Lightweight, Multifunctional Nanocomposites for High-Voltage Insulation on the Moon

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Research Objectives

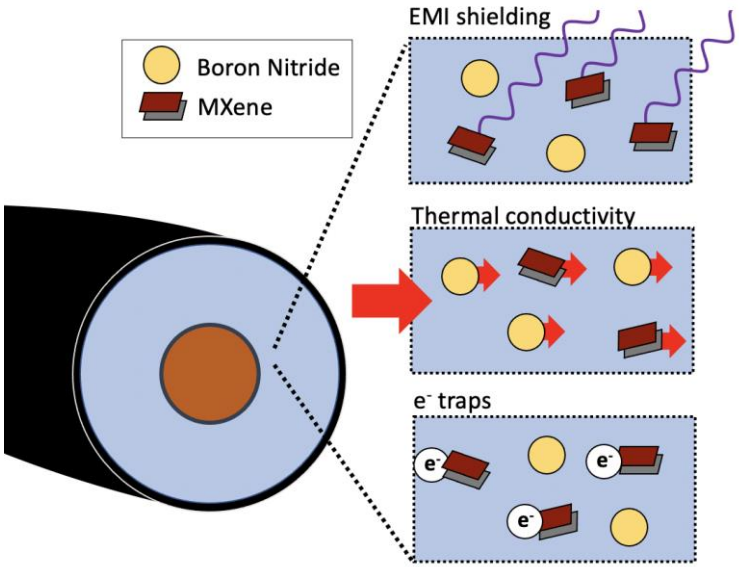
Create multifunctional nanocomposites with improved thermal conductivity, dielectric strength, EMI shielding, and mechanical durability in relation to current state of the art

Objective 1: Study BN fillers for thermal conductivity and dielectric strength

Objective 2: Study Mxene fillers for EMI shielding and dielectric strength

Objective 3: Investigate combining BN and MXene fillers for multi-functionality

Advance from TRL 1 to TRL 3



These nanocomposites will have improved electromagnetic interference (EMI) shielding, thermal conductivity, and dielectric strength for use in high voltage power transmission (HVPT) cables. This multifunctionality will be given by the addition of BN and MXene nanofillers.

Approach

Using both molecular dynamics simulations and experiments, probe thermal conductivity, dielectric constant, EMI shielding effectiveness, breakdown strength and Young's modulus of:

(1) BN-filled nanocomposites

(2) MXene-filled nanocomposites

(3) Combinations of BN and MXene-filled nanocomposites

Potential Impact

Development of lightweight and robust nanocomposites that function as both insulation and shielding for HVPT cables on the Moon

Improved properties enable a higher efficiency lunar grid with extended cable lifetime and potentially recyclable insulation

Transferable research means possibilities for use in high voltage applications on Earth that would benefit from increased efficiency and protection from extreme conditions, such as transmission from renewable energy sources

Polymers with high dielectric strength and EMI shielding can also find uses in microelectronics