

**Department of Materials Science and Engineering
University of Maryland, College Park, Maryland**

ENMA481: Introduction to Electronic and Optical Materials

Course Description: The goal of the course is to familiarize the students with basic as well as state of the art knowledge of some technologically relevant topics in materials engineering and applied physics. The topics include dielectric/ferroelectric materials, magnetic materials, superconductors, and optical materials. There will be an underlying emphasis on thin film and device fabrication technology. Lectures will be on fundamental physical properties and description of different materials as well as new developments in the fields.

Prerequisite: ENES 230 or equivalent

Textbook: Principles of Electronic Materials and Devices, Second Edition by S.O. Kasap (Available at the University Bookstore)

Course Website: on ajconline (www.ajconline.umd.edu)

Course Goals to meet ABET 2005 Criteria:

1. How are the electrical optical and magnetic properties related to the crystal structure and electronic structure of materials.
2. How does the band structure relate with the properties related above
3. How does growing a sample in thin film affect these properties
4. Perform an experiment based on these principles.

How this course works:

Lectures will be from materials covered in the textbook as well as others (literature, etc.) The homework problem sets will be on materials covered in lectures and sometimes from reading assignments. The exams will cover materials from lectures and sometimes from problems. An integral part of learning different aspects of thin-film and device fabrication technology, there will be laboratory exercises where students will perform fabrication of epitaxial multilayer thin films, microfabrication of devices using photolithography, and device characterization.

Class periods will be roughly divided into 2/3 lectures, 1/3 laboratory experiments. See below for more information on lab exercises.

Lecture Schedule (subject to change):

Topics	Approximate # of lectures Chapter	
Review of solid state physics, classical physics, quantum mechanics	2	from 1-3
Dielectric/ferroelectric materials	4	7

Magnetic materials	4	8
Superconductors	2	8
Optical materials	2	9
Thin film fabrication techniques, photolithography	2	
Combinatorial materials science		

Lab Exercise:

For the weeks of lab exercise, there will be no lectures. Instead, there will be one ~ 3hr lab period, and we will meet in the appropriate lab. Prior to the exercise, there will be a handout and a discussion in class about the exercise. Students will be divided into two groups. Each group can then pick a 3-hour period to get together and do the exercise during the week. TA and I will be present in the lab during the exercise. Everyone will turn in a complete lab report written following the guideline to be given in the handout.

Epitaxial high K dielectric capacitors with metal-oxide electrodes

The week of 9/23: pulsed laser deposition of multilayer thin films

The week of 10/7: photolithography measurement of capacitors

The week of 10/21: deposition of pt top electrode and lift-off

The week of 11/4: measurement of capacitors.

Grading Scheme:

Homework Sets:	20% (roughly biweekly)
Midterm:	20% (tentatively 11/11)
Lab report:	20% (including participation and performance)
Final presentation and report:	20% (due the week of 12/9)
Final Exam	20%

Class Hours:

Mondays and Wednesdays 3:30PM-4:45P

Classroom: CHE 2140, Building 90 (Chemical and Nuclear Engineering-CHE)

Course Instructor: Prof. Ichiro Takeuchi

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Office Hours: TBA, second week

Lab report due: 11/18

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