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M2Or1C-02: [Invited] Magnetotransport Studies of Alpha-Sn and Topological Heterostructures

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Topological materials have signature electronic states with high intrinsic mobility due to their symmetry-protected quantum channels. The large spin orbit coupling in narrow bandgap alpha-Sn provides a fruitful playground for basic research in topological electronics through exploration of its various electronic dimensionalities including 3D topological insulator and Dirac semimetal phases. Overcoming fabrication challenges associated with the low temperature phase of tin, we present a comprehensive union of experimental and theoretical descriptions of the magnetoelectric transport in this material and its band structure [2]. We address various complexities that showcase the rich physics present in gray tin and in topological insulators and Dirac semimetals in general [3]. In addition, we explore topological heterostructures with magnetic materials in order to interact directly with the unique spin textures present in topological materials. Thin film parameters such as strain, interface sharpness, thickness, and doping profiles play vital roles in determining the resulting electronic behavior of these materials. Magnetotransport measurements provide evidence to support our theoretical model using magnetic and electric fields at varying temperatures and geometries as experimental knobs. We reveal quantum oscillations, charge neutrality point behavior, and various Hall effects that paint a picture of the diverse and elegant transport physics in gray tin and topological heterostructures.

Primary author: VAIL, Owen

Co-authors: Dr ECKBERG, Chris (University of California, Los Angeles); Dr DE COSTER, George (Army Research Lab); Dr FOLKES, Patrick (Army Research Lab); Dr TAYLOR, Patrick (Army Research Lab)

Presenter: VAIL, Owen

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