Rotary Reactor Setup for Atomic Layer Deposition of Artificial Solid Electrolyte Interphase

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Background

Solid Electrolyte interphase (SEI) is a protective coating that exists in commercial batteries which can prevent corrosion between the electrode and electrolyte. It can prevent electrode-electrolyte reactions, which degrade battery functionality, while still allowing the battery to charge and discharge.

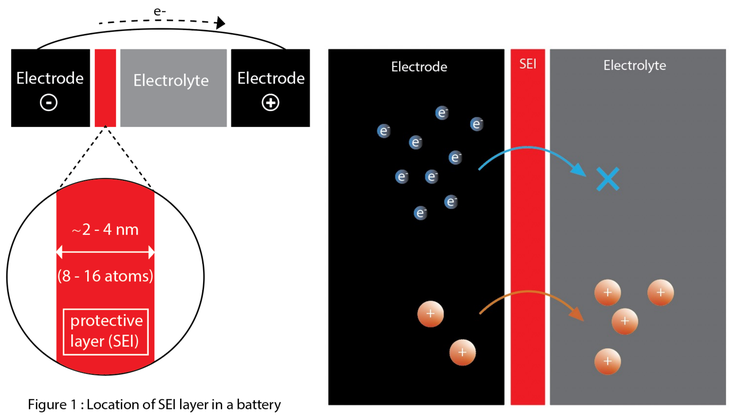
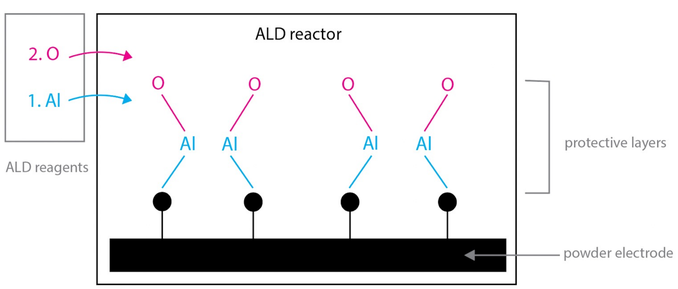


Figure 1 : Location of SEI layer in a battery

Our goal is to develop artificial SEIs on new types of powdery electrode materials that can contribute to the development of a promising type of battery – the fluoride ion battery – which can potentially store more energy and have abundant raw materials.

Atomic Layer Deposition(ALD) is a synthetic technique that can create protective films which are controllable in both uniformity and thickness.



Acknowledgements:

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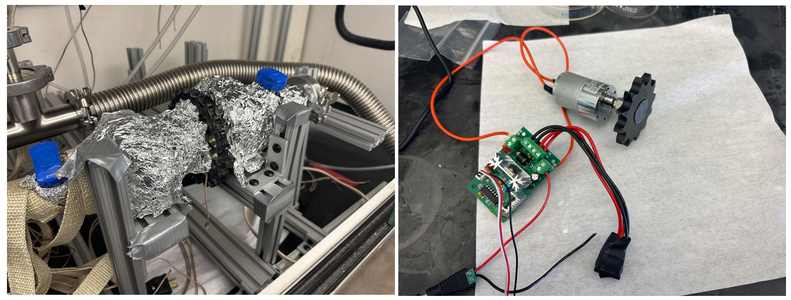
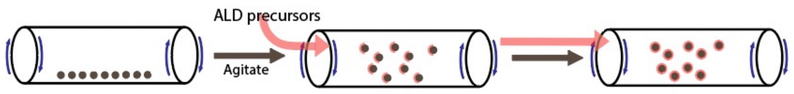
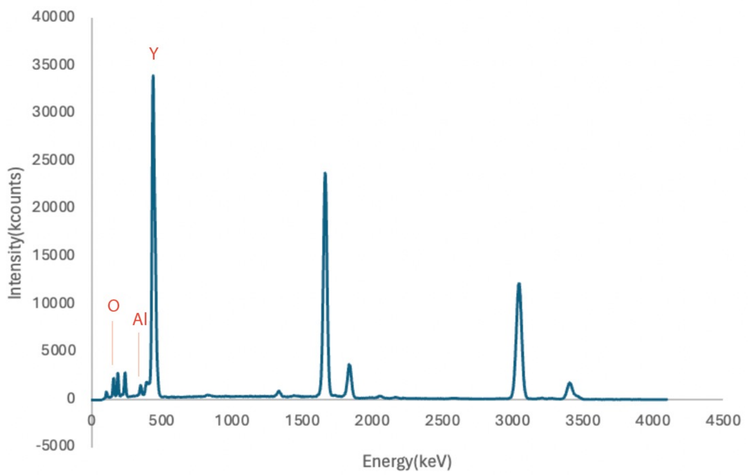
Synthesis via Rotary ALD



We have built a Rotary ALD Reactor consisting of a gear incorporated heatable chamber and a motor driven gear.



Composition:

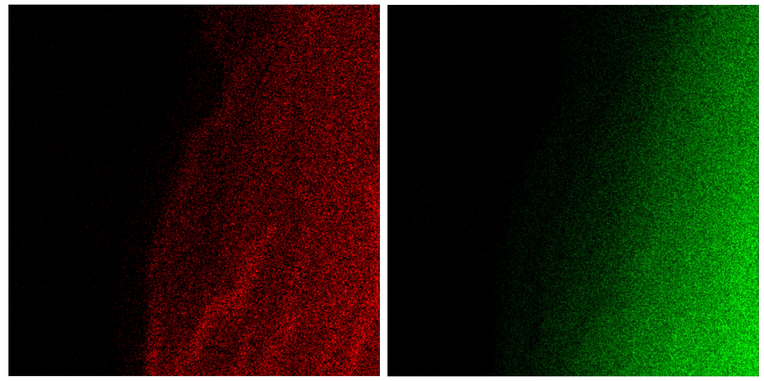


SDS data confirms the existence of aluminum particles within the yttrium carbide electrode sample

references:
1. McCormick, J.A. et al. *J. Vac. Sci.A.* 2007, 25,1, 67–74. doi:10.1116/1.2393299.
2. Nowroozi, M.A. et al. *J.Mater. Chem. A.* 2021 , 9, 10, 5980–6012, doi: 10.1039/d0ta11656d.

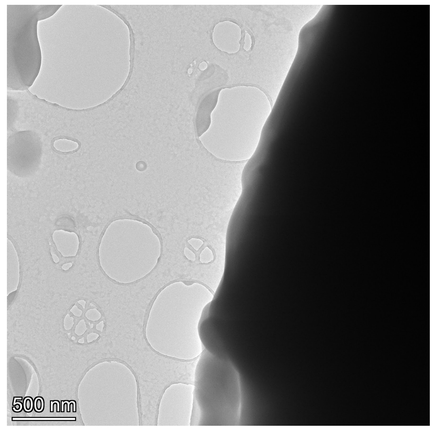
Film Characterization

STEM mapping



Aluminum particles (red, from the thin film) are found overlapping with Yttrium Particles (green, from the electrode powder)

TEM imaging



Conclusions

We have successfully constructed a rotary ALD reactor that is ready for powder deposition. Using this reactor, we have demonstrated that aluminum oxide can be deposited onto our yttrium carbide electrode material as a potential solid electrolyte interphase. This can contribute to further studies in SEI properties and new batteries.

Future Directions:
1.producing more uniform film for better functionality
2.Investigating SEIs with various compositions and their relationships between battery materials