Contribution ID: **590** Type: **Invited Oral**

M1Or2D-01: [Invited] Terahertz spectroscopy on topological superconductor thin films and heterostructures

Monday 10 July 2023 11:00 (30 minutes)

The AC conduction of superconducting heterostructures of SmB6/YB6 are investigated via time domain terahertz spectroscopy[1]. A two-channel model of thickness-dependent bulk states and thickness-independent surface states accurately describes the measured conductance of bare SmB6 thin films, demonstrating the presence of surface states in SmB6. While the observed reductions in the simultaneously-measured superconducting gap, transition temperature, and superfluid density of SmB6/YB6 heterostructures relative to bare YB6 indicate the penetration of proximity-induced superconductivity into the SmB6 overlayer; the corresponding SmB6-thickness independence between different heterostructures indicates that the induced superconductivity is predominantly confined to the interface surface state of the SmB6.Our results show that SmB6 behaves as a predominantly insulating bulk surrounded by conducting surface states in both the normal and induced-superconducting states in both terahertz and DC responses, which is consistent with the topological Kondo insulator picture. In the second part, I will present the observation of a gapless superconducting state in Fe(Te,Se) epitaxial thin films and in Fe(Te,Se) heterostructures with Bi2Te3 and MnTe grown by hybrid symmetry epitaxy. Clear $1/\omega$ behavior arises in the imaginary conductance below the superconducting transition; however, there is no concomitant suppression of the real conductance, indicating a gapless superconducting state. Furthermore, a sharp, low-frequency peak in the real conductance emerges alongside the superconductivity. We model these anomalous features of the superconducting state to determine the origin of this novel behavior.

References:[1] Phys. Rev. Lett. 130, 096901 (2023).

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Session Classification: M1Or2D: Special Session: Topological Materials for Electronics II