

Ultrafast High-Temperature Sintering System

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What is sintering?

Sintering is a process that transforms a powder into a solid by heating particles together causing them to bond.



Traditionally this is done in a tube/box furnace for an extended amount of time (10 hours or more!).

What is UHS?

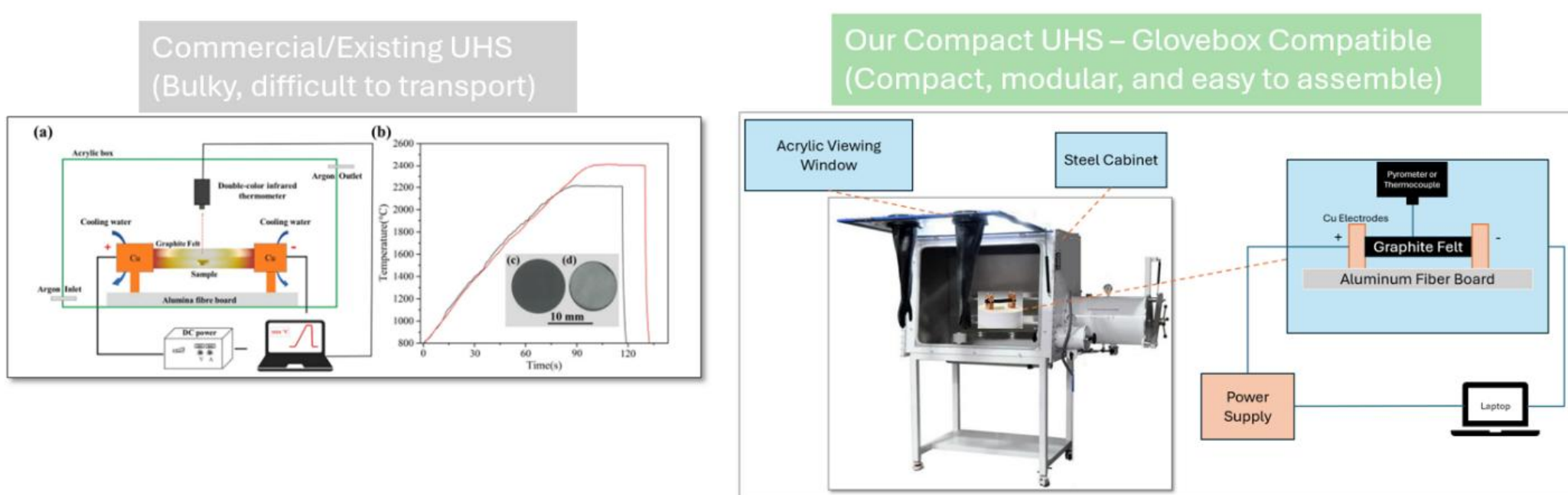
UHS is the process of sintering materials very quickly by heating an element to an excess of 3000° C at a rate of $\approx 10,000^{\circ}\text{C}/\text{min}$ using electricity. The sintering only takes a few seconds.



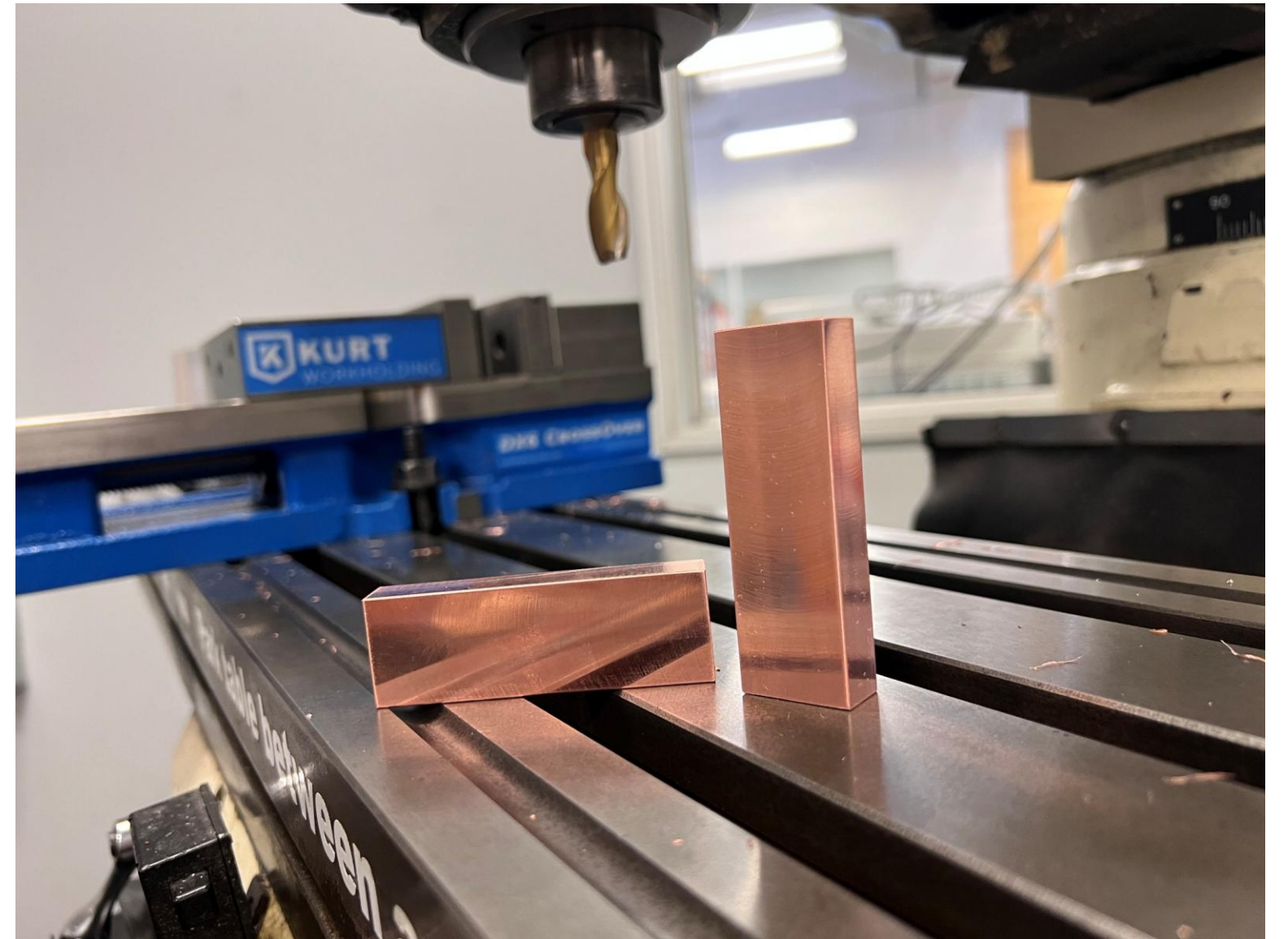
By utilizing this method, we can achieve full densification while reducing the loss of volatile elements while minimizing grain growth.

The Project

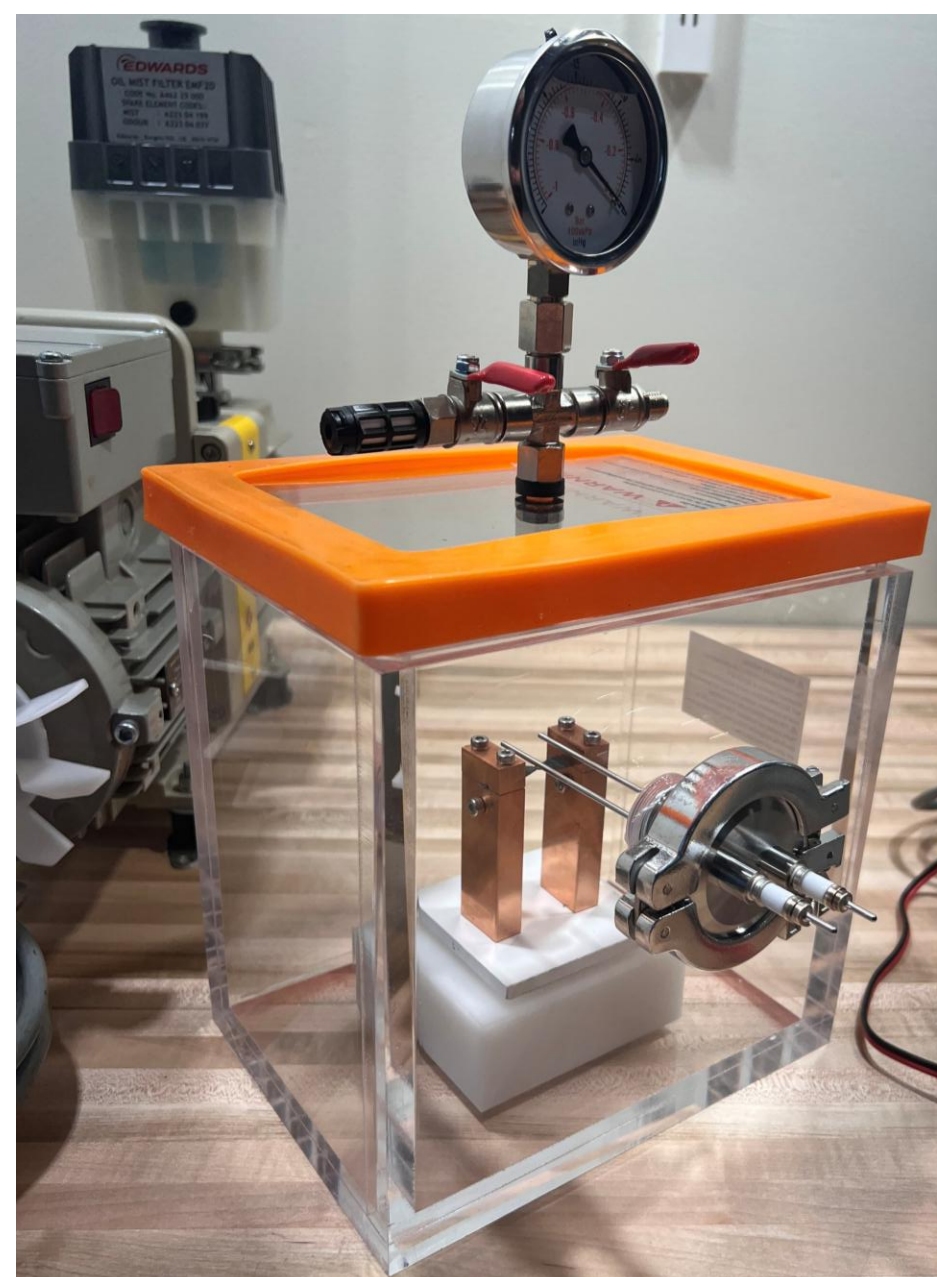
Research methods, design, build, and test a UHS system



Building the system

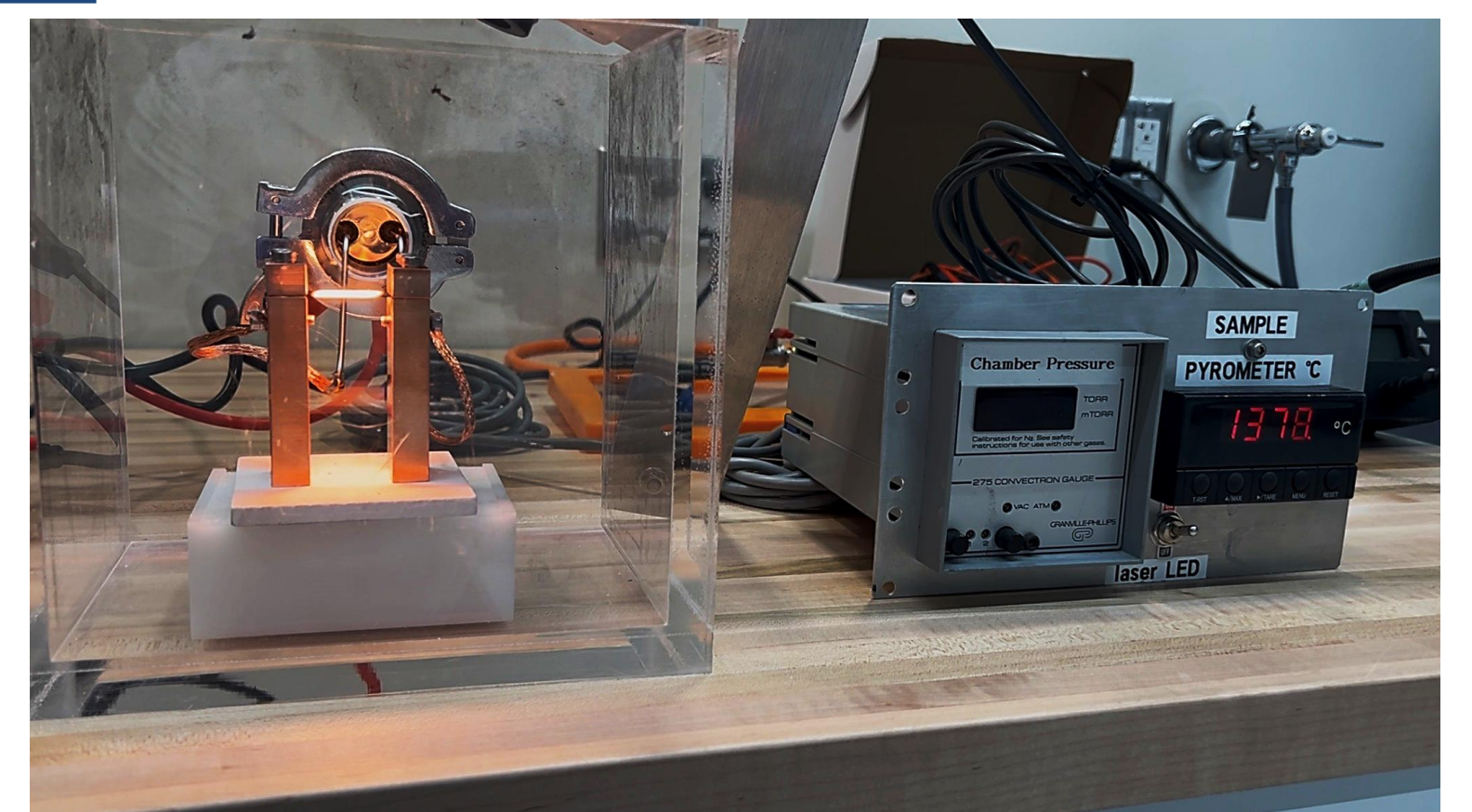


Oxygen-free copper electrodes needed to be milled to clamp graphite felt and connect to power supply.



Vacuum chamber was drilled and hole was threaded to support an NPT to KF40 adapter with a KF40 power pass through.

Results



- Unit heats to over 1375° C in ≈ 2 seconds
- Can maintain this temperature under vacuum

What's next?

- Build an Arduino control system
- Build a pyrometer controller to ensure accurate temperatures
- Sinter materials and test using XRD and SEM against current sintering methods
- Research new uses for UHS systems such as battery recycling