SOLAR CELL DESIGN AND PROCESSING  635:405

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COURSE TEXTS
Recommended:
1. Practical Photovoltaics: Electricity from Solar Cells, Richard J. Komp, Aatec Publ., Ann Arbor, MI

Course Objectives:

The objectives of this course are to provide the students with opportunities to develop the following competencies and skills:

a. Understanding of the basic principles of operation for standard silicon solar cells.
b. Understanding the effects of semiconductor doping to create p-type and n-type regions and junctions for capturing light.
c. Understanding the wide range of processing techniques used for making different kinds of solar cells.
d. Understanding the design challenges for capturing wide spectral regions with high efficiency.
e. Understanding of advanced multilayer structures for enhancing the solar energy capture efficiency.
f. Understanding the current-voltage tradeoffs when designing and using solar cell systems.

Course Format:

This course is of the lecture format with an occasional hands-on in-class activities used to emphasize solar cell design. Each semester includes a design contest that helps students understand the current/voltage trade-offs encountered in solar cell optimization and the role that processing choices can play in improving the system efficiency.

Assessment of Outcomes:

Student progress is assessed informally by class participation. Outcomes are assessed formally through examinations and student evaluation forms.

Relationship to Program Objectives:

This course provides contributions to program objectives 1 through 5. With respect to general ABET proficiencies it contributes significantly to (a), (b), (c), (e), (g), (h), (i), (j), (k), and (l).
Course Topical Coverage:

I. Introduction
   A. The Available Solar Spectrum
   B. Absorption of Light by Matter
   C. Material Electronic Structure: The Band Gap
   D. p-n Junction Formation and Internal Fields
   E. p-i-n Structures
   F. Motion of Electrons and Holes
   G. Generation and Recombination Processes
   H. Macro-Electrical Characteristics

II. Standard Semiconductor Processing
   A. Diffusion
   B. Oxidation
   C. Photolithographic Patterning

III. Techniques for Depositing Thin Films
   A. Evaporation
   B. Sputtering
   C. Solution Deposition Techniques
   D. Heterojunction Devices

IV. Contact Formation
   A. Ohmic Contacts
   B. Transparent Conductors
   C. Metallization
   D. Series Resistance Effects

V. Optical Effects
   A. Anti-Reflection (AR) Coatings
   B. Refraction and Non-Normal Illumination
   C. Textured surfaces for Light Trapping
   D. Dual- and Multi-Junction Cells

GRADING CRITERIA

The final grade is based upon these aspects, with their respective weights:
   Occasional in-class activities: 20%
   Individual HW’s: 20%
   Semester Design Project (Individual or Small Team): 30%
   Mid-Term Test: 15%
   Final Exam: 15%