# Title: Developing Oxychalcogenide Membranes for Superconducting Power Transmission

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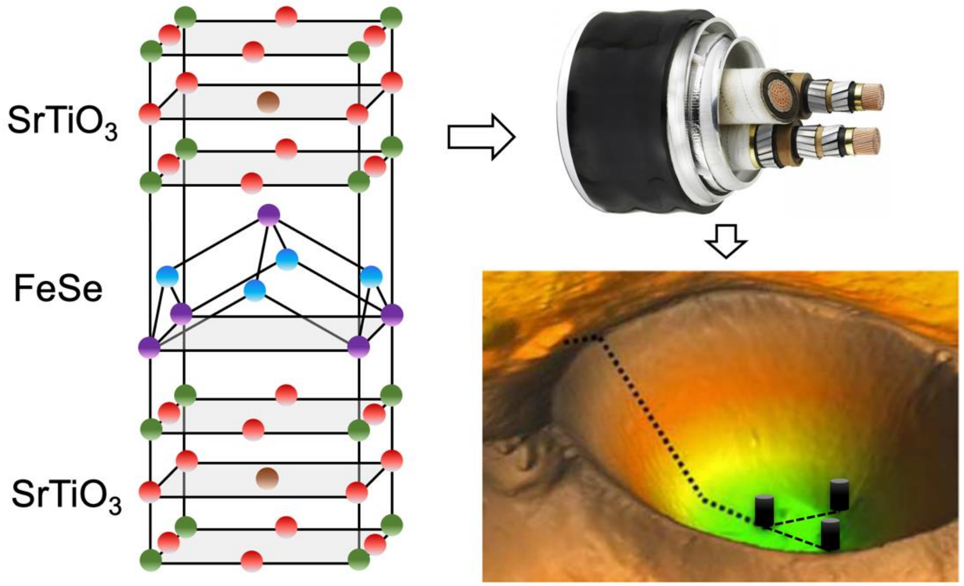
## Research Objectives

- *Goal:* Fabricate oxychalcogenide high-temperature superconducting (HTS) membranes for power transmission in permanently shadowed regions near the lunar south pole.
- *Innovation:* Leverage the PI's newest developments in interfacial high-temperature superconductors, $FeSe/SrTiO_3$, and fabricate monolayer $FeSe/SrTiO_3$, superlattices, and proof-of-concept cables.
- *SOA:* Copper-oxide-based HTS materials have high $T_c$'s, but are harmed by the anisotropic critical current and the challenge of obtaining rare earth dopants.
- *TRL:* Start with PI's prior fundamental research at TRL 1-2, building through systematic material innovation to achieve lab-based proof-of-concept at TRL 3.

## Approach

- Employ PI's molecular beam epitaxy setup to fabricate high temperature interfacial superconductors, $FeSe/SrTiO_3$.
- Fabricate $SrTiO_3$ membranes using the combination of a soluble-layer approach and remote epitaxy.
- Fabricate $(FeSe/SrTiO_3)_n$ superlattice membranes to achieve high critical current density ~ $10^6$ A/cm$^2$.
- Fabricate $(FeSe/SrTiO_3)_n$ superlattice membranes onto rolling-assisted biaxially textured substrates, with the ultimate reach goal of a 1-meter-long superconducting cable.




Developing $FeSe/SrTiO_3$ membranes as a material platform for superconducting power transmission near lunar stations.

## Potential Impact

- Unlock new material potentials to enable sufficient power transmission for labs, sensors, rover vehicles and other work stations near a lunar base (addressing NASA shortfalls 1592 and 1597).
- Enable new modalities for powering manned and un-manned missions to exploit the frozen water in the permanently shadowed regions.
- Advance fundamental scientific research on novel high-temperature superconducting membranes
- Initiate efforts in utilizing interfacial high-temperature superconductors for realistic power transmission lines.
- Train the future material engineering workforce for space missions.