PHY 6938 Experimental Materials Physics

Tentative Syllabus for Spring 2025

Class meeting time: MW 12:30pm-1:45pm

Pre-requisite: Solid State Physics 1 (PHZ 5405) or similar background

Course material: There is no specific textbook, course material will be made available on Canvas.

Assignments: Regular (close to weekly) homework assignments, which includes problems as well as discussions of journal articles.

Grades: 100% Homework. Letter Grade (S/U grade, optional)

Synopsis:

Building on concepts in Solid State Physics this course explores experimental methods that help us to understand real materials in single crystal or thin film forms. This includes extended- and defect-structures, electronic properties, and surface/interface modifications.

This course will touch on the following (not necessarily in this order):

Materials synthesis: Epitaxial films, heterostructures, and low dimensional materials- mostly by molecular beam epitaxy

Structure: X-ray and electron diffraction methods

Compositional and chemical analysis: Ion scattering spectroscopy (Rutherford backscattering), Auger spectroscopy, x-ray photoemission spectroscopy, x-ray absorption spectroscopy, Moessbauer spectroscopy.

Defects: Positron annihilation, dislocations and mechanical properties.

Electronic structure: Fermi-surface mapping by de Haas van Alphen effect and angle resolved photoemission spectroscopy. Relationship between Fermi-surface and alloy structures in electronic phases. Electronic properties of graphene and carbon nanotubes.

Surface and interface properties: Surface structure, work function, electronic surface states, Fermi-level pinning and interface states.