In-situ and ex-situ ellipsometry characterization of thin films

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Course Objectives
• Understand the rationale for application of ellipsometry for thin film materials characterization.
• Learn the fundamentals of ellipsometry by theory and applications.
• Understand data fitting and error evaluation.
• Develop strategies for ellipsometry measurement and data analysis.
• Apply in-situ and ex-situ ellipsometry for thin film device characterization.

Course Description
This course will begin with the plane wave concept in linear optics and the use of polarization to investigate physical and structural properties of thin film materials in a technique termed ellipsometry. Principles of physical optics connecting optical properties of materials with the underlying physical processes from the Terahertz to the Deep ultraviolet spectral regions will be explained. The interplay of crystal structure, geometrical form, order and anisotropy will be discussed. Selected examples for fast (in-situ) and wide spectral range (ex-situ) instrumentation operation will be explained, including concepts for fast mapping and imaging. Examples will cover the application of ellipsometry to determine surface and interface roughness, alloy composition, stress and strain in heterointerfaces, for examples, including the optical Hall effect to determine free charge carrier properties in complex heterostructures. Further emphasis will be paid to in-situ monitoring of thin film growth and process conditions.

Course Content
• Principles of ellipsometry (Maxwell, polarization, instrumentation)
• Optical material properties (model dielectric functions; effective medium approximations)
• Ellipsometry characterization of layer stacks
• Form and low-symmetry induced anisotropy
• Monitoring thin film materials growth and growth process characterization
• Mapping and imaging ellipsometry
• Thin film device characterization
• Nanostructured thin films

Who should attend?
Anyone interested in using optical methods to characterize thin film materials and their structural and physical-optical properties either during deposition or after deposition. Anyone regardless of their state in their career will find this course useful.

Course Materials
Course notes (powerpoint files) and reference lists will be provided