3.003 Principles of Engineering Practice

Making Local Solar-Powered Electricity

SoloLoco

background

Photo by Pujanak on Wikimedia Commons.

- *Fossil fuels becoming more scarce and more expensive*
- *Solar energy usage increasing at 2% per year*
- *Grid-connected sources lose 6.5% of energy produced in distribution*

issues

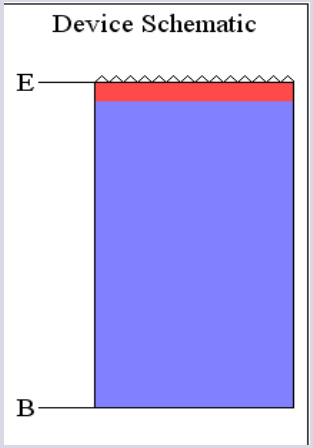
$$FOM = \frac{efficiency}{volume * manufacturing\ cost}$$

- **Cost** – Si thin films more expensive to manufacture but are safer and more abundant than alternatives
- **Thickness vs. lifetime** – thicker cells last longer, but thin cells have shown higher efficiency

ANALYSES:

- Chose thin film because of higher efficiency
- Chose Si because of better reliability in long run, less toxicity, and more abundance than other options, particularly CdTe

HOW IT WORKS (MODELS):



- Surface area: 100 cm^2
- Thickness: 30 um
- Texture: .1(thickness)= 3 um
- Doping: 1x10^16 cm^-3
- ARC thickness: (500 nm)/4 = 125 nm
- ARC refractive index: (n1*n2)^.5 = 2 (silicon nitride)
- Efficiency: 15.21%

ASSUMPTIONS AND LIMITATIONS:

- Simulation assumes sun is at its peak
- Limited by DC current flow from solar panels
- Limited by lack of energy storage technique/device

consequences

- Manufacturing process will be more expensive than Si wafers or CdTe thin films
- Manufacturing process will originally rely on fossil fuels (though it may later rely completely on solar power)
- Solar technology will only work during the day and won't be able to compensate for the evening peak in energy usage

recommendations

- Implement manufacturing process gradually to allow for improvements in technology and increased support of project
- Develop DC household appliances whenever possible
- Invest in research for converting DC current to AC and for solar energy storage techniques

We will be able to rely on 30% solar power within 50 years

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