DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,

Candidacy Exam Presentation

Date & Time: 17th December 2021, 11:00 am
Where: https://drexel.zoom.us/j/84147357207

Novel spin-orbit-torques in topological materials and their use in spintronics

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Abstract:

For over 60 years, computation power of silicon-based processors has increased in accordance with Moore's Law, but we are fast approaching the physical limit of how many transistors can be packed on a chip. Spintronics (*neologism for "spin transport electronics"*) promises to offer a solution and revolutionize the electronics industry by coupling the spin degree-of-freedom and charge transport properties of electrons. Spintronic devices can also bridge the speed gap between secondary nonvolatile storage units such as HDD and SSD (10 ms) and primary volatile memory units such as RAM and DRAM (100 ns) while maintaining the nonvolatility of the former. This presentation explores the mechanisms involved in manipulation of spin and charge current in spintronic devices: spin-transfer-torque – the spin-momentum transfer caused by interaction of polarized electrons in magnetic tunnel junctions, and spin-orbit-torque (SOT) – the relativistic coupling of spin and orbital momenta in a lattice. The physical phenomena, like spin Hall effect and Rashba-Edelstein effect, that help understand SOTs in thin films will be further examined. I will also survey the material systems that efficiently support SOTs and show why topological materials such as topological insulators, Weyl semimetals, and Dirac semimetals, owing to their exotic electronic properties, perform much better than traditional heavy metals.