

Study of High-Temperature Carbon Nanotube Yarn Sensor

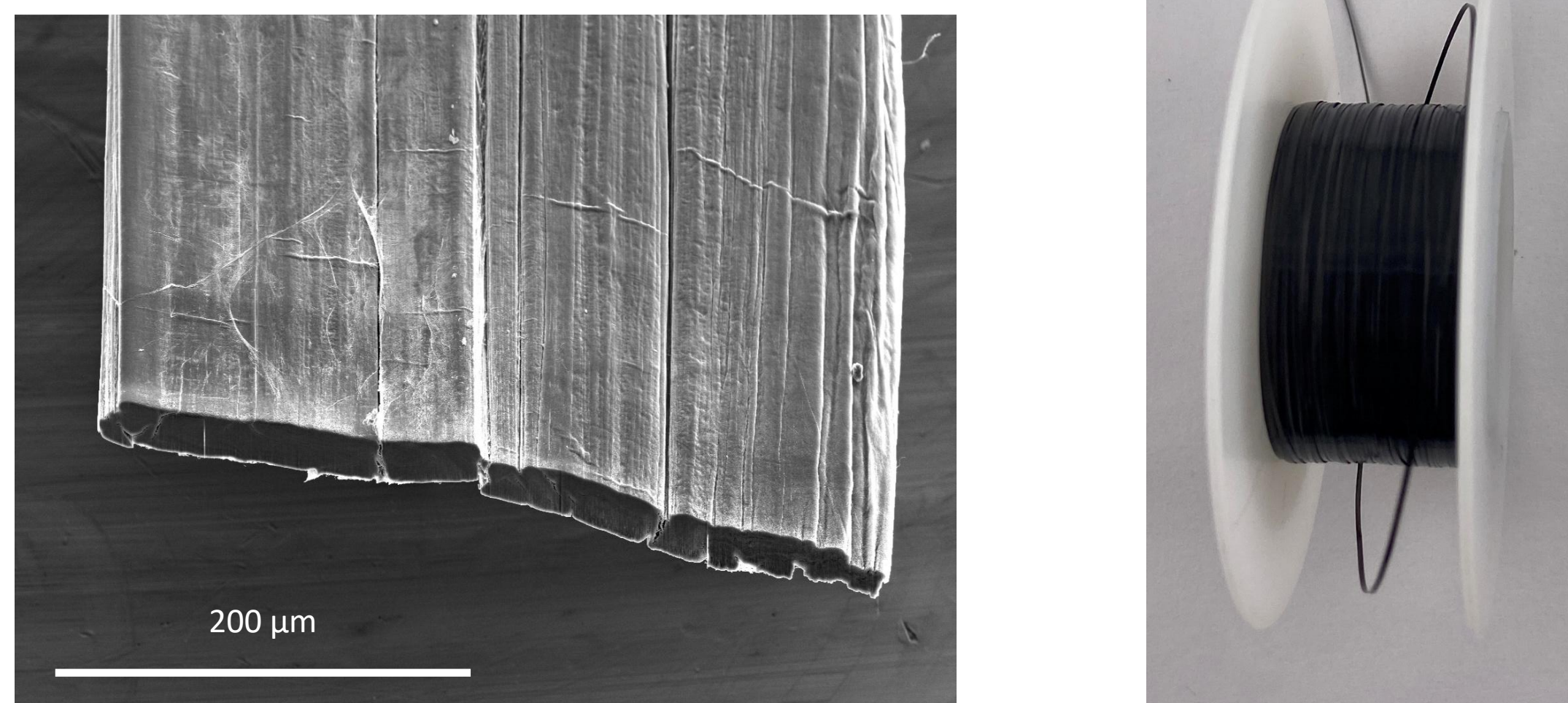


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Mentored by Dr. Liang, Dr. Evers,
Dr. Gibson, and Dr. DeGraff



Introduction

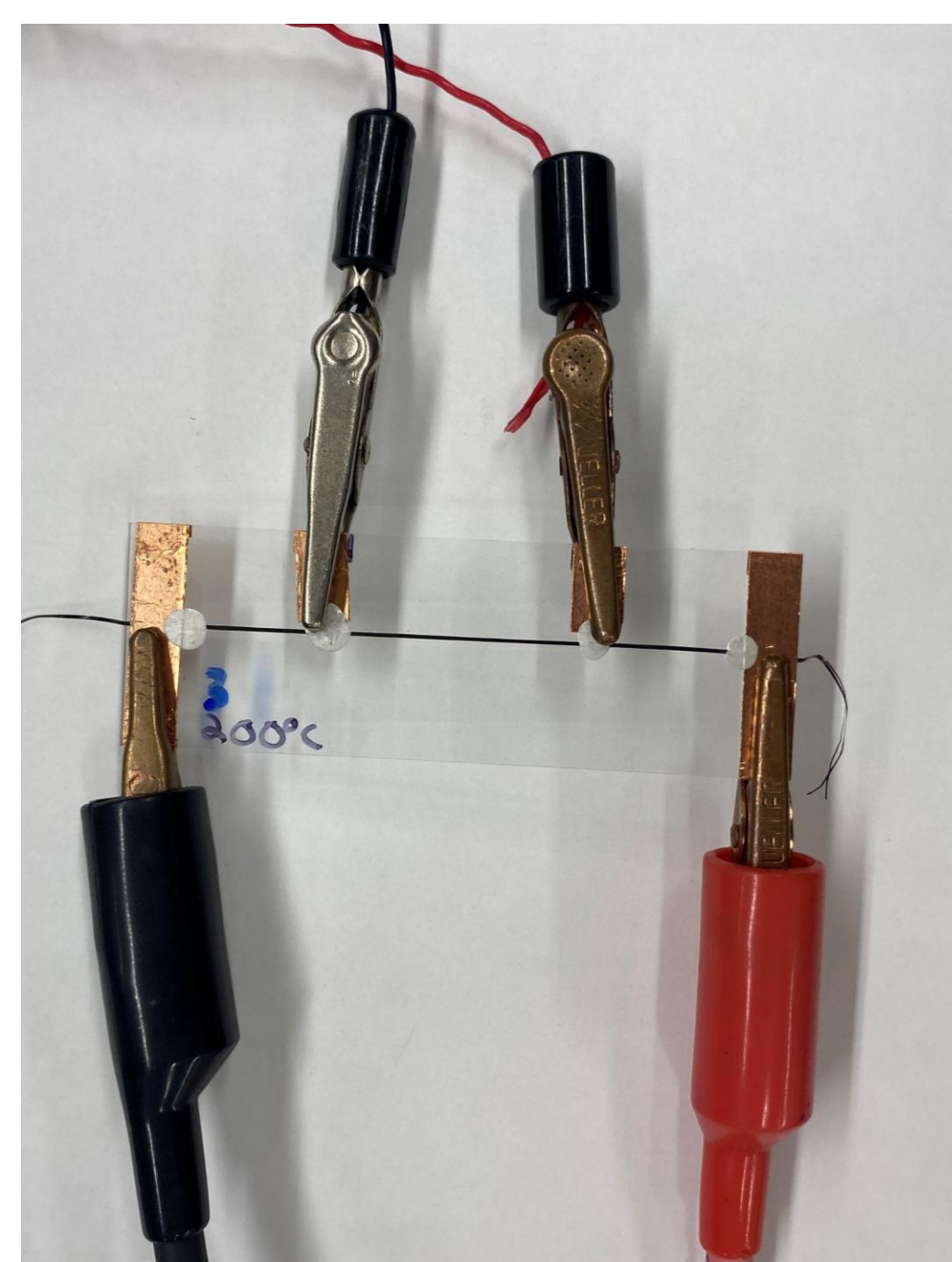
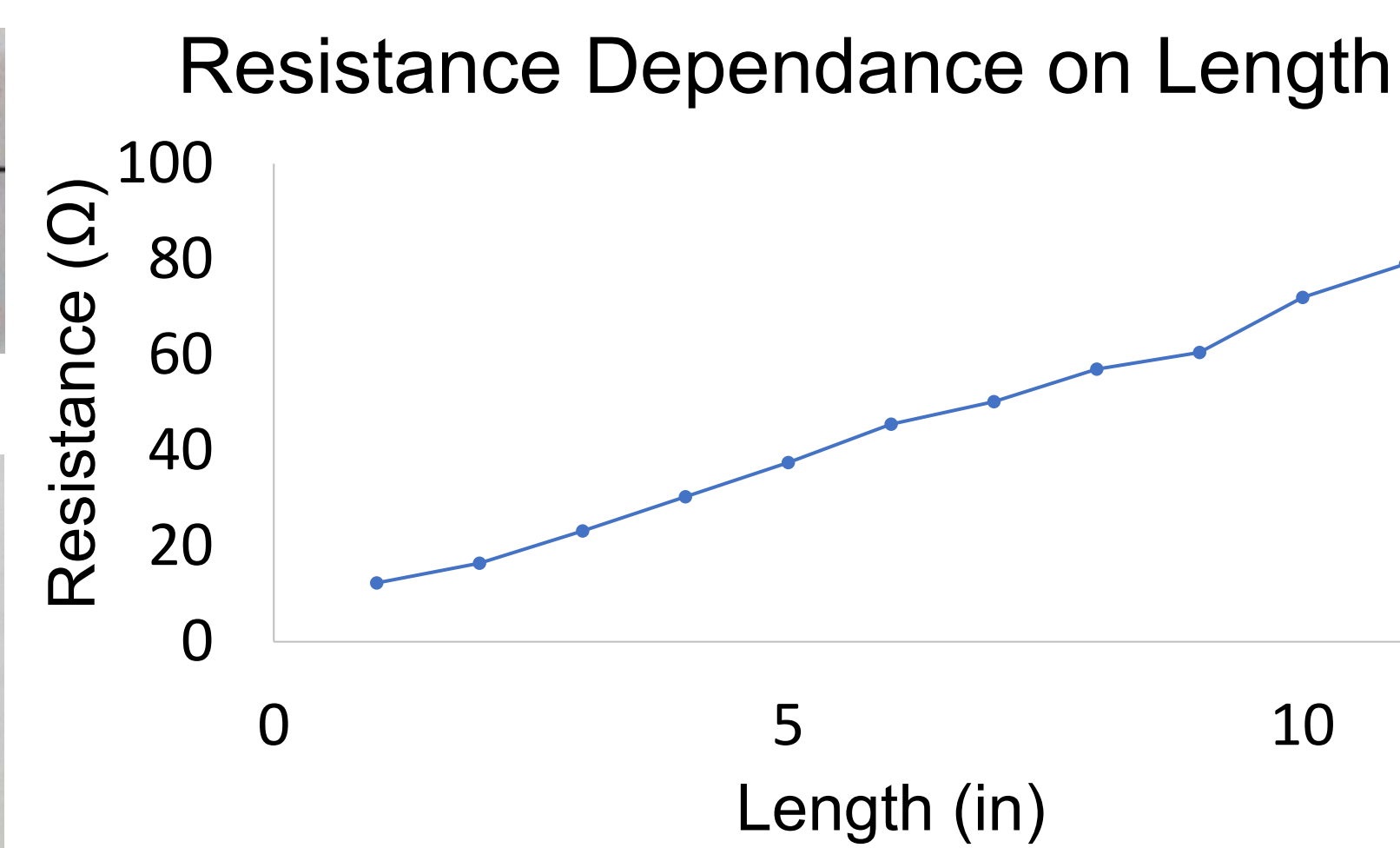
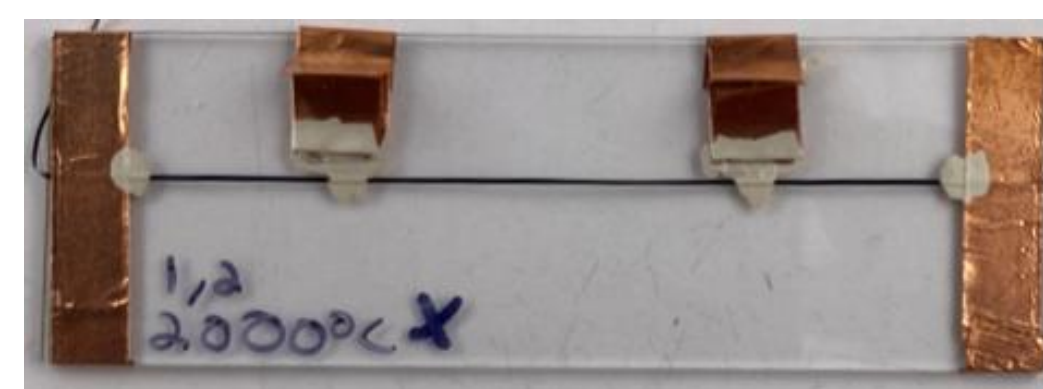
- Carbon Nanotube Yarns (CNTY) show piezoresistive effects
- CNTY to be utilized as high temperature multifunctional sensors
- Amorphous polymer, moisture, residual iron catalyst, and CNTs are present in CNTY's
- This research focuses on utilizing CNTY as high-temperature sensors



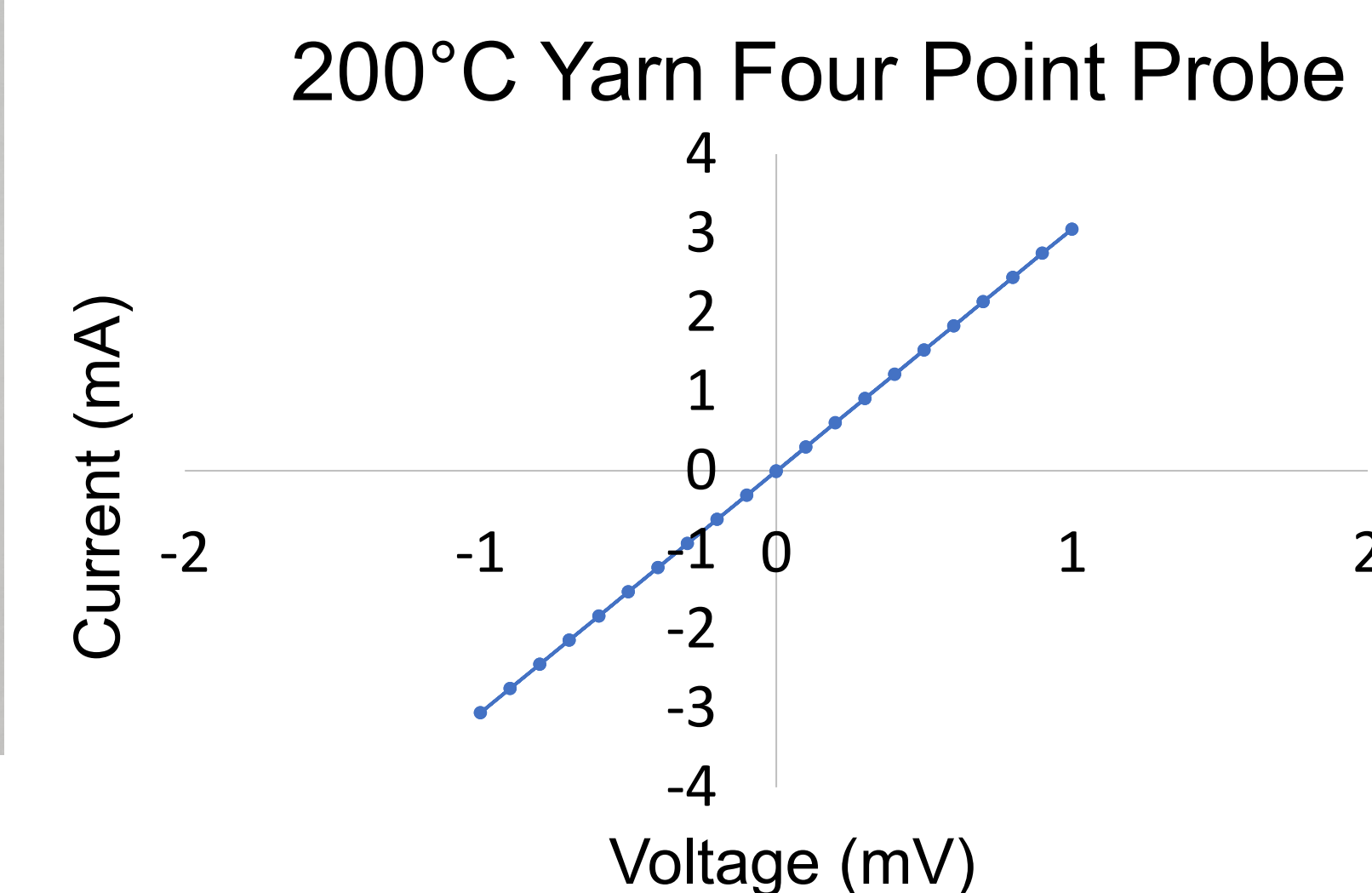
Microscope Image of CNTY and Spool of CNTY

Electrical Testing

- Four point probe eliminates contact resistance, and variance in length



Four Point Probe Set Up

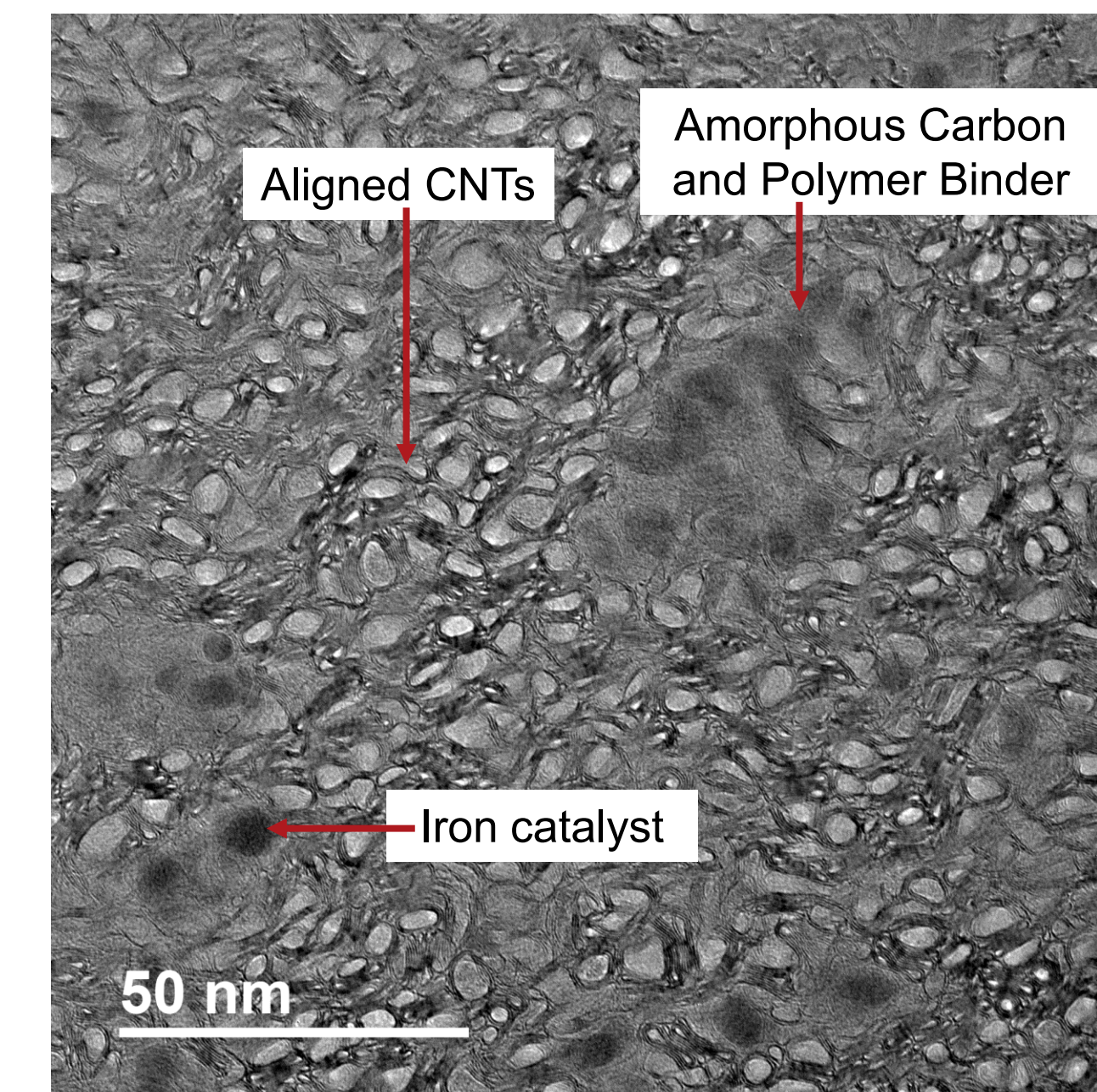


Acknowledgments

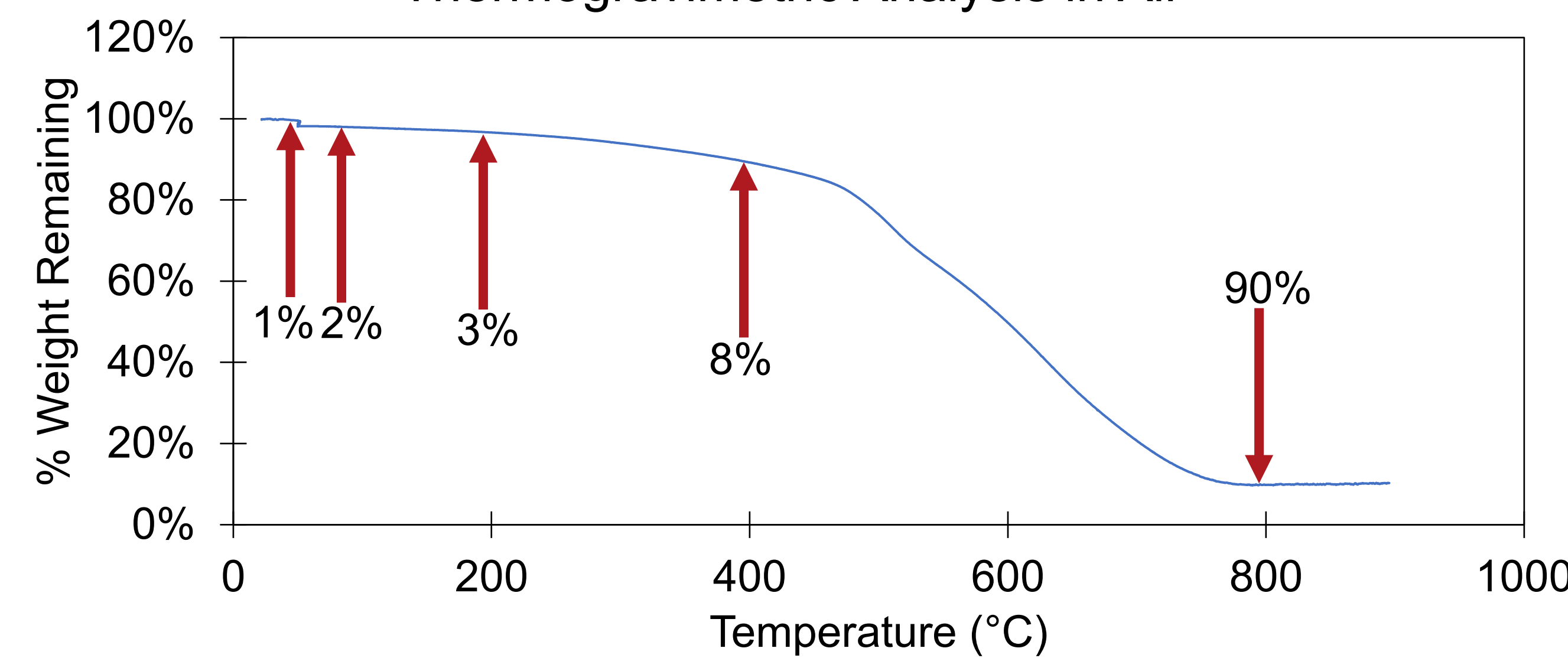
Thank you, Dr. Cecil Evers, Dr. Richard Liang, Dr. Joshua DeGraff, and Dr. Murray Gibson
Composites Part B: Engineering, 280, 111465.
<https://doi.org/10.1016/j.compositesb.2024.111465>

Thermal processing

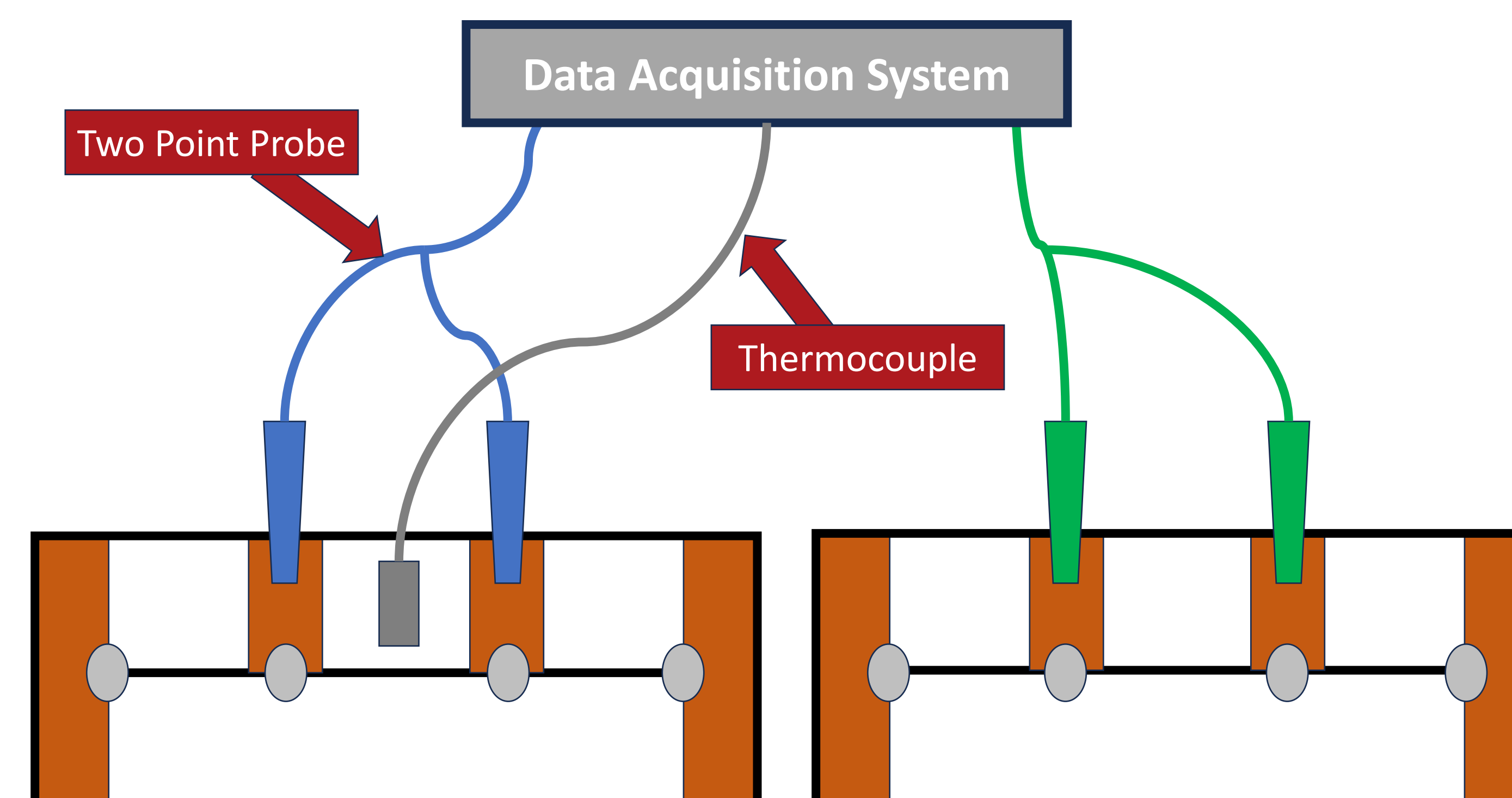
- Type K thermocouple used as yarns were heated to 200°C at 400RPM
- Two point probe connected two yarns to the Data acquisition system
- Additional copper contacts were attached to samples



Thermogravimetric Analysis in Air

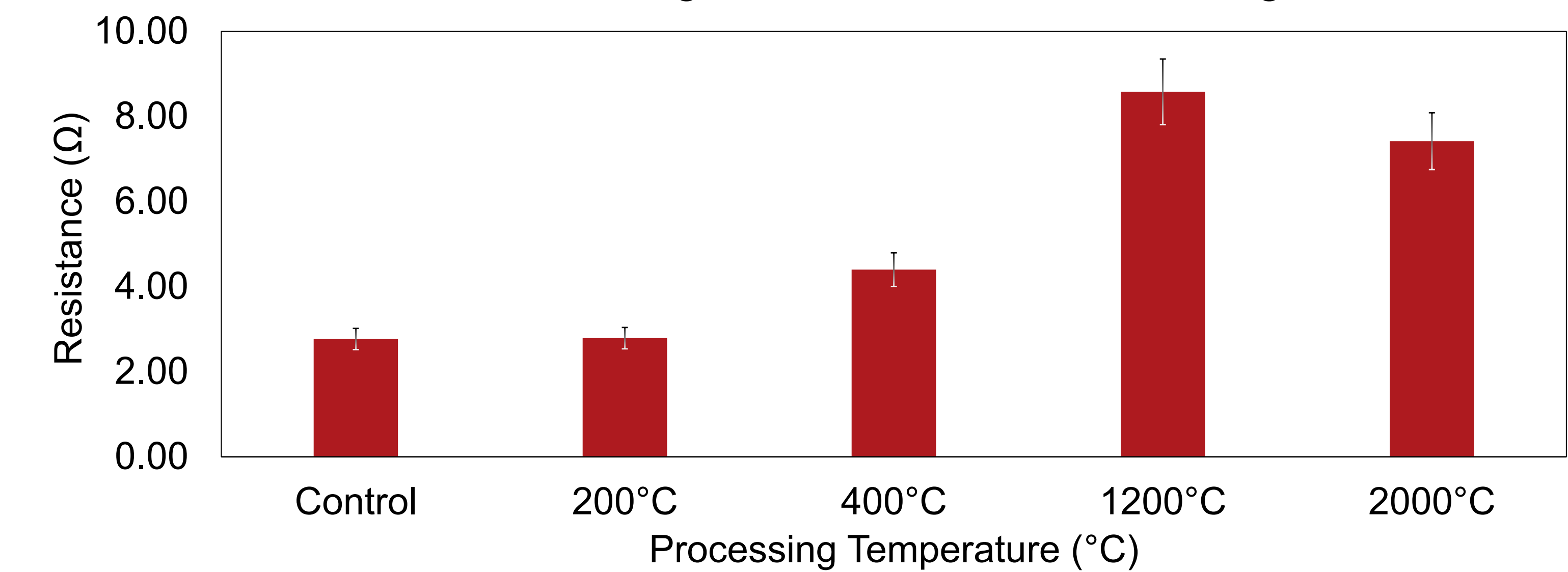


Temperature	Purpose
100°C	Eliminate Moisture
200°C	Glass Fiber Composite Curing
400°C (in Vacuum)	Eliminate Amorphous Polymer
1200°C (in Vacuum)	Leaves only CNT's
2000°C (in Vacuum)	Improves Alignment of CNT's

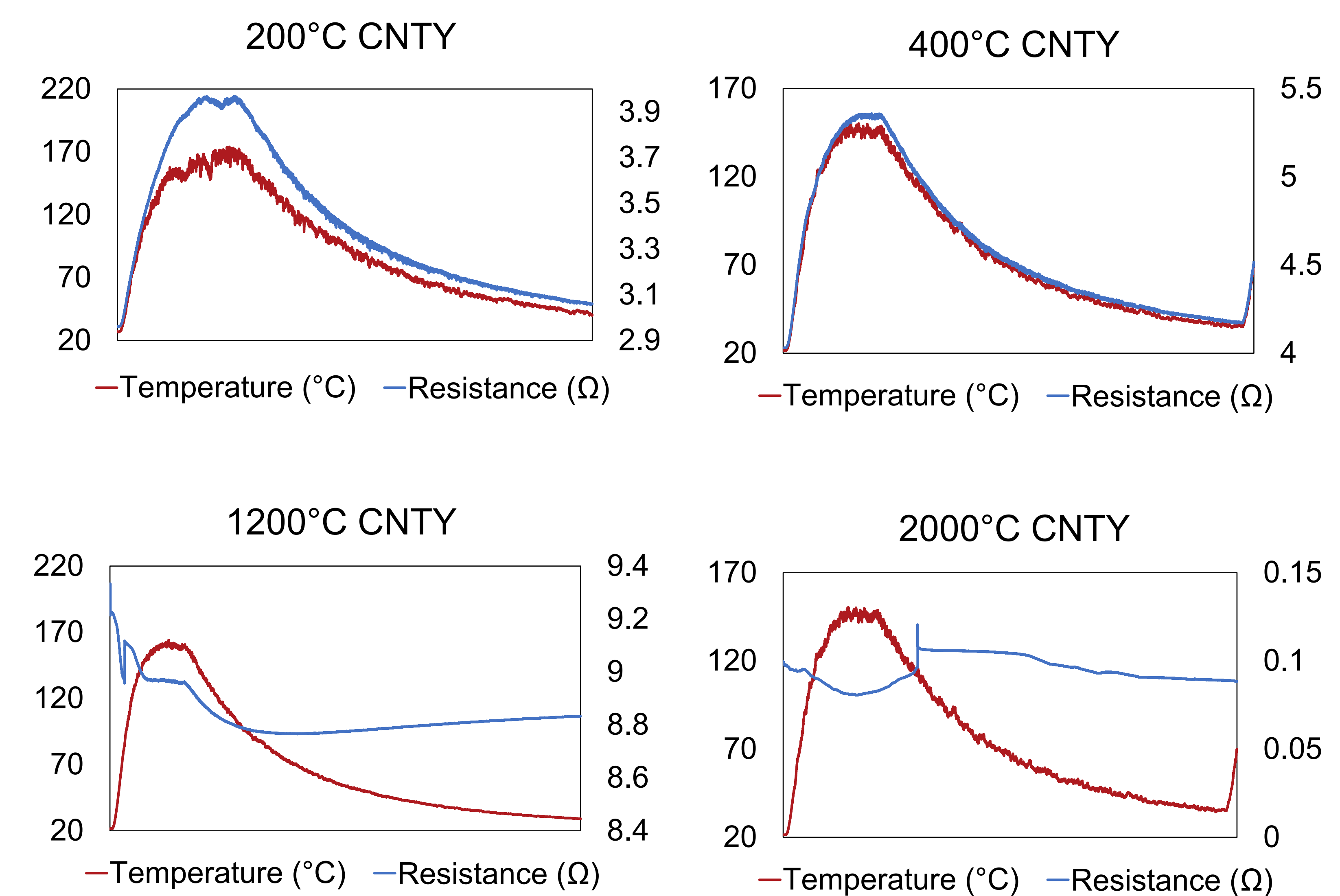


Results

Resistance Change due to Thermal Processing



Resistance Changes with Temperature



Conclusion

- 200°C and 400°C CNTY respond consistently to temperature changes
- 1200°C CNTY show significant drop in resistance before increasing with thermocouple
- Highly aligned CNTYs after graphitization show little change due to temperature
- **Application of Carbon Nanotubes as Temperature Sensors**