

EEE 598 Nanoscale Fabrication and Characterization

Fall 2012

Course Description: This course is designed to provide a comprehensive understanding of the traditional and creative technologies used for fabricating nanoscale structures and devices, as well as the understanding of the techniques for characterizing them. Different approaches for creating nanostructures and nanodevices, including ‘top down’ and ‘bottom up’ techniques, will be covered, with a discussion of the capabilities and limits of each. Topics covered in the fabrication will include: ‘top-down’ optical and electron beam lithographic pattern generation, soft lithography and nanoimprinting; and ‘bottom-up’ self-assembly and applications. Nanoscale characterization will be primarily focusing on the application of scanned probe techniques to exploring material and device properties at nanoscale. Topics in the characterization will include: scanning tunneling microscopy and spectroscopy, scanned force microscopy, near-field optical microscopy.

Fascinating physical properties of nanoscale materials and devices will be introduced along with these techniques.

Who should take this course: This advanced undergraduate level and graduate level course is intended for students in both the School of Engineering and the School of Liberal Arts and Sciences who are interested in or are already engaged in the study of nanostructures and nanodevices.

Prerequisite: Although not required, Solid State Physics and basic Semiconductor Device courses will be useful.

Class Schedule: Tues Thurs 12:00PM - 1:15PM, PSF 123

Instructor: Hongbin Yu, ERC 159, Tel: 965-4455, email: yuhb@asu.edu

Office Hours: TBA

Course Objective

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Course Outline

Nanoscale fabrication:

Top-down:

- state-of-the-art optical lithography
- e-beam and focused-ion lithography
- imprint lithography
- scanning probe based lithography

Bottom-up assembly:

- inorganic: chemical synthesis, vapor-liquid-solid growth; nanoporous template;
- organic molecular self-assembly: self-assembled monolayer; DNA-assembly

Nanoscale characterization:

Introduction to the theory, operation and application of scanning probe-based characterization of the structure, electronic, electrical, magnetic and optical properties, including:
scanning tunneling microscopy and spectroscopy; atomic force microscopy; magnetic force microscopy; scanning capacitance microscopy; electric force microscopy; near-field scanning optical microscopy

Course Text

The course will draw predominantly on material from the specialist literature. Some of the discussions are also covered in the following books:

- *Introduction to Nanoscale Science and Technology*, Ed. M. Di Ventra, S. Evoy and J. R. Heflin, Kluwer Academic Publishers (2004).
- *Nanofabrication: Principles, Capabilities and Limits*, Author: Zheng Cui, Springer; (September 12, 2008)

Course Notes

A comprehensive set of Power Point notes will be provided for this course and may be viewed/downloaded from the course website: <http://myasucourses.asu.edu>

Course Assessment

Assessment will be based on performance in homeworks (50%), term paper and final presentation (50%).