Studying Sodium-ion Battery Degradation in Coin Cells

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Objective

The objective of this research is to study the behavior of sodium-ion coin cells cycled at slow rates in extreme temperatures because cells tend to malfunction in said conditions. The reasons behind said anomalous behavior in Na-ion cells are still largely unstudied and widely motivate this research.

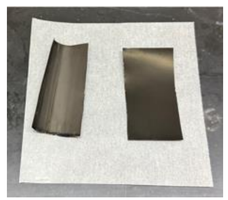
Methods and Results:

A series of steps were followed to manufacture the sodium-ion coin cells in the lab:

1. Opened discharged battery in fume hood with wire pliers.

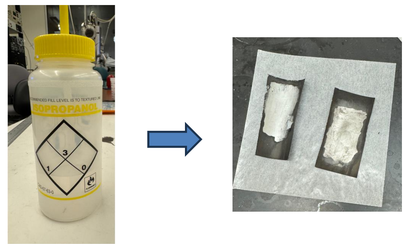
2. Unrolled battery and identify cathode, anode and separator.

- Aluminum used in the cathode/anode was observed to be 3.679mg.



3. Took slices of the cathode and anode.

- With isopropanol, slowly scratched one side to remove the binder.
- The binder holds oxides and carbon and enhances the ionic conductivity of the battery.
- Slices were cleaned using dimethyl carbonate and store in vacuum oven.



4. Cut the slices into 12mm coins using a puncher.

- Prepared the Counter Electrode using pure Na metal. Rolled it until it is flat and thin on a plastic sheet (no metal contact) and punch a 14mm coin.

5. Stuck out the 14mm Na coins to steel caps and structured the coin cell with the elements ordered as in the figure.

- The anode is hard carbon and the cathode is a layered sodium oxide. 2 anode cells and 2 cathode cells were put together.
- Consider the electrolyte [0.5M NaClO4 in PC]

Top shell (rough)
Spring
Counter Electrode
Electrolyte (150µL)
Separator
Electrolyte (50µL)
Cathode/Anode
Bottom shell

6. Placed the assembled cell in cramping machine to fit everything properly.

Final Na-ion coin cells

7. Started testing with RPT protocol on BioLogic Battery tester.

Next steps

Comparing the behavior of coin cells at extreme temperature cycling to the performance of cylindrical cells could bring interesting results on how batteries behave and how they can be improved. Another interesting alternative is the research into solid state battery design that could bring more stability at low temperatures. This research could prove useful for the electric vehicle industry and in second life applications for batteries.

FURI

Acknowledgements: I want to make a special acknowledgment to Intel Corporation and their Intel Sponsored Microelectronics Research Grant that made this possible.

Acknowledgements: I want to thank my mentor Dr. Nicholas Rolston for the opportunity to do research, for all his unwavering guidance and support. Special thanks to Master's Student Harshitha Marikundam and to the whole BatteryML team at Rolston's Lab: https://rolston.lab.asu.edu/research/batteryml/ .

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