**Topological Materials Synthesis and Device Applications**

Topological materials such as topological insulators (TIs) and Dirac and Weyl semimetals are an emergent class of quantum materials whose properties are protected by symmetry and topology of the bulk band structures.  Therefore, these properties are robust against scattering, leading to near dissipationless carrier transport. For example, in topological insulators, the timer-reversal symmetry protected surface states exhibit spin-momentum locking where the electron spin is locked to momentum, and hence an unpolarized charge current creates a spontaneous spin polarization.

The goals of this program is to synthesize topological materials by molecular beam epitaxy and metal organic chemical vapor deposition, and their heterostructures with magnetic materials, to demonstrate control and manipulations of spin and charge transport through electrical and optical means. Of particular interests are the exploration of device applications such as nonvolatile magnetic topological memory that utilize the current generated spins in TI to switch the magnetization of a ferromagnet via spin orbit torque.  Physical processes such as spin transport at heterointerfaces and spin dynamics will be investigated to optimize efficiency and demonstrate prototype devices that are relevant in next generation low power electronics and spintronics, information processing, and in-logic memory.

Extensive facilities exist for epitaxial growth, transport, magneto-optical studies, structural/magnetic characterization, and class 100 cleanroom for nanofabrication.

**Reference:**

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Key words:
Topological insulator, Dirac semimetal, Weyl semimetal, spintronics, spin-momentum locking, spin transport, molecular beam epitaxy, metalorganic chemical vapor deposition