

EEE 598 Nanotechnology and Energy Spring 2011

Course Objective: The objective of this special topics course is to explore the relation between advances in nanotechnology and renewable energy technology, particularly solar energy and storage. The course will provide on a common framework for understanding electronic structure in crystalline, non-crystalline and molecular systems within atomic orbital theory. Then different nanostructure systems and their electronic and optical properties will be covered, including heterojunctions, quantum wires, quantum dots, nanoparticles, etc. The latter part of the course will then focus on different energy conversion technologies and the role of nanostructures within these approaches will be covered including photovoltaic, thermoelectric, and photochemical energy conversion technologies.

Topics:

- 1) Optical and electrical property of materials, chemical bond picture, basic absorption processes (2 weeks)
- 2) Thermodynamics of energy conversion (1 week)
- 3) Nanostructured system (3 weeks)
 - Growth, synthesis, and fabrication of nanostructures
 - Electronic, chemical and optical properties of quantum wells, quantum wires, quantum dots, and nanoparticles
- 4) Photovoltaic energy conversion (4 weeks)
 - Basic concepts of p-n and heterojunction solar cells
 - Multi-junction solar cells
 - Multiple electron/multi-exciton structures
 - Multiple energy level/intermediate band devices
 - Hot carrier/thermophotonic devices
- 5) Thermoelectrics and other energy harvesting (1 week)
- 6) Photonic bandgap and nanoplasmonic schemes for light trapping (1 week)
- 7) Photochemical energy conversion (3 weeks)
 - Electrochemical energy conversion processes
 - Dye sensitized solar cells
 - Photocatalysis
 - Artificial photosynthesis
- 8) Student Project/Presentations (1 week)

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Class Schedule: T-Th 3:00-4:15pm ECG G315

Prerequisites by Topic:

Background in physical chemistry or solid state physics, bond theory, modern physics, understanding of semiconductor junctions.

Textbook:

There is no required text, handouts, notes, reference papers and reference texts will be provided

Grading:

Homework assignments (40%); Midterm (30%), Final projects (30%)