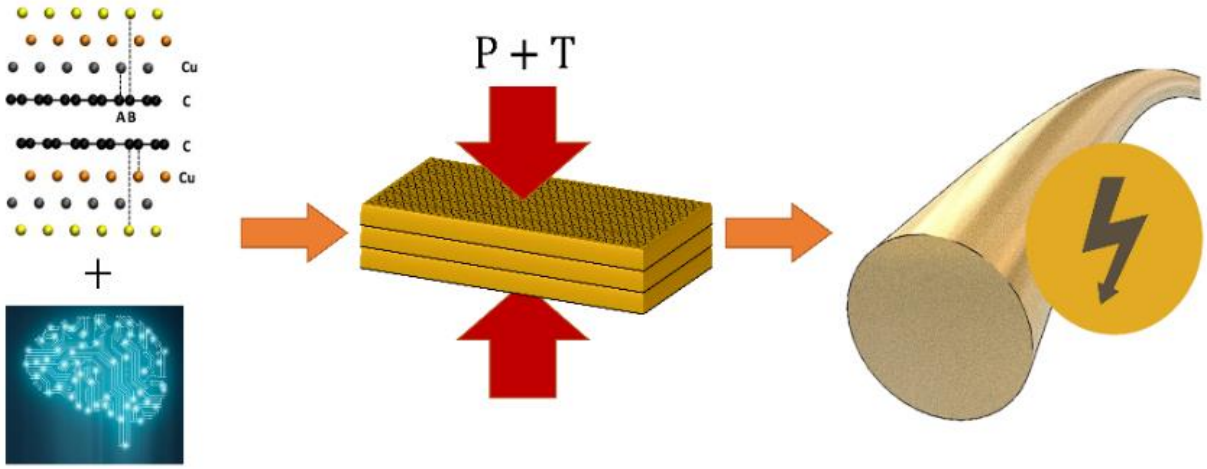
Ultra-Conductive Copper Wires for Lunar HVPT

PI: Mehran Tehrani, University of Texas at Austin
Co-PI: Michael Cullinan, University of Texas at Austin
Co-PI: Ivana Gonzales, University of New Mexico



Research Objectives

- Objective: design, manufacture, and characterize ultra-conducting graphene-copper wires for high voltage applications.
- Innovations: design of novel ultra-conductors using atomistic simulations and machine learning, fabrication and characterization of the designed multi-layered nanostructures, and their assessment for lunar applications.
- State-of-the-art advanced electrical conductors are only a few percentages more conductive than copper. This project aims to fabricate copper-graphene ultra-conductors that significantly outperform copper's specific conductivity.
- The proposed project is currently at a TRL2 and will transition to a TRL3 upon completion.

Approach

We will conduct powerful atomistic simulations coupled with machine learning algorithms to design copper-graphene structures that demonstrate ultra-conductivity. The theoretically designed structures will be fabricated, processed into a wire form, and characterized under a lunar-relevant environment for high voltage power transmission (HVPT). As such, we will assess the performance and aging of the fabricated wires under high voltages, thermal vacuum cycling, and high-energy radiation. Finally, the proposed tasks will measure the mechanical and electrical properties of the copper-graphene conductors and correlate these properties to their processing and structure, paving the way for their scalable manufacturing.

Potential Impact

The higher electrical conductivity of the proposed copper-graphene materials, compared with copper, translates directly to a lower HVPT cable weight or decreased electricity waste, potentially reducing resistive losses or weight by 3-4 times. Developing ultra-conductors is of utmost importance for all NASA missions where weight and energy savings are at a premium, specifically for a sustained human presence on the moon. Owing to graphene's exceptional properties, compared with copper, the proposed graphene-copper composites will be more radiation-resistant, and their performance and integrity less affected by the extreme lunar temperature fluctuations.