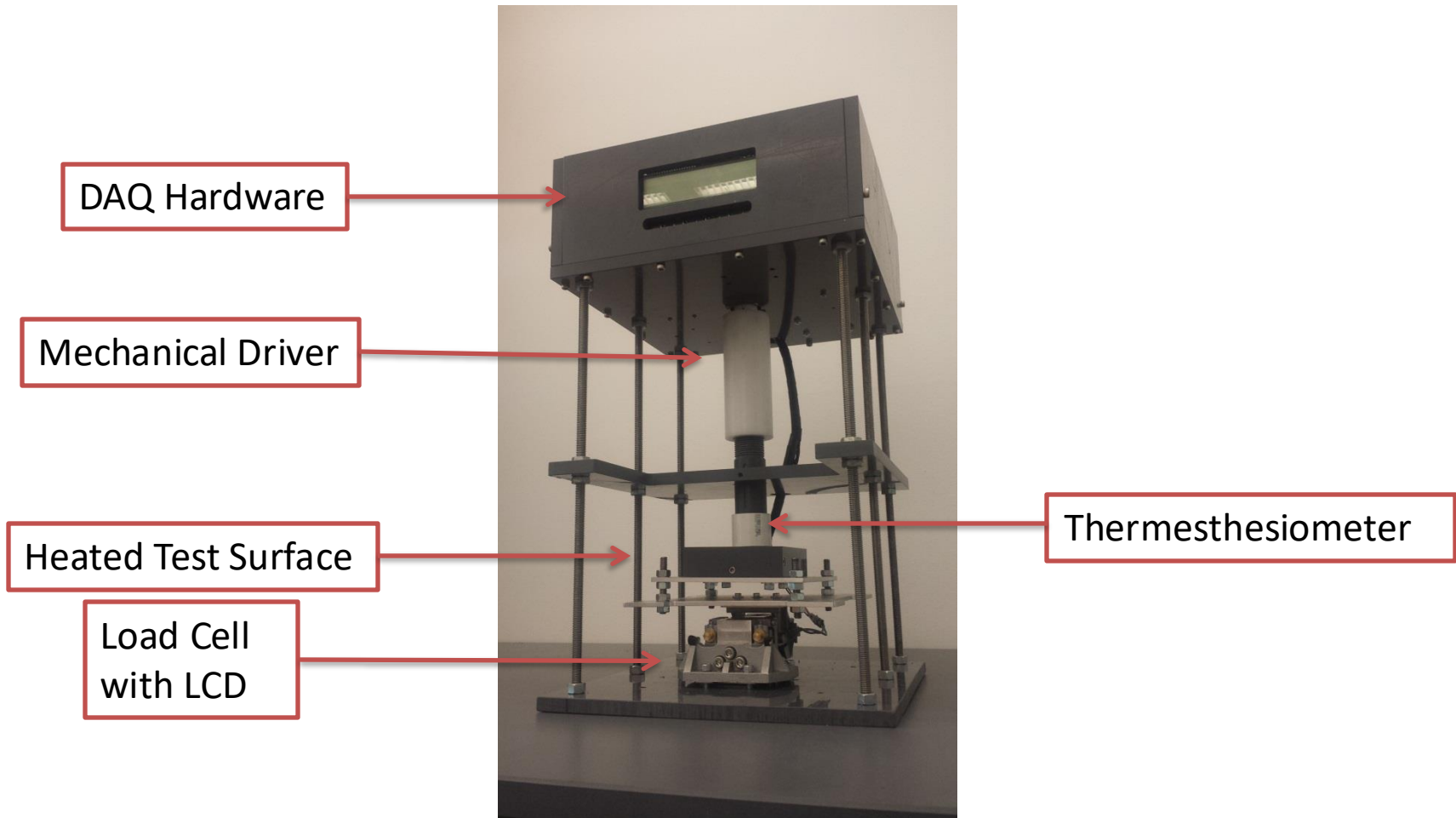


Thermal Effusivity Measurements for Composite Materials

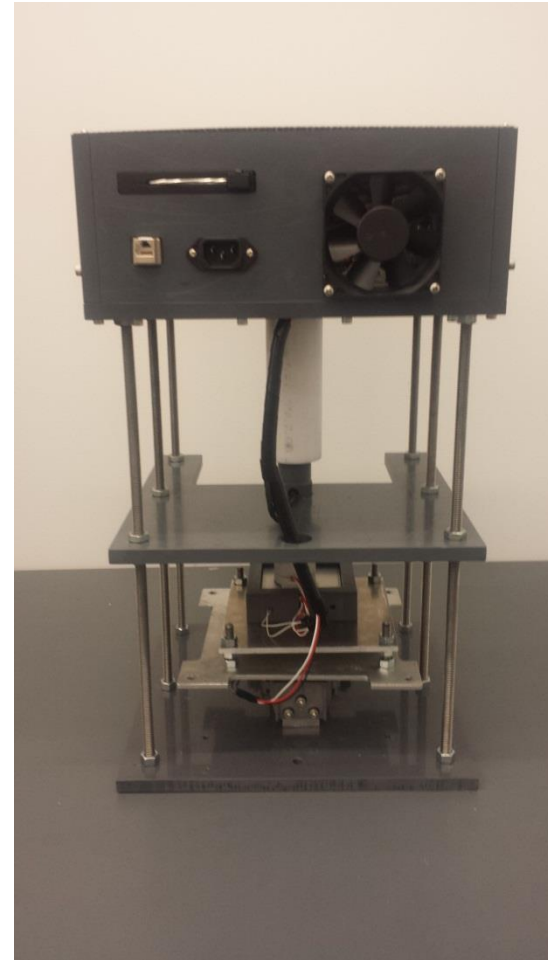


DAQ and Electronics

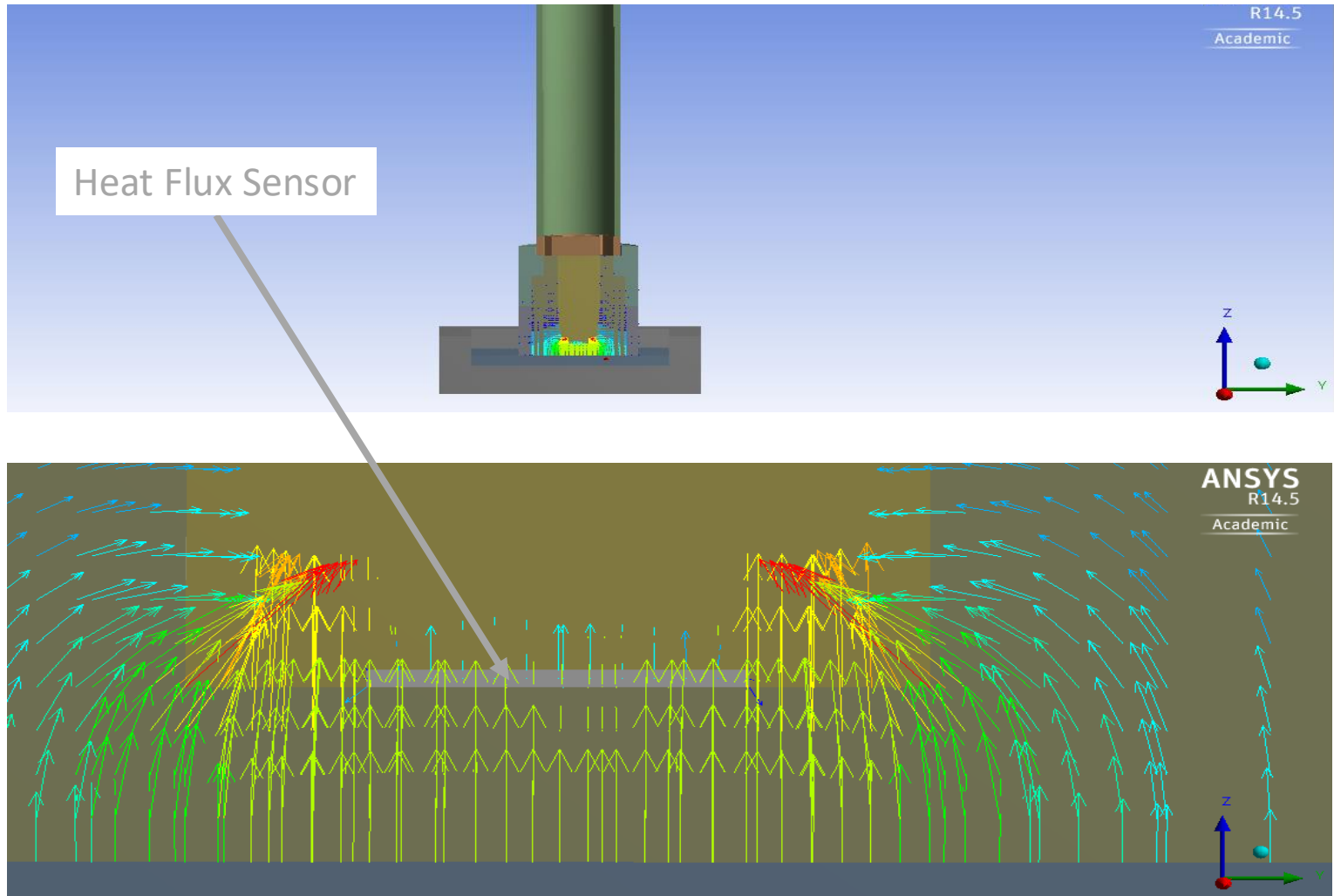
- ✓ DAQ (National Instruments)
 - Digital Out (32 Channel)
 - Analog Read (4 Channel)
- ✓ Micro-controller with Bipolar Stepper Motor
- ✓ Miniaturized heat flux sensor with $\pm 3\%$ accuracy
- ✓ Pt100 RTD with $\pm 1^\circ\text{C}$ accuracy
- ✓ MSR45 Heat Flux Data Logger
- ✓ Solid-state Relays for PID Controls
- ✓ 12V Power Supply for Stepper and Load Cell
- ✓ 5V Power Supply for Digital Out, Relays and Microcontroller
- ✓ Cooling Fan
- ✓ Kapton, resistive heating element ($21^\circ\text{C} - 200^\circ\text{C}$)
- ✓ Load Cell (0 to 6000 grams $\pm 1\text{g}$)
- ✓ Housed in a PVC shell:
 - .5" thick walls
 - Low enough conductivity $k = .19 \frac{\text{W}}{\text{mK}}$

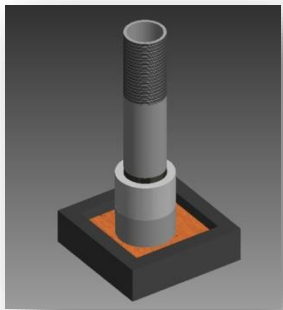


- ✓ Breathable grating for air circulation
- ✓ USB Hub for heat flux sensor data and uploading code to the micro-controller.
- ✓ Ethernet Cable for DAQ System
- ✓ Power Outlet

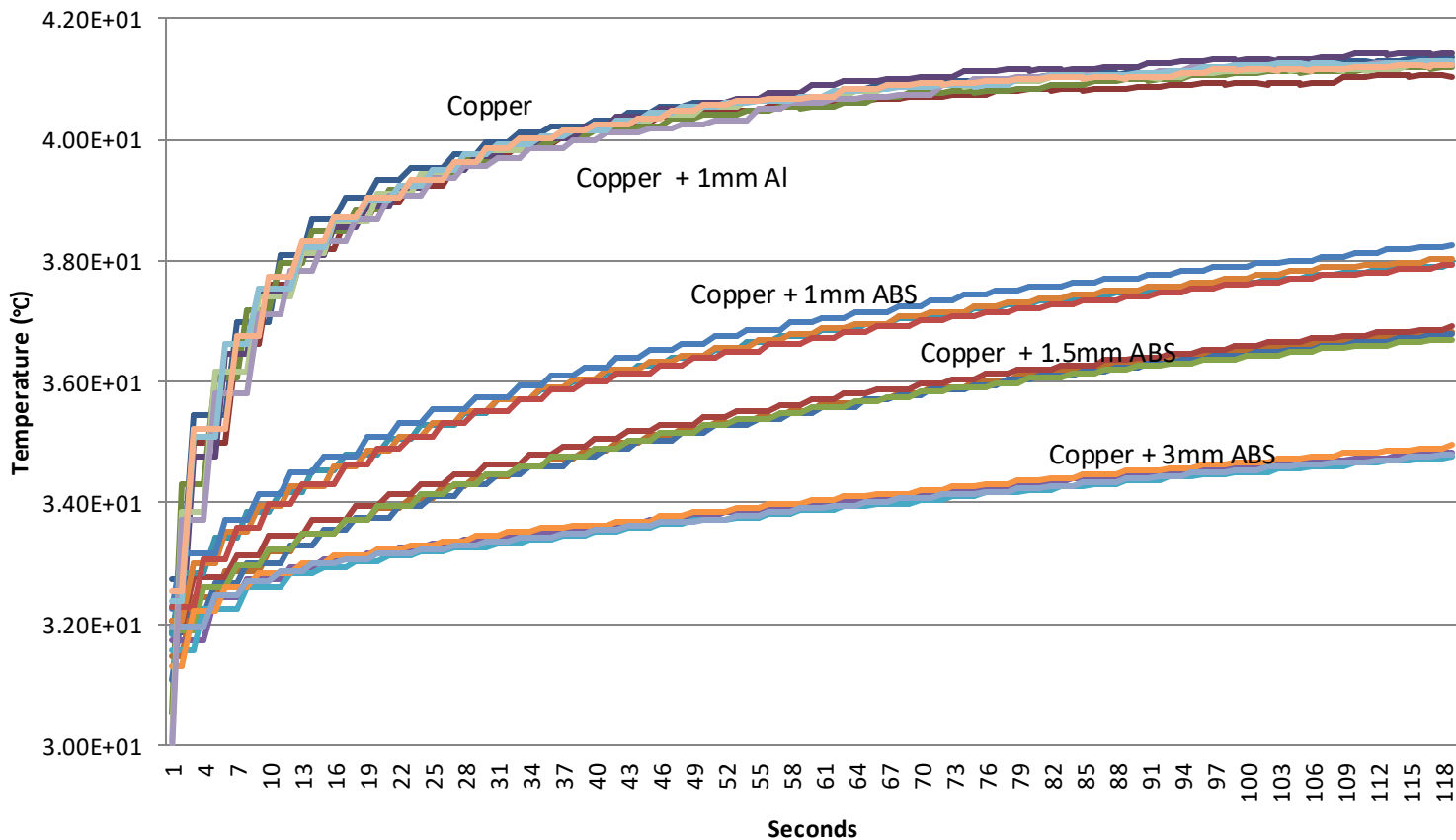
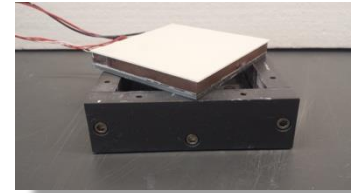


Heat Flux Sensor Design Considerations: ANSYS Simulations



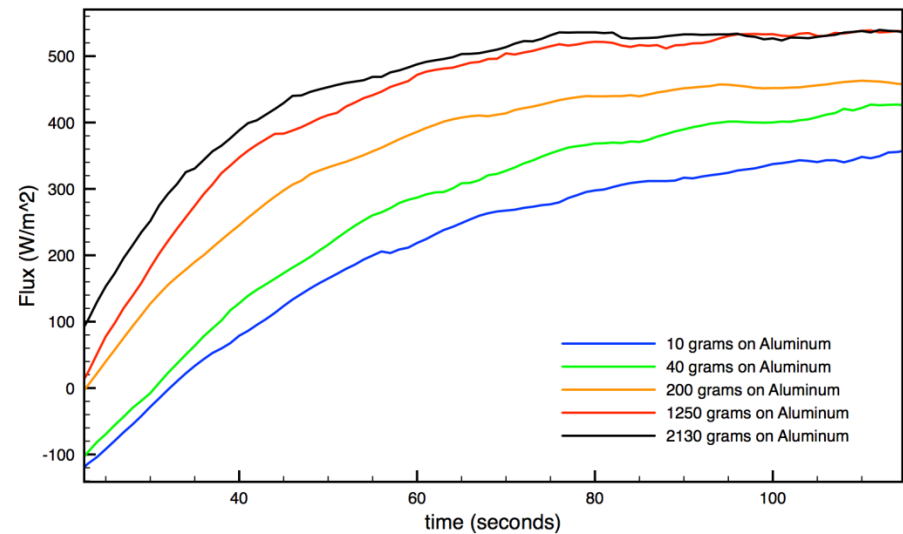
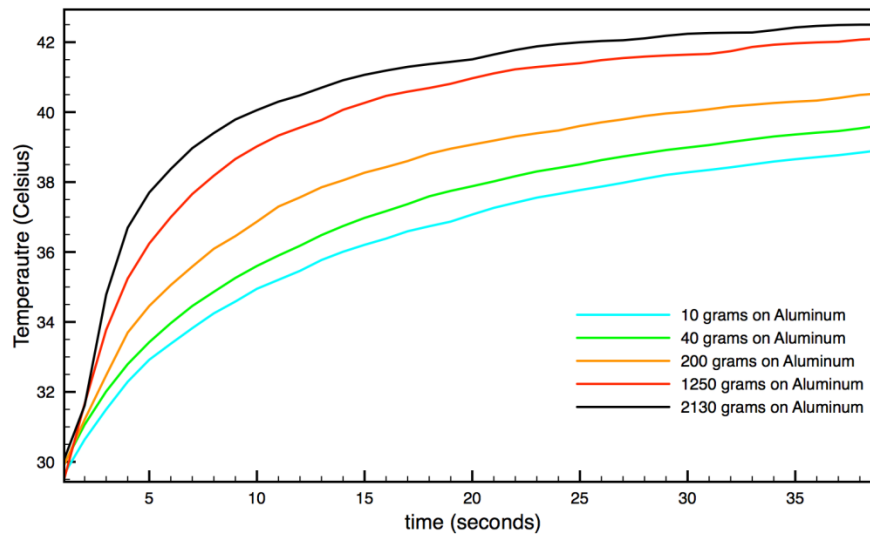


Testing Composite Thermal Response: Copper + ABS 44 Surface VS 32.5 Test Surface



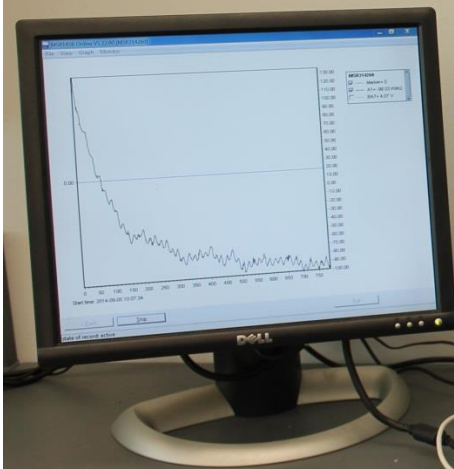
Contact Resistances and the Transient Thermal Response

Setpoint at $T = 42^{\circ}\text{C}$



Complete System

- Heat Flux Readout



- PID Control
- Data Logging



- Automated Instrument

