14:635:405
"Solar Cell Design and Processing"
Fall 2016

Registration number: 09360

Meeting Times: **Wednesday, 12:00 – 1:20** **and** **Friday, 1:40 – 3:00**

Instructor: Dunbar P. Birnie, III, Professor in Materials Science and Engineering
e-mail: dunbar.birnie@rutgers.edu
Campus phone: 848-445-5605 Office location: CCR 129

New and improved solar cells are being developed every day it seems. Technology popular press articles feature these technologies and make us all believe that we'll have these solar cells on our house next year – yet often there is no follow through. Why is that? Are the early technical claims valid? Will we be able to harness the sun's energy in a cost effective manner? → **This class is aimed at building and exercising the technical tools to make informed evaluations of these new technologies. Don't believe all you read!! – instead be able to make reasoned judgement on your own**:

Solyndra – the political punching bag!

Was this a good technology? How did it work? Was it better than flat panel solar?

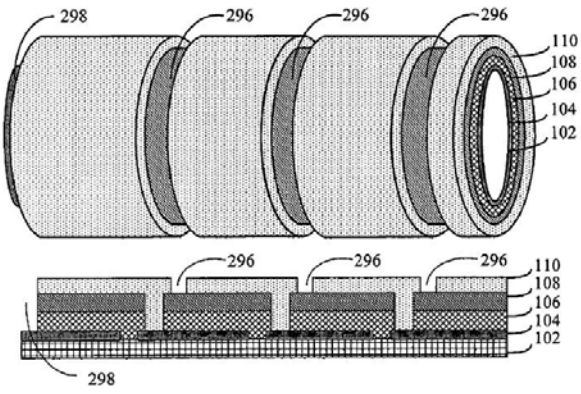

Image from Solyndra Patent 7,235,736.

Here's a technology that was featured in MIT's *Technology Review* as one of the top 10 "Breakthrough Technologies" for 2013.

Same questions apply….. Is this a good technology? How does it work? Will this be better than flat panel solar? Etc…

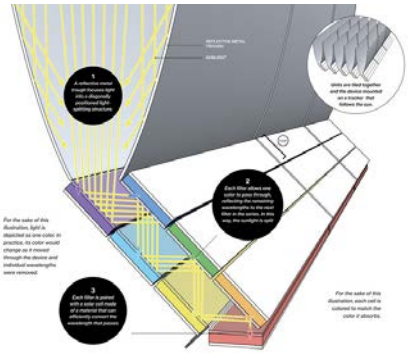

Image from Technology Review website

Technology Emphasis: Among the design projects and lecture materials there will be a strong emphasis on **entrepreneurism** and **innovation** related to solar technology and utilization. This will include examination of patents and current news items that relate to solar technology.

Design Content: We will focus on solar power from the large system level down to the nanoscale device engineering level. Often this will lead to design optimization discussions allowing us to understand the variables under our control and aspects where improvement can be achieved.

Grading: Design Projects (sometimes Individual or Small Team): 30%, Homework: 30% total, Mid-Term Test: 20%, Final Exam: 20%; Graduate students taking this class will have an additional term-paper/project advanced-topic assignment.

Office Hours: Best by appointment - arranged by email (dunbar.birnie@rutgers.edu).

Class Website: Lecture Material, HW, handouts and other info via a class SAKAI site.

Technical Material Coverage:

I. Array and System Practical Issues

A. The Sun's Motion and Seasonal Variations
B. Array Placement, Tilt, Installation
C. Inverters and Power Generation
D. Solar Hot Water Heaters
E. Systems utilization of solar – including balancing systems with battery backup for resilient power systems.
F. Solar for powering Electric Vehicle Systems and Commuter transit

II. Photovoltaic Device Operation

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

III. Advanced Topics

A. Anti-Reflection (AR) Coatings
B. Refraction and Non-Normal Illumination
C. Textured surfaces for Light Trapping
D. Dual- and Multi-Junction Cells
E. Heterojunction Devices
F. Ohmic Contacts, Metallization
G. Transparent Conductors
H. Series Resistance Effects
I. Novel alternative Systems – Dye Sensitized and Organic Cells
J. Nanorod Solar Cells