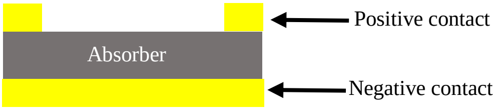
For this project, you'll design a solar cell with the following structure:



For this structure, you'll optimize the thickness and doping for the absorber layer for maximum power conversion efficiency, under illumination from the Sun. You can choose any of the following material as the absorber (first come first offered):

1. Lead halide perovskite (any composition reported in the literature)

2. GaAs

3. Polycrystalline Silicon

4. Monocrystalline Silicon

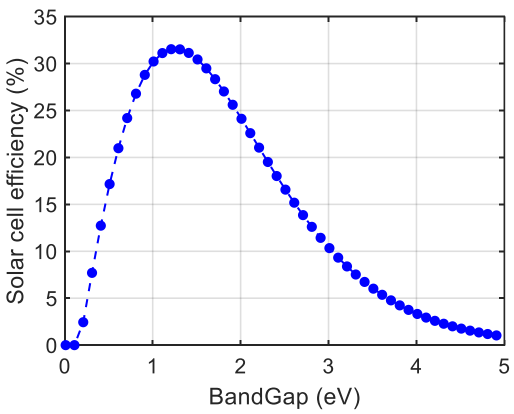
5. CIGS

6. CdTe

Each material can be chosen by up to 5 people. Sign-up here for the materials is here. The last date to sign-up is **April 4, 2020**.

You'll need to use MATLAB for this project. Instructions on how to access and install MATLAB is provided here.

We will assume the generated electron-hole pairs are readily separated by the contacts and collected, and we'll use a constant value of series resistance R_s and shunt resistance R_{sh} as an input to the simulation.



Download the code from the GitHub link https://github.com/zomair/ELENG134-UC-Berkeley. You'll only need to use the device_params.m file to provide inputs to the simulation and run PV_JV.m to obtain the output V_{oc}, J_{sc}, FF, V_{mpp}, and I_{mpp}.

Task 1: Reproduce the Shockley-Queisser limit.

Plot the solar cell efficiency vs bandgap, as shown above. Consider the Sun is a blackbody emitter at 6000K, and the solar cell is at 300K. Assume perfect material quality for the solar cell and step-function absorptivity of the solar cell. (**Due Wed April 8**)

Task 2: Find the material parameters

From literature, find the absorption coefficient as a function of wavelength, SRH lifetime, electron and hole effective mass, refractive index, and electron and hole Auger recombination coefficient at 300K, for the material that you chose. (**Due Wed April 8**).

Task 3: SQ limit for AM 1.5

Plot the SQ limit, like task 1, using AM 1.5 as the incident spectrum instead of approximating the Sun as a blackbody at 6000K. Compare with the results from task 1. (**Due Wed April 8**)

Task 4: Doping optimization

Plot doping concentration (donor doping ND) vs solar cell efficiency, and find the optimum doping for your solar cell. (**Due Wed April 15**).

Task 5: Plot the solar cell efficiency vs the thickness of the absorber layer. What determines the optimum thickness? (**Due Wed April 23**).

Grading policy:

1. Grades will be assigned based on the accuracy of the results, as well as a proper explanation of the results. Use the obtained V_{oc}, J_{sc}, V_{mpp}, and I_{mpp} to explain the results, and provide insights.

2. Collaboration is encouraged, however, the report has to be your own. Mention the names of anyone you've talked/ collaborated, and on what topic.

3. Provide proper bibliography to any external sources you've used.

4. Show all non-trivial steps in your coding/ calculation.

5. The code might/will be updated during the duration of the project. Any updates to the code will be announced on bcourses. It is **YOUR** responsibility to download the latest version of the code from the GitHub repository mentioned above.

6. The submission portal will be available on the Gradescope in due time.