

Development of High-Temperature Thermophotovoltaic Heater

Nikolas Deffigos, Mechanical Engineering

Mentor: Dr. Liping Wang

School for Engineering of Matter, Transport and Energy

Abstract

Thermophotovoltaic energy conversion is seen as a viable option for efficiently converting heat to electrical energy. A heating device heats a selective emitter, which in turn releases thermal radiation with correct energy bandgap. This radiation is then absorbed by a thermophotovoltaic cell and converted to usable electricity. This project seeks to develop a high temperature heater capable of maintaining a temperature of 1000°C, as lower temperatures greatly decrease the efficiency of the system. The heater will be machined and integrated into the existing TPV system, and experiments will be conducted to determine the efficiency of energy conversion at this higher temperature.

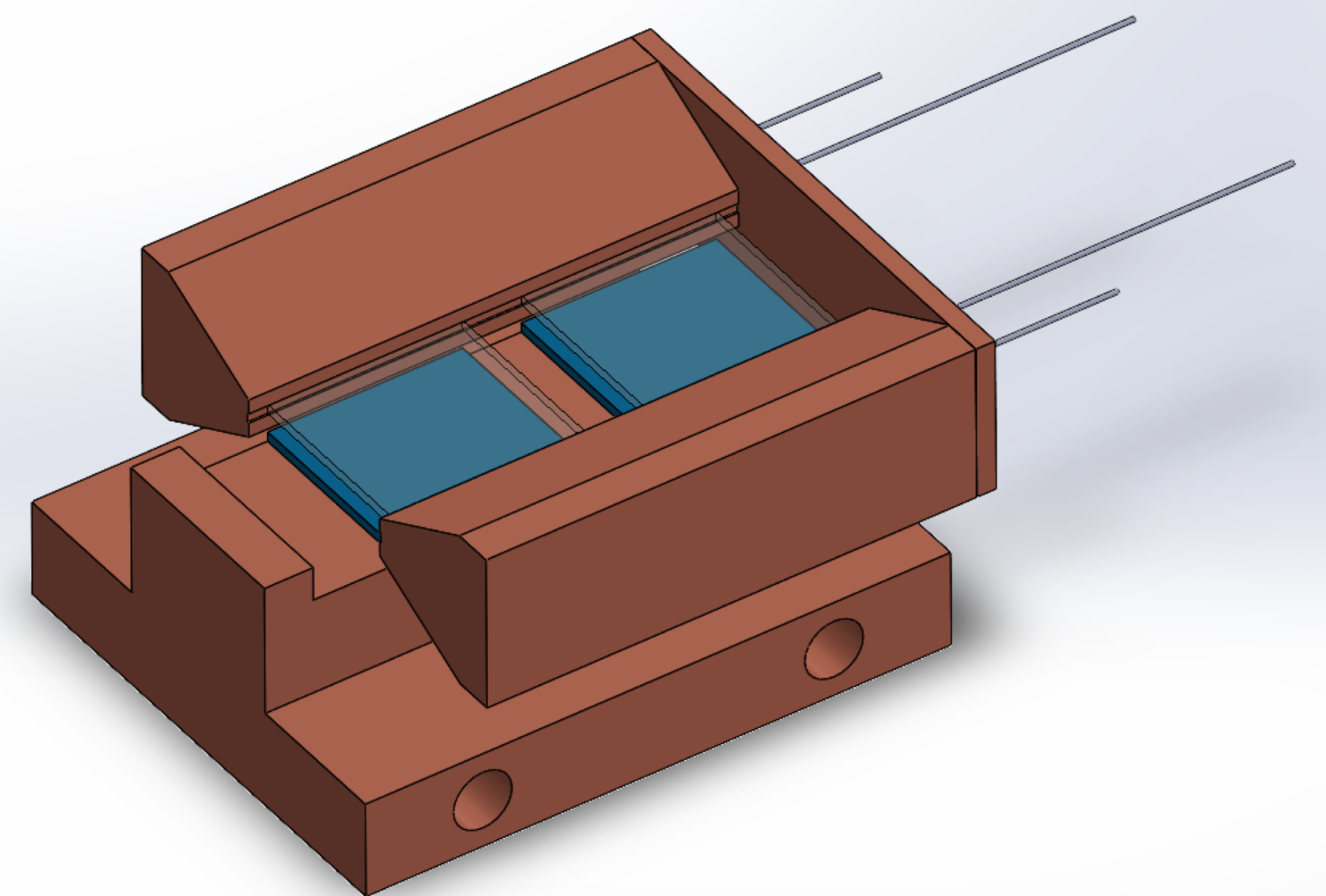
Future Works

Initially, solar TPV was going to be the focus of this project, but with covid-19 it was not possible, so Dr. Wang and I began the development of this TPV heater. The heater components will be machined and then tested, so that efficiency measurements can be acquired. My honors thesis will be the continuation of this project, and will be a compilation of design work and testing results.

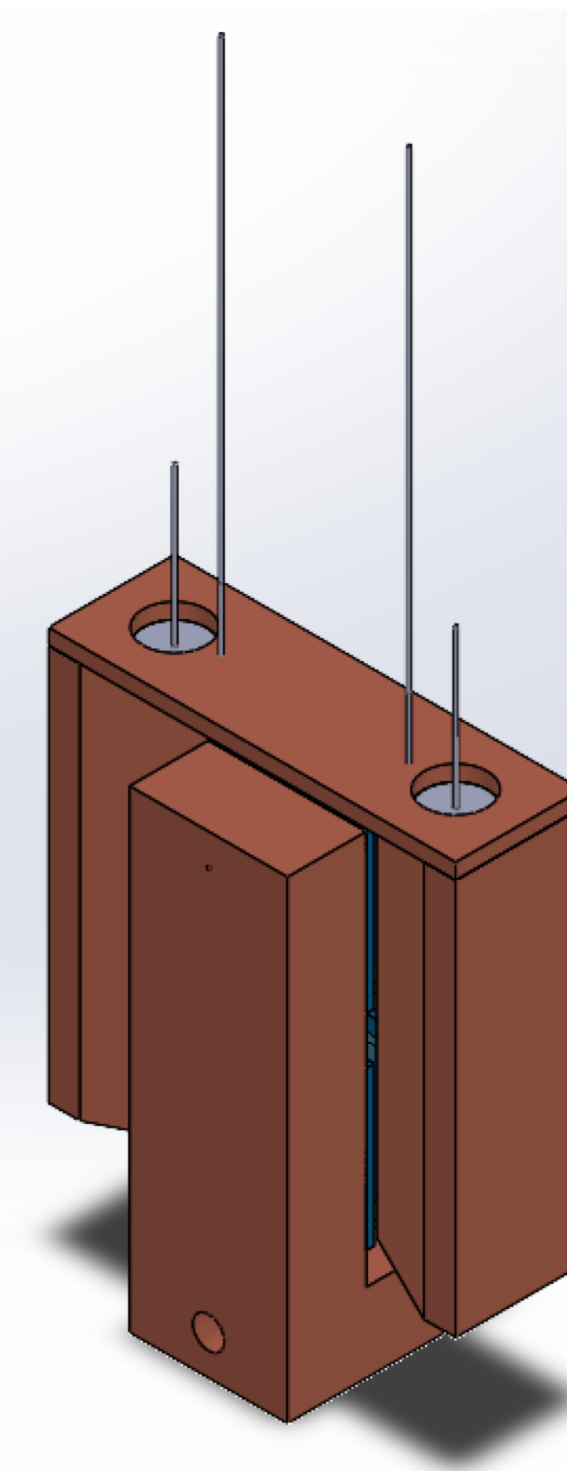
References

[1] Sakakibara, Reyu, et al. "Practical Emitters for Thermophotovoltaics: a Review." *Journal of Photonics for Energy*, vol. 9, no. 03, 2019, p. 1., doi:10.1117/1.jpe.9.032713.

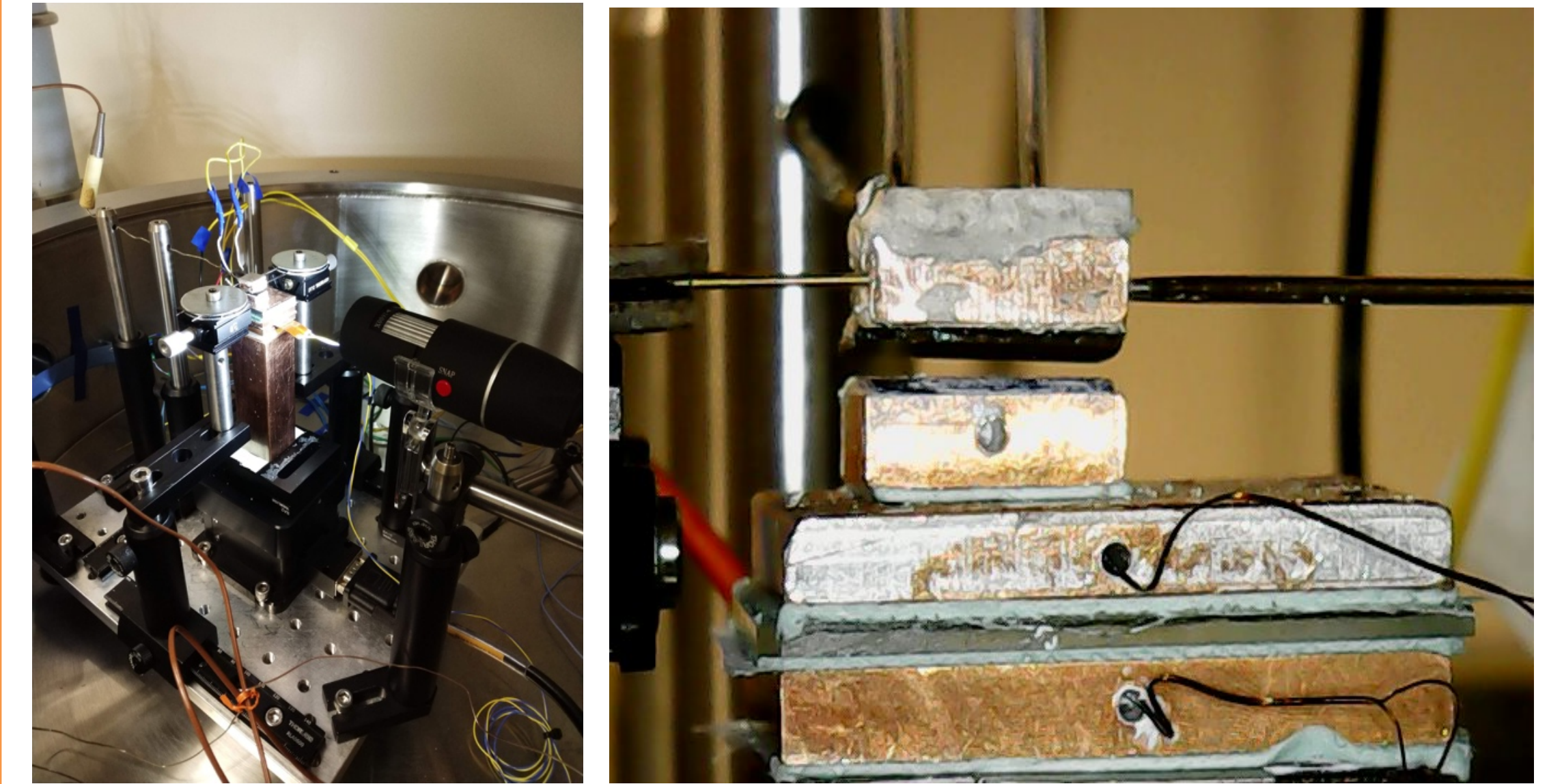
Heater Design 1



Heater Design 2



TPV System Setup



Description of Heater Design

- The first heater design is a horizontal heater that will be used to conduct measurements on the efficiency of the emitter and cell
- Cartridge heaters are placed in the copper blocks, and the blocks have two emitters slid in between them
- A U-shaped copper block will have two cells on each interior side, and it is separable so it can be used in the horizontal and vertical heaters
- The vertical heater uses the same cartridge heater emitter, but has cells on both sides of the U-shaped copper block
- The second heater design will be applied to the entire TPV system for testing.

TPV Schematic₁

