ENEE: 719A Nanostructure Fabrication Technology

Course Goals:

The science and technology needed to fabricate structures at nanometer dimensions will be presented. The course is aimed both at those who wish to fabricate micro/nano devices for research in electronics, quantum effects, chemistry, biology, materials science or other areas and at those interested in understanding, using, or advancing the state of the art in integrated circuit processing technology. The concepts and instruments used in nanofabrication for research have largely been developed because of the needs of the integrated circuit industry.

Recently interest in nanotechnology as a research topic has greatly increased. This is due mainly to two broad factors: First, the integrated circuits industry is beginning to see the end of the road for the ever shrinking transistor as we know it. Barriers in technology (nanofabrication), in fundamental physics, and in economics are looming. Totally new methods of information storage and manipulation at even smaller dimensions are being sought. And second, the ability to fabricate at dimensions approaching those of atoms and molecules has opened many new areas of endeavor, from manipulation of DNA, to carbon nanotube devices, to better materials for automobile bumpers.

The course will examine lithographic techniques for defining structures, techniques for altering a substrate at nanometer dimensions, and touch on some of the applications of the fabricated structures.

Course Prerequisite(s):

A good understanding of sophomore level physics, and ENEE480 Fundamentals of Solid State Electronics (or equivalent) or permission of instructor.

Topics Prerequisite(s):

Textbook(s)

None

Reference(s):

H. I. Smith, "Submicron and nanometer structures technology" (NanoStructures Press, Sudbury MA)

I Brodie and J. J. Muray, "The physics of micro/nano-fabrication" (Plenum Press, New York and London)

Core Topics:

- Fourier optics, theoretical limits of optical microscopy and optical lithography
- Resists- radiation sensitive polymers which form the basis of lithography.
- Ion and electron sources and beam optics
- Electron beam lithography and scanning electron microscopy
- Ion beam microfabrication (implantation, milling, deposition, microscopy and lithography)
- Other "post optical" lithographies: electron projection, ion projection, x-ray, imprint, and extreme ultraviolet
- Pattern transfer to the substrate: etching in reactive gaseous plasmas, lift-off and elecroplating
- Scanned probe techniques
- Examples of applications: quantum devices, short channel MOSFET's, novel materials, etc.

Optional Topics:

Course Structure:

Two 75 min lectures per week. Graded homework weekly.

Grading Method:

Homework

Exams

Projects, term papers (The option to have part of the grade determined by this alternative will require prior approval by the instructor.)

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