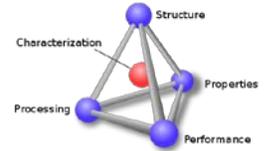


ECE 723 Optical Properties of Semiconductors

Fall 2014 MW 2:20-3:35 Room 313 MRC

Instructor: Robert Kolbas

Taught every other year



Non-ECE majors welcome! I like to have ECE, Material Science and Physics students in ECE 723. The diversity makes for more interesting questions and discussions.

The formal pre-requisite is ECE530. If you are a **Material Science student** and have completed your first year you probably have learned most of what is in ECE 530 if you have done any semiconductor and solid state physics courses. If you are a **Physics student** and completed the first year you have had enough quantum mechanics and just need some semiconductor knowledge (pn junctions) to be ready for ECE723.

Course Outline

1. Semiconductor Materials

1. Overview and introduction
2. Evolution of semiconductor materials
3. Physical properties and important parameters
4. Atomic bonding and crystal structure
5. Band structure (energy-momentum, density of states)
6. Heterostructures and superlattices

2. Optical Constants in Solids

1. Reflectivity
2. Index of refraction, absorption coefficient, etc.
3. Kramers-Kronig Relations
4. Waveguides and Fabry-Perot cavities

3. Absorption of Light in Semiconductors

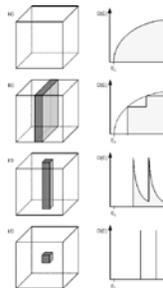
1. Photon-electron interaction
2. Direct transitions, indirect transitions
3. Excitons, free and bound
4. Doping effects
5. Other absorption processes
6. Field effects
7. Quantum well and superlattice absorption characteristics
8. Material characterization techniques

4. Recombination in Semiconductors

1. Radiative and nonradiative recombination
2. Band to band recombination
3. Excitons, free and bound
4. Doping effects
5. Other recombination processes
6. Defects and traps
7. Quantum wells and superlattice radiative recombination
8. Material characterization techniques

5. Photodetectors

1. Review of junctions (pn, Schottky)
2. Photoconductive detectors
3. Photovoltaic detectors
4. Other detectors
5. Performance characteristics
6. Design criteria

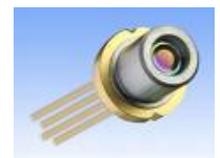


6. Semiconductor Light Emitting Diodes and Lasers

1. Light emission from pn junction devices
2. LED design and performance
3. Einstein A and B coefficients
4. Stimulated emission and gain
5. Optical and electrical pumping
6. Semiconductor laser operation
7. Laser design
8. Semiconductor laser menagerie
9. Quantum well lasers
10. Surface emitting lasers

Top eight reasons to take ECE723 this Fall:

8. Good way to learn some EE without needing all the background courses.
7. Learn how to use energy band diagrams for bulk and nanostructured materials 'pain free'.
6. 311 pages of on line class notes; 600 power point slides on line (some in color to keep you awake).
5. Looks like you learned something practical on a Physics resume (I'm a Physics major).
4. Kolbas is a minor rep on many Ph.D. thesis committees in Mat. Sci. and Physics.
3. Learn optical characterization of bulk and nanostructured semiconductor materials.
2. Ties together the concepts from several different courses.
1. ECE 723 will not be taught again until the Fall of 2016.



If you need help registering (because of the ECE530 prerequisite) contact me at kolbas@ncsu.edu.