An Analysis of Li Pouch Cells for Energy Storage

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Objective

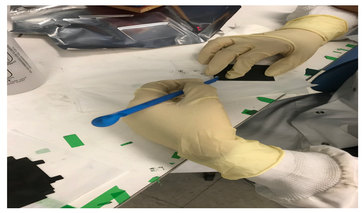
Our goal is to understand how pouch cells work to develop and assist with future pouch cell experiments.

Research Background

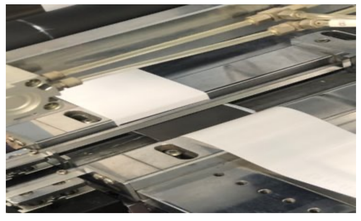
Developing renewable energy is necessary to combat increasing pollution and batteries – as a result- are approaching a point of carbon neutrality. Pouch cells are a specific type of battery that is an essential part of energy storage research because of the inexpensive cost to manufacture, ability to test various parameters on a small scale, and the ease of replication. Our research is focused on using pouch cells to determine whether an electrolyte produces satisfactory cycling behavior. An electrolyte with good cycling behavior may be used to produce cheaper and more effective batteries.

Methodology

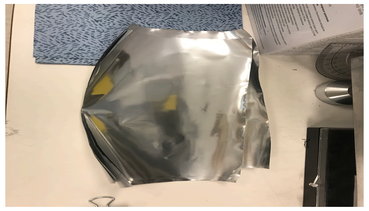
$LiNiMnCoO_2$ (NMC) plated copper and graphite plated aluminum were used as an anode and cathode respectively. A polymer separator was layered in between each interface.



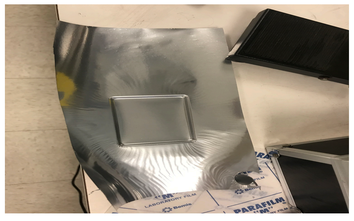
Scrapped graphite and NMC off tabs to allow for electrical connection



Stacked anodes and cathodes with polymer separator in between



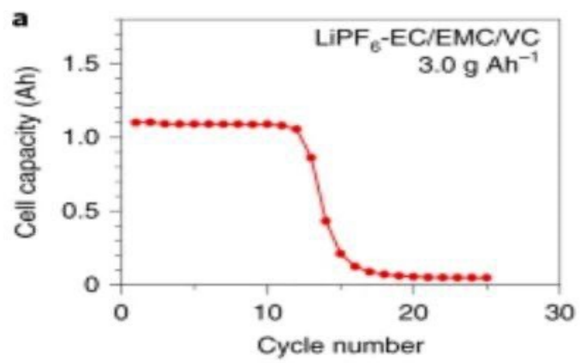
Casing material



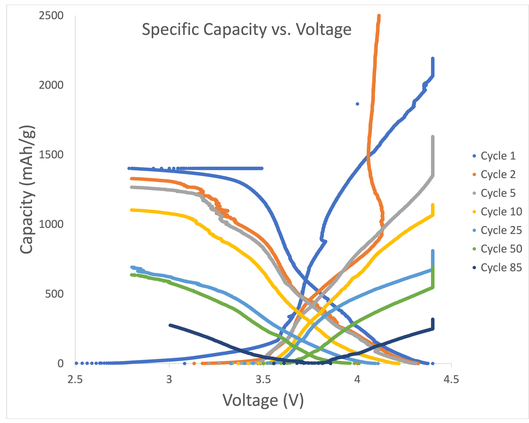
Pressed casing material

Cell is placed in casing and sealed with a vacuum and heat

Results



Capacity vs Cycle to track the capacity decay[2]



Specific Capacity versus Voltage visually demonstrates the efficiency of the battery

$LiPF_6$ was determined to be a good electrolyte to use in a lithium pouch cell because of the slow metal deterioration and the reduced gas production. The right graph demonstrates the differences in capacity between the charge and discharge phases. This demonstrates that the electrolyte is good for cycling because of the consistency and efficiency between various cycles[1]. Our goal was to understand the effects of an electrolyte on a pouch cells because of our future work in testing different electrolytes and their effects.

Summary

- Pouch cells were created by encasing a cell composed of layered anode, cathode, and polymer separator with $LiPF_6$
- The cycling behavior was recorded and compared with literature papers
- $LiPF_6$ was determined to be a good electrolyte because of its slow metal deterioration, low gas production, and its consistent efficacy.

Future Steps

- Different electrolytes cycling behavior will be tested to determine a cheaper lithium alternative
- Long-term goal is to manipulate pouch cells for graduate research projects

References

1. Wang, David Yaohui, et al. "Effect of Mixtures of Lithium Hexafluorophosphate (LiPF6) and Lithium Bis(Fluorosulfonyl)Imide (LiFSI) as Salts in Li[Ni1/3Mn1/3Co1/3]O2/Graphite Pouch Cells." *Journal of The Electrochemical Society*, Vol. 162, No. 1, 2014, doi:10.1149/2.0821501jes.
2. Niu, Chaojiang, et al. "High-Energy Lithium Metal Pouch Cells with Limited Anode Swelling and Long Stable Cycles." *Nature Energy*, Vol. 4, No. 7, 2019, pp. 551–559., doi:10.1038/s41560-019-0390-6.