TECHNOLOGY

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Novel Rechargeable Lithium-ion Battery

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Background

As we transition to utilizing renewable energy sources like solar and wind, there is a need to develop robust, high-density energy storage to address the unpredictability of these resources. Batteries have drawn significant interest due to their ability to provide stable, continuous power, though typical battery chemistry lacks the specific energy density required to store this energy efficiently and economically. State-of-the-art lithium-ion batteries do not have high cycle ability, nor electrochemical stability. Moreover, they carry safety concerns due to the flammable nature of the state-of-the-art electrolyte. To reach an energy density comparable to gasoline, the development of lithium batteries that are stable under high-temperatures is necessary.

Researchers at the University of Calgary have recently developed a cell comprising a novel garnet-type structure as a separator for elemental lithium and an aqueous electrolyte in a Li-air battery architecture; this same architecture can also be applied to Li-S cells. Li-air batteries have been explored due to their light weight and high energy density, though there have been challenges in finding fast Li-ion ion conducting and electrochemically stable solid electrolyte separators. Using the Li-rich $Li_{6.5}La_{2.5}Ba_{0.5}ZrTaO_{12}$ (LLBZT) electrolyte, the researchers were able to demonstrate stability following exposure to H_2O, D_2O, 1 M LiOH, and 1 M LiCl at room temperature. The structural integrity of the battery was also retained following solution treatment and heating. Additionally, the battery displayed a constant open circuit voltage of 3 V that was both reproducible and reliable.

This innovative LLBZT electrolyte has demonstrated the capacity to overcome many of the barriers that have prevented Li-air batteries from achieving wide-spread adoption and commercial success. Given its suitability for incorporation into tubular batteries, this has significant potential to be successfully employed in the next generation beyond Li-ion batteries.

Areas of Application

- Mobile energy storage
- Electric vehicles
- Grid-scale energy storage

Competitive Advantages

- More stable than typical Li-air or Li-S batteries
- LLBZT retains its crystal structure and electrochemical stability with metallic lithium
- High open circuit voltage (3 V)
- Reproducible and reliable performance that is consistent over time

- Can be incorporated into tubular cells

Intellectual Property Status

- PCT application filed

Publications

- Solid State Ionics 318 (2018) 71-81