Characterizing Anti-Perovskite Films for Solid-State Electrolytes in Batteries

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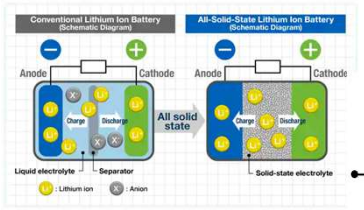
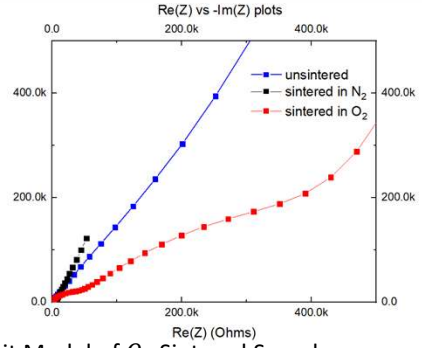
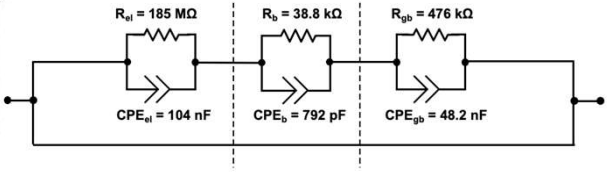
Background

- Goal: create thin-film solid-state batteries
- Advantages over lithium-ion batteries: higher energy density, faster charging, increased safety, flexibility and durability
- Anti-perovskites are a class of material being explored for use as solid-state electrolytes due to their high ion conductivities





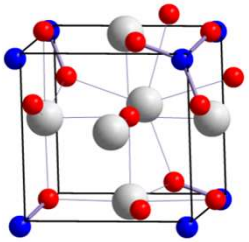
Equivalent Circuit Model of O_2 Sintered Sample



Preliminary Results

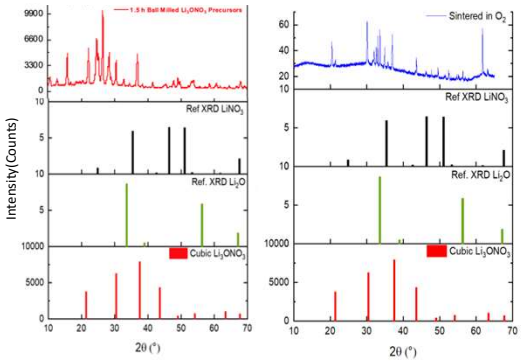
- Conductivity values:
- $1.15 * 10^{-7} S/cm$ unsintered
- $4.07 * 10^{-6} S/cm$ sintered in N_2
- $3.12 * 10^{-6} S/cm$ sintered in O_2
- Visually dense thin films
- XRD and EIS align with theoretical results

Right: Simulated Crystal Structure of Li_3ONO_3



Right: Optical Image of Li_3ONO_3 Film

XRD Analysis



Process & Methods

- Ideally rapid, low-cost manufacturing processing

Stoichiometric $LiNO_3$, Li_2O and 15wt.% PEG in Ethanol

Blade or spin coating

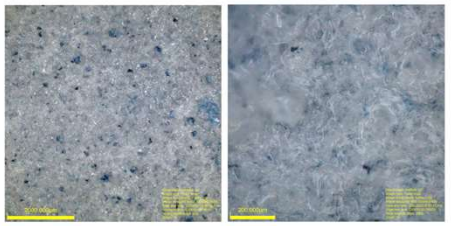
Rapid 10 min heat press 110 psi

Rapid thermal anneal in air for sintering (200°C) ~ 1 min

Challenges Faced

- Instability in atmosphere, particularly Li_3OCl
- Lack of literature on Li_3ONO_3
- Film density (see microscopy)
- Blade coating speed/temperature settings
- Accurately curve fitting conductivity data

Optical Microscopy - Li_3ONO_3



Conclusion

Visually dense, uniform films of Li_3ONO_3 were created that match theoretical results and have an ion conductivity on the order of $10^{-6} S/cm$, showing that this material is a strong candidate for use as an SSE.

References:
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