Mechanism Panel Abstract & Speaker Biography

Electrolyte decomposition in Li-S cells

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Introduction

Li-S cells are attractive due to their high potential gravimetric energy density, but unfortunately they achieve only low cycle numbers. A major reason for this is the continuous decomposition of electrolyte during cycling.

As low electrolyte/sulfur ratios are required for high gravimetric energy density, this electrolyte decomposition reduces the obtainable cycle number to below 50. It is therefore extremely important to evaluate, reduce or ideally prevent this electrolyte decomposition by utilizing new electrolyte compositions and additives, separators and protection layers.

Experimental

Mass spectrometry ion current responses for up to 128 masses were recorded next to the pressure and electrical charge/discharge data for Li-S, LiSi-S and LiC-S. Consequently gaseous electrolyte decomposition products were related to cell current, voltage and state of charge. Gas chromatography was applied to examine the decomposition products contained within the liquid electrolyte. All measurements were performed twice and were made with two different mass spectroscopes with different software to double-check the results. All applied test cells were carefully checked for leakages and had very low leakage rates.

Results

- In the liquid electrolyte ethanol, methanol, methoxy-ethene and traces of acetone were identified as decomposition products of ether based electrolytes.
- The test cell might have an impact on the results (hard case, polymer case)
- The presence of $LiNO_3$ has an impact on the decomposition reaction
- Gaseous products are especially CS_2 and N_2

Conclusion

Various Li-S chemistry systems were successfully examined by mass spectrometry resulting in the determination of liquid and gas phase electrolyte decomposition products. The test setup, temperature, internal cell pressure and applied electrodes have an impact on the measurement and results.

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Speaker Biography:

Markus Hagen

Profile

- Battery research for >7 years
- Focus on next generation materials:
  - Alloy anodes (Sn, Si)
  - Sulfur cathodes (S8, Li2S)
  - Analytics (Electrolyte)
  - Novel membranes/separation
- Project manager of various public and industry projects

Employment History

09/2015 – now: Group leader “Batteries” at Fraunhofer ICT

09/2013 – 09/2015: Scientist at Fraunhofer ICT

09/2009 – 09/2013: PhD research at KIT/Fraunhofer ICT, Applied Electrochemistry

Education

09/2013: PhD – Lithium-Sulfur cells

05/2009: Diploma - Business Engineering at the Karlsruhe Institute of Technology (KIT)