Title and Research Team

Title: Three-dimensional Hierarchical Structures as Multi-layer Insulation for Terrestrial and Space Applications

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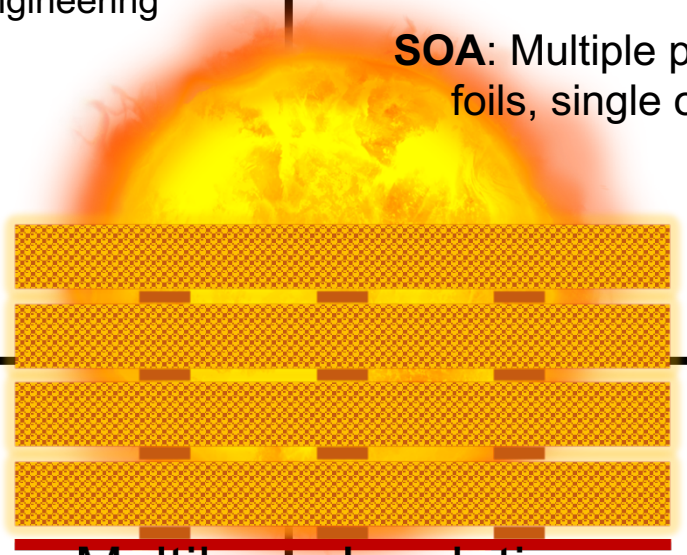
Research Objectives

Overall Goal: Design and manufacture three-dimensional hierarchical structures (3DHS) using scalable fabrication techniques

Innovation: Tailor geometry at the micro/nanoscale to obtain the desired optical response, thermal insulation, mechanical strength and electrical conductance

SOA: Multiple pairs of reflectors and spacers made of aluminum foils, single or double-aluminized Mylar or Kapton sheets that provide insufficient thermal insulation

- Start TRL: 1
- End TRL: 3



Approach

- **Computationally analyze** propagation of electromagnetic radiation, heat diffusion, and overall insulation performance of multi-layered insulation (MLI).
- **Fabricate MLI** using electrospinning, micro- and nano-imprinting, and self-assembly techniques
- **Experimentally characterize** the performance of the MLI by obtaining radiative properties, overall insulation performance, and characterize the mechanical, draping and electrical properties.

Potential Impact

Benefits to Space Science and Technology:

- Significantly improve the thermal insulation performance
- Provide freeze-protection for electronic systems in space
- Provide insulation for cryogenic systems enabling space exploration

Other Benefits:

- Control liquid-vapor phase change to improve the performance of thermal power plants and electronic cooling technologies
- Oil-water separation, seawater desalination, food processing, heat recovery, biomedical applications, optics, photonics, and energy storage