ME 516: Thin-Film PV Technology

Course Goals:
Explore the science and technology of solar energy conversion, with a goal of incorporating cutting-edge trends in the field. Using thin-film PV devices as an example, provide a combination of theoretical and hands-on experiences, giving the student a sense of approaches more generally applicable in contemporary photovoltaic device research.

Topics Covered:
1. Basics: Review of fundamentals of photovoltaic energy conversion
2. Thin-film solar cell designs
3. Important parameters governing solar cell performance
4. Materials science of thin-film solar cell materials
5. Characterization tools for solar cells and materials
6. Simulation software for modeling solar cell operation
7. Lab techniques for making thin-film solar cells

Grading:

4-5 Homeworks: 25% (article readings/computer modeling/problems)

Advanced topic presentation: 25% (1 readings/research/presentation)

Device project: 25% (1 lab project/report/presentation)

Midterms (no Final): 25%
Approximate Syllabus (subject to change)…

Jan 8   Intro to thin-film PV
Jan 13  Review of solar cells: Semiconductor physics and design
Jan 15  Review of solar cells: p-n junction in thermal equilibrium; Class review
Jan 22  Review of solar cells: p-n junction under bias and in light; Class review
Jan 27  Recombination mechanisms
Jan 29  Loss mechanisms; Limits on Single Junction PV; Tandem
Feb 3   Types of thin-film PV (CIGS/CdTe/CZTS, DSSC, nanoparticle)
Feb 5   Characterization approaches. Visit to SMIF
Feb 10  Review for mid-term
Feb 12  Midterm #1 (on device physics)
Feb 17  Detailed look at CdTe TF Technology (announce special topic choices)
Feb 19  Detailed look at CIGS TF Technology (Special projects discussed)
Feb 24  CZTS and “earth abundant” Technologies
Feb 26  Device Modeling and Analysis (AMPS1D and SCAPS)
Mar 2   Amorphous Si and organic PV
Mar 4   Detailed look at perovskite PV (Labs planned; go over 2nd midterm sched.)
Mar 9, 11  SPRING BREAK!
Mar 16  Intro to lab; go over fab and characterization approaches
Mar 18 to Mar 31– Schedule lab time to do projects (up to 3 groups)
April 1  Presentation of lab results (2-3 group; 20-30 min each)
Syllabus (approximate… work in progress):

Apr 6     Student presentations on advanced topic (20/5 min each) or lit review
Apr 8     Student presentations on advanced topic (20/5 min each) or lit review
Apr 13    Class Review or 3rd day of student presentations
Apr 15    Mid-term #2 (on technologies)