"Charge-to-spin conversion and spin-orbit torques in MBE-grown quantum materials"

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Monday, February 12th, 2024 at 4:00pm

Hammond Auditorium (Engineering 120)

Abstract

The demonstration of current-induced spin-orbit torques (SOTs) in heavy metal thin films has provided exciting new ways to harness spin-charge conversion at the device level for the next-generation magnetic-based memory technology. While the targeted material systems are prepared mainly by sputtering in SOT studies, epitaxial quantum materials have still been largely unexplored in this context. In this talk, I will present our recent research on the SOT phenomena in quantum material heterostructures grown via molecular beam epitaxy.

In the first part, I will discuss the charge-to-spin conversion in topological materials [1-3], including the topological insulator BiSb alloy and the topological semimetals. We show that the topological material heterostructures enable unique pathways to test fundamental scientific concepts, such as the bulk-boundary correspondence, in the context of spintronics. We also show that the complicated SOT phenomena in the topological semimetals depend strongly on whether the semimetals are in a pristine or naturally oxidized state.

In the second part of my talk, I will report the synthesis and characterizations of a full van der Waals epitaxial heterostructure consisting of a Dirac semimetal, ZrTe$_2$, and a two-dimensional ferromagnet, CrTe$_2$ [4]. We observe robust ferromagnetism in CrTe$_2$ thin films down to one-unit-cell thickness. Furthermore, anomalous Hall measurements suggest the existence of chiral magnetic structures in thicker CrTe$_2$ films. Finally, we demonstrate SOT-assisted magnetization switching in the CrTe$_2$ via the current-induced spin-torques from ZrTe$_2$.


Biography

Dr. Yongxi Ou received his PhD in physics from Cornell University in 2018. After that, he joined Prof. Nitin Samarth’s group at Pennsylvania State University as a postdoctoral researcher and then became a research assistant professor in the Department of Physics. His research interests include the study of spin-orbit interactions and spin-orbit torque phenomena in heavy metal thin films deposited via sputtering technique, as well as in quantum and low dimensional material heterostructures grown via molecular beam epitaxy.