Influence of the Stretching on the Ionic Conductivity of Solid Polymer Electrolyte.

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Introduction

- Context:** Conventional Li-ion batteries can leak and react. [1].
Solution? Replace the liquid electrolyte by a non-flammable dry **Solid Polymer Electrolyte (SPE)**.
- Interest:** Flexibility, process easiness, lack of volatile compounds, and chemical and electrochemical stability toward Li metal [2].
- Targeted application:** Room temperature Li battery comprising SPE.

Objectives

- 1 - Ionic transport:** Develop a solid methodology to determine ionic conductivity σ upon SPE stretching: **through-plane** ($\sigma_{\perp}$) vs. **in-plane** ($\sigma_{\parallel}$).
- 2 - Instrumentation:** Design of a setup to couple electric measurements and elongation as a function of temperature and under inert gas.
- 3 - Modeling:** Determination of the current vector density depending on the SPE geometries (elongation effect) to calculate accurately $\sigma_{\parallel}$ and $\sigma_{\perp}$.

1- Ionic transport

The SPE electrolyte resistance R_{el} is determined by Electrochemical Impedance Spectroscopy (EIS) [1]

2- Instrumentation

3 - Modeling

Stationary electric current in conductive medium

→ Ohm's law $J = \sigma E$
with J current density (A/m²).

R_{el} in experiment ↔ R_{el} in modeling → σ_{Exp} vs. σ_{Model}

4-Results $\sigma_{\parallel}$ vs $\sigma_{\perp}$

PEO/LiTFSI & PEO/LiTFSI + NCC (cellulose) [3]

Modeling

$\sigma_{\parallel}$ upon stretching

Conclusion & perspective

- $\sigma_{\parallel} > \sigma_{\perp}$ for all PEO based SPEs (homopolymer, composite, statistical)
- Modeling captures the experimental behavior
- Other transport properties to be characterized

References

- [1] D. Lisbona, T. Snee, Process Saf. Environ., 89 (2011) 434.
- [2] W. Xu et al., Energy Environ. Sci., 7 (2014) 513.
- [3] M.S. Azizi et al. J. Phys. Chem. B 2004, 108, 10845-10852.

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