

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:

<u>4-5 Homeworks:</u>	25% (article readings/computer modeling/problems)
<u>Advanced topic presentation:</u>	25% (1 readings/research/presentation)
<u>Device project:</u>	25% (1 lab project/report/presentation)
<u>Midterms (no Final):</u>	25%

Approximate Syllabus (subject to change)...

- Jan 20 Intro to thin-film PV
- Jan 25 Review of solar cells: Semiconductor physics and design
- Jan 27 Review of solar cells: p-n junction in thermal equilibrium; Class review
- Feb 1 Review of solar cells: p-n junction under bias and in light; Class review
- Feb 3 Recombination mechanisms
- Feb 8 Loss mechanisms; Limits on Single Junction PV; Tandem
- Feb 10 Types of thin-film PV (CIGS/CdTe/CZTS, DSSC, nanoparticle)
- Feb 15 Characterization approaches. Visit to SMIF
- Feb 17 Review for mid-term
- Feb 22 Midterm #1 (on device physics)**
- Feb 24 Detailed look at CdTe TF Technology (announce special topic choices)
- Mar 1 Detailed look at CIGS TF Technology (Special projects discussed)
- Mar 3 CZTS and “earth abundant” Technologies
- Mar 8 Device Modeling and Analysis (AMPS1D and SCAPS)
- Mar 10 Spring Break
- Mar 15 Amorphous Si and organic PV
- Mar 17 Detailed look at perovskite PV (Labs planned; go over 2nd midterm sched.)
- Mar 22 Intro to lab; go over fab and characterization approaches
- Mar 22 to Apr 3– Schedule lab time to do projects (up to 3 groups)
- Apr 5 Presentation of lab results (2-3 group; 20-30 min each)

Syllabus (approximate... work in progress):

- Apr 7 Student presentations on advanced topic (20/5 min each)
- Apr 12 Wellness Day...
- Apr 14 Student presentations on advanced topic (20/5 min each)
- Apr 19 Student presentations on advanced topic (20/5 min each)
- Apr 21 Mid-term #2 (on technologies)

Lab project is dependent on virus constraints... It may be moved to end of semester or replaced with another activity if needed