APPLIED AND ENGINEERING PHYSICS 661

NANOCHARACTERIZATION

FALL 2006

Instructor: Prof. D. A. Muller

Office: 274 Clark Hall
Phone: 255-4065
email: dm24@cornell.edu

Office Hours: Wednesday 4:00 – 5:00 pm
Friday 3:30 – 4:30 pm
OR BY APPOINTMENT

Lectures: M W F 2:30 – 3:30 pm, Baker 219

Teaching Assistant: TBA

Texts: There is no textbook for the course, but course notes will posted on the blackboard web site and the following books have been placed on reserve in the Physical Sciences Library:

J I Goldstein et al, *Scanning Electron Microscopy and X-ray Microanalysis*.

R.F. Egerton, *Electron Energy-Loss Spectroscopy in the Electron Microscope*

David B. Williams and C. Barry Carter, *Transmission electron microscopy : a textbook for materials science*

Andrew Zangwill, *Physics at surfaces*, Cambridge University Press, NY, 1988

Leonard C. Feldman, James W. Mayer, *Fundamentals of surface and thin film analysis*, North-Holland, NY, 1986.

Roland Wiesendanger, *Scanning probe microscopy : analytical methods*, Springer-Verlag, NY, 1998.

Homework: Usual procedure: Assignments will be handed out in class roughly once every 2 weeks, computer-based data will be on the courseinfo web site.

Grading: Homework, 65%; Term paper 30%; Class participation 5%
For Phd students taking the class S/U, the term paper is not required

Web Site: http://blackboard.cornell.edu/

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A graduate-level introduction to the tools used to image and probe optical, electronic, chemical and mechanical properties at the nanoscale and below. As no single method can provide all these answers, and the field is still developing, the discussion centers on the physics of the interaction processes used for characterization, quantification and interpretation of the collected signals, common artifacts, the engineering tradeoffs made in constructing the actual instruments, and the fundamental detection limits for each method. Topics include:

- the interaction of electrons, ions and photons with materials;
- charged particle optics, image formation and sources;
- scanned probe and force microscopy;
- scanning and transmission electron microscopy;
- x-ray microanalysis;
- electron energy loss spectroscopy; and
- a brief survey of non-imaging methods such as RBS, Auger spectroscopy and SIMS.

Emphasis is placed on those instruments available for use on campus or likely to be encountered in cutting-edge research or industry.

Prerequisites: Assumed knowledge for this course includes Fourier transforms, basic electromagnetism and undergraduate quantum mechanics or chemistry. Undergraduates should consult with the instructor before enrolling in this class.

Each student in this course is expected to abide by the Cornell University code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the students own work.