

## Workshop on Quantum Materials Epitaxy

### Room Ballroom A - Session QME-SuM2

#### Topological and Magnetic Materials II

**Moderator:** Prof. Chris Palmstrøm, University of California, Santa Barbara

10:30am **QME-SuM2-9 Molecular Beam Epitaxy of Topological Semimetal Heterostructures**, *Nitin Samarth*, Penn State University **INVITED**

The landscape of topological quantum materials has expanded greatly with the discovery of topological Dirac states in both the bulk and surface of certain semimetals. This talk provides an overview of the synthesis by molecular beam epitaxy (MBE) of topological semimetal thin films ( $\text{Cd}_3\text{As}_2$  [1],  $\text{ZrTe}_2$  [2], TaAs [3], NbAs [4] and their characterization using x-ray diffraction, angle resolved photoemission spectroscopy, and quantum transport. The potential application of these films for spintronics is studied by measuring spin to charge interconversion after interfacing them with conventional metallic ferromagnets (permalloy) or two dimensional ferromagnets ( $\text{CrTe}_2$ ).

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1. W. Yanez *et al.*, *Phys. Rev. Applied* **16**, 054031 (2021).
2. Y. Ou *et al.*, *Nat. Commun.* **13**, 2972 (2022).
3. R. Xiao *et al.*, *Phys. Rev. B* **106**, L201101 (2022).
4. W. Yanez *et al.*, *Phys. Rev. Applied* **18**, 054004 (2022).

11:00am **QME-SuM2-11 Controlling Magnetism in Layered Quantum Materials Through Designer Defects**, *Matthew Brahlek*, Oak Ridge National Laboratory **INVITED**

Understanding how functional phenomena can be modified in epitaxial thin films is crucial for designing and manipulating properties. In this talk I will discuss several interesting examples where novel routes to control magnetic properties arose from understanding why defects form and ultimately how to control their formation. I will discuss the large electronic and magnetic response that is induced in the layered magnetic topological insulator  $\text{MnBi}_2\text{Te}_4$  by controlling the propagation of surface oxidation as well as native defects imparted during synthesis. I will also discuss how ferromagnetism can be externally turned on with a high level of continuous control through the application of low energy helium implantation in the ultra-high conductivity, non-magnetic layered oxide  $\text{PdCoO}_2$ . These two examples highlight how a detailed understanding of synthesis by molecular beam epitaxy is critical to understanding and designing properties which is critical to driving new applications.

11:30am **QME-SuM2-13 Epitaxy of Rare Earth Compounds on Atomically Flat Surfaces**, *Joseph Falson*, Caltech **INVITED**

In this presentation I will discuss the epitaxy of oxides and chalcogenides on atomically flat crystalline surfaces generated by high temperature laser annealing. In the case of rare-earth tellurides, we can induce large amounts of epitaxial strain and relieve this by tuning the thickness of films one monolayer at a time. Furthermore, I will discuss the role of laser heating in stabilizing off-stoichiometric oxide films. Finally, I will discuss ongoing efforts to reduce the residual impurity concentrations in ZnO-based heterostructures, where we expect laser heating to play a key role.

12:00pm **QME-SuM2-15 Reactive Force Field Simulations as Versatile Tool to Explore the Growth Kinetics in Molecular Beam Epitaxy of Quantum Materials at the Atomic Scale**, *Roman Engel-Herbert*, Paul Drude Institute, Germany **INVITED**

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