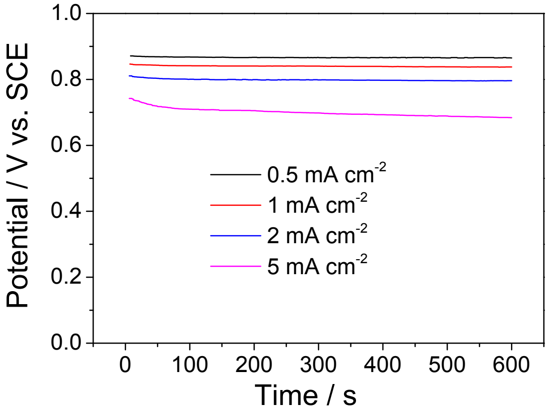

Figure S6. Discharge curves for Br single electrode (1 mol L^{-1} Br_2) in 7 mol L^{-1} LiBr at different current densities.

When the current density increases from 0.5 to 5 mA cm^{-2}, the voltage decrease is only about 0.3 V, indicating excellent electrochemical redox kinetics.

7. The stability of both the solid state electrolyte film

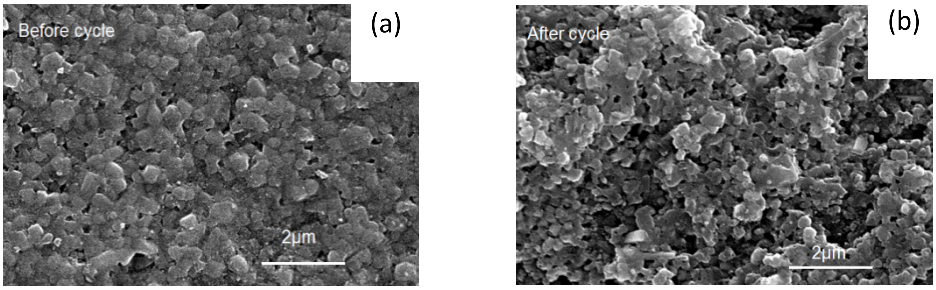

Figure S7. SEM micrographs of LISICON layer before and after 100 cycles at 35% depth of discharge.

8. Comparison between different aqueous rechargeable lithium batteries

Table S1. Some data about the highest power densities for different aqueous rechargeable lithium batteries.

System	Current density / mA cm^{-2}	Average discharge voltage / V	Highest power density / mW cm^{-2}	Reference*
Li//I	12	2.9	34.8	16
Li//$Fe(CN)_6^{3-}$	6.5	1.8	12.5	22
Li//Br	12.3	2.5	29.7	This work

*: In the list of references of the main context.