Aqueous Synthesis and Rapid Printing of Binder free Li_2OHCl Thin Films for energy Storage

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Background:

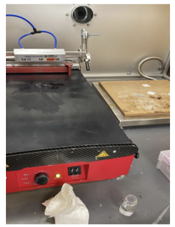
- Anti-Perovskite materials offers low cost, scalable, and moisture-stable Solid-State batteries.
- Anti-Perovskite materials are suitable for energy storage due to their high ionic conductivity and their chemical stability
- Li_2OHCl is aqueous based solution which when blade costed and heated above the boiling temperature creates a thin film of Li_2OHCl which has high ionic-conductivity and good morphology.
- This process does not need highly regulated conditions such as moisture free laboratory. This can be done in a lab with moisture and can be transferred to the glove box.
- Unlike other researched anti-perovskite material such as Li_3OCl this material is proven to be stable at humidity of 10% for more than 24 hours, and it is also stable at high temperature of 300° C for long period.

Goals:

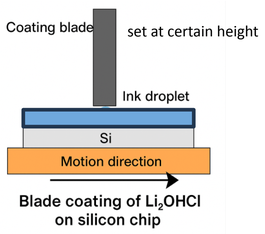
- To make anti-perovskite films that have good morphology and show promising results for large scale manufacturing in lower costs.

Processing Conditions of Samples:

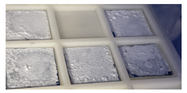
- Prepare an ink of Li_2OHCL which is completely transparent and then blade coat the ink upon a silicon chip.
- Once blade coated, transfer the chip to the hot plate which is set to 75° C and keep it on same temperature until most of the water has evaporated from the surface.
- Then after gradually increase the temperature to 110° C and once all the moisture has evaporated from the surface.
- Transfer it into the sample box where the humidity is around 10% and then test it for some hours/days and make sure that the substrate is not reacting much in the low moisture level and maintaining its structure.



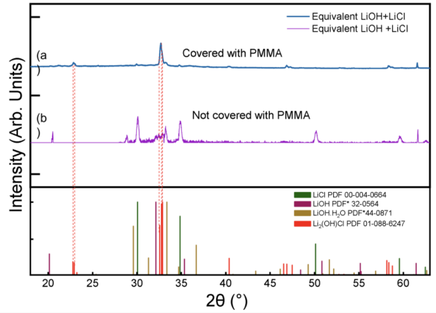
Blade coater and hot Plate for coating substrate upon silicon.



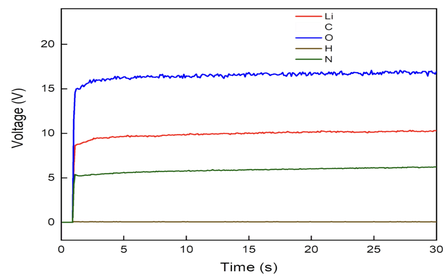
Blade coating of Li_2OHCl on silicon chip

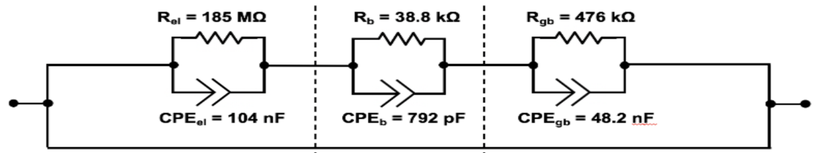
Li2OHCl	Li3OCl
a) No exposure to air	b) No exposure to air
	
c) 24 hours in 10% humidity.	D) 25 mins in 10% humidity

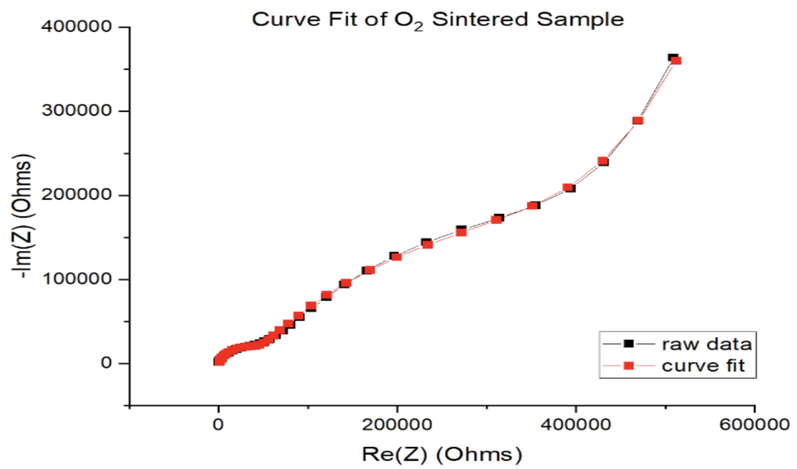
X-Ray Diffraction Analysis data



GDOES Data:







Results:

- We successfully received good phase results in the xrd of Li_2OHCL and the EIS data also shows promising results which can be improved in future by making sure all the tests are conducted immediately after the fresh samples are made.
- Upon experimenting we were able to find process condition that greatly affect the morphology of the substrate which would help in improving the substrate in future research.

Next Steps:

- Try to improve results in profilometry as currently the height of the substrate on the silicon chip is not too uniform and the aim is to get uniform height below 5 microns on the chip.
- Try to coat Li_2OHCL on stainless steel or copper sheet so that we can ensure that it is good to be used in a battery.

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