

# Air-Free Transfer Vessel For Sensitive Energy Storage Materials

Keegan Erdmann, Engineering (Mechanical Systems)

Mentor: Xin Xu, Assistant Professor, Polytechnic School, Ira A. Fulton School of Engineering



## Research question

Our team's goal is to manufacture an air-tight vessel capable of transporting air-sensitive materials from a glovebox to a Scanning Electron Microscope

## Background

- Research for lithium battery cells continues to increase<sup>[1]</sup>
- Lithium oxidizes when exposed to oxygen and moisture
- Air-free vessel is required for safe moving and protecting the sample<sup>[2]</sup>
- Vessel can automatically open when in vacuum

## Machines Used

1. Tormach CNC Mill
2. Jet Mill
3. Metal Lathe
4. Metal Bandsaw

## Next Steps

- Design a new model that allows for easy machining

## Acknowledgments

Professor Xin Xu, Cauê Nogueira and ASU Chandler Innovation Center for helping me in this project

## Parts to be machined

1. Cap
2. Flat sample
3. Lever arm
4. Main
5. Right angle mount
6. Spring mount

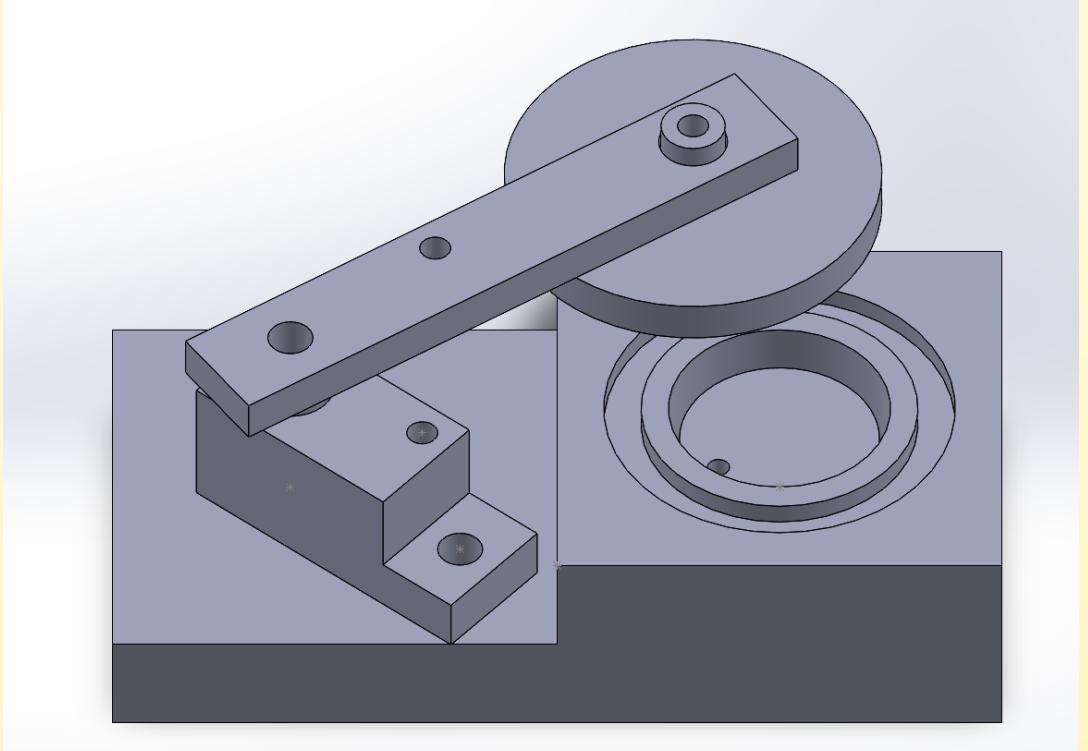


Figure 1: CAD

## Methodology

For flat pieces:

- Cut piece to required length with mill
- Drill and thread holes manually

For Cylindrical pieces

- Machine specific length with Metal Lathe
- Manually thread the sample studs



Figure 2: Real

## References

- [1] Janek, J., Zeier, W.G. Challenges in speeding up solid-state battery development. *Nat Energy* 8, 230–240 (2023).  
<https://doi.org/10.1038/s41560-023-01208-9t>
- [2] J. Schneider, D. Agocs, and A. Prieto, Design of a Sample Transfer Holder to Enable Air-Free X-ray Photoelectron Spectroscopy, *ACS Publications*, Aug. 24, 2020.  
<https://pubs.acs.org/doi/full/10.1021/acs.chemmater.0c01895>

## How it Works

- Put the vessel into a vacuum chamber

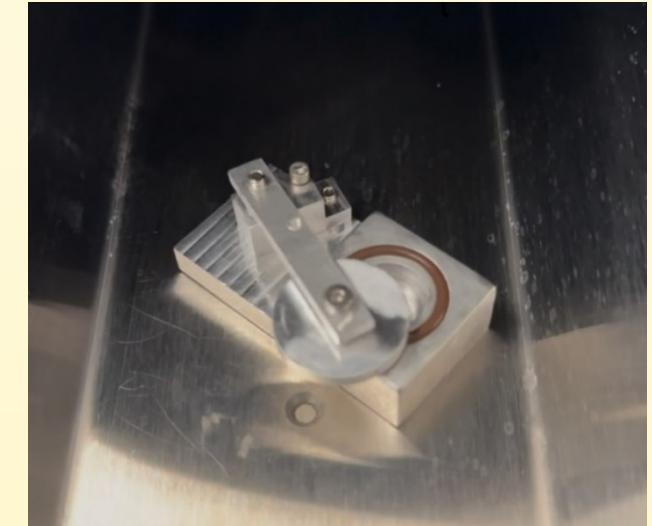


Figure 3: Vessel

- Evacuate all air in the chamber
- Once air leaves the vessel, fill the tube with argon



Figure 4: evacuate all air

- The pressure of the argon will seal the vessel shut
- Internal Pressure greater than external pressure, therefore lid will open

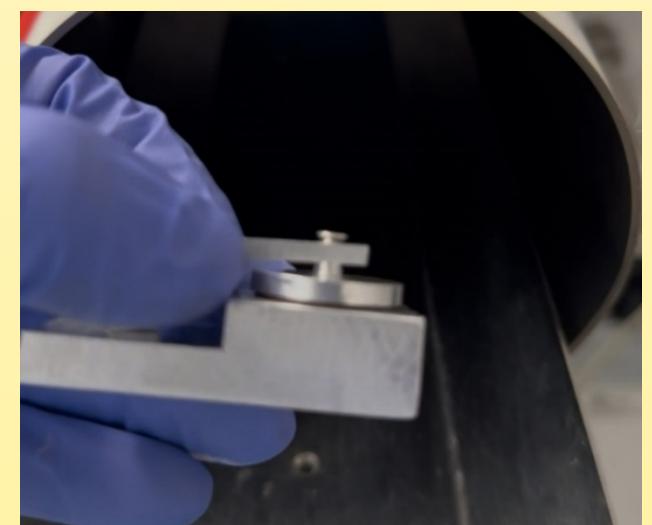


Figure 5: Sealed Vessel



Figure 6: Spring Mount



Figure 7: Lever Arm