Establishing a Testing Method for a Microscale Graphene-Coated Copper Wire

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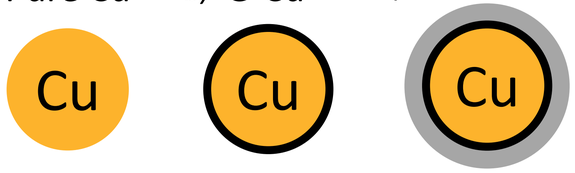
Objective

Determine and implement an improved testing method to characterize the thermo-electrical properties of microscale graphene-coated copper wire.

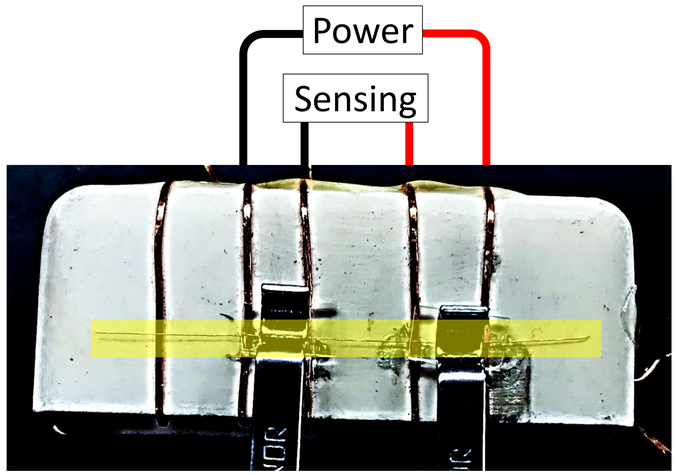
Motivation

- Layering microscale copper wire with an **axially-continuous graphene coating** can improve current carrying capacity, electrical and thermal conductivity, and oxidation and corrosion resistance.
- Added as an **insulating layer** between a central copper wire and a nickel outer layer, graphene can prevent the alloying and diffusion of the two metals, increasing the usable application temperature.
- Characterizing the thermo-electrical properties of these wires requires a **consistent and accurate method to record data**.

a) Pure Cu *b)* G-Cu *c)* Ni-G-Cu



Wire Configurations with G=graphene (Cross Sectional View)



Wire Sample Mounted with 4-Point Probe Measurement

Methodology

Requirements and available equipment were determined and options for a new test method investigated.

Requirements

- Must apply constant voltage and increasing current until test article failure.
- Must document current, voltage, and time data.
- Prefer method that does not require adding a PC to the existing test setup.

Available Instrumentation

- Keithley 2260B-30-72 720W power supply
- Keithley DMM6500 6 1/2 digit multimeter
- Keithley 2450 SourceMeter

Outcome

- Test functions written in Test Script Processor (TSP) are **executed from a USB drive** on the 2450 SourceMeter.
- Current (limited to maximum 1A), voltage, and time are measured by the 2450 and written to the USB drive.
- Power is supplied by the 2260B-30-72 commanded by the 2450 via TSPNet LAN commands.
- **A PC is not required to run test sequences**, although TSP functions can be modified on a computer before being uploaded to the USB drive.

2450 SourceMeter and 2260B-30-72 Power Supply Required for New Test Method

Future Work

- Complete TSP function programming and testing with instruments.
- Create and document a method to generate new functions as needed.

References
[1] H. Kashani, C. Kim, K. Perkins, and W. Kang. An Axially Continuous Graphene-Copper Wire for High Power Transmission: Thermo-electrical characterization and mechanisms, (Journal manuscript in progress).

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