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Shedding light on the subtle differences in Li-S cell operation when using safer ionic liquid based electrolytes

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Lithium-sulfur (Li-S) batteries have the potential to replace lithium-ion batteries due to their high theoretical energy density and potentially reduced environmental impact. However, they still face many challenges in terms of operation and safety to become more attractive in a commercial-standpoint. Of particular interest is the use of safer, less-flammable electrolyte compositions involving ionic-liquids (ILs). Despite an increase in capacity retention as well as enhanced safety when using IL-based electrolytes, there is still a lack of understanding on the inherent electrochemistry involved when using these electrolyte compositions in Li-S cells, in particular whether there is a difference in SEI composition relative to using conventional organic solvent based electrolytes.

Herein synchrotron-based techniques namely in-situ X-ray powder diffraction and ex situ X-ray Absorption Near Edge Structure (XANES) spectroscopy, both performed at the Australian Synchrotron, are used to clarify the subtle differences between using IL-based and more conventionally used organic solvent-based electrolytes in Li-S cells. Our in-situ X-ray powder diffraction studies revealed the formation of the generally less-stable β-S8 phase upon multiple charge-discharge cycles when using the C4mpyr-TFSI based electrolyte. The data also showed a more distinct formation of solid Li2S when using the C4mpyr-TFSI based electrolyte versus using DOL/DME-based electrolyte, suggesting that C4mpyr-TFSI based electrolytes facilitate for complete reduction of S8 to Li2S. Whilst the use of LiTFSI and LiNO3 salts is generally known to stabilize the SEI in Li-S cells, XANES spectroscopy of electrochemically treated Li-S cells revealed subtle differences in the SEI composition when using C4mpyr-TFSI-based vs DOL/DME-based electrolytes. A larger buildup of TFSI-anion was observed on the Li-anode when using the C4mpyr-TFSI electrolyte relative to the DOL/DME composition, which could account for the cell's improved performance when using the C4mpyr-TFSI-based electrolyte.

Speakers Gender

Female

Travel Funding

Yes

Level of Expertise

Student

Do yo wish to take part in the poster slam

Yes

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