EECE 577 Assignment 2

Due date: October 20, at the beginning of class.

Objective: Due to its favourable bandgap and absorption coefficient, copper indium gallium diselenide (CIGS) is being widely investigated for use in low-cost, thin-film solar cells (see, for example, Nanosolar's web-site). CIGS can be p-doped by vacancies, and is used in conjunction with n-CdS to form a heterojunction solar cell. In this assignment the goal is to determine if high-efficiency cells (15-20%) can be made using CIGS as the base, but with a Schottky-barrier front region in place of the n-CdS.

Irradiance data for the AM1.5G spectrum can be found on the course web-site in the file Spectrum.txt. The wavelength is in column 1 and the irradiance is in column 3. The data can be read into MATLAB by the statements

```
AM15G=dlmread('Spectrum.txt','');
wavelength=AM15G(:,1);% nm
S=AM15G(:,3);%(W/m2/nm)
```

1. Find a reference for data on the absorption coefficient of CIGS. Quote the reference and write the data and corresponding wavelength in a two-column format, e.g., in a file CIGS.txt. If the wavelength values do not match those used in AM15G, interploation can be used to generate an appropriate set of alpha values:

   ```
   CIGS_optical=dlmread('CIGS.txt','');
   wavelength_CIGS=CIGS_optical(:,1);% nm
   CIGS_alpha=CIGS_optical(:,2);%(W/m2/nm)
   alpha_CIGS = interp1(wavelength_CIGS,CIGS_alpha,wavelength,'cubic');   % /m
   ```

2. Choose a metal or transparent film, such as graphene; quote a reference, and show the data, for the transmittance and sheet resistance for the metal thickness you decide to use, and for the workfunction.

3. Quote references, and give the data for the required material properties for CIGS: bandgap, electron affinity, intrinsic carrier concentration, effective density of states in the valence band, permittivity.

4. Choose, giving reasons for your choice, values for: base length, doping density, minority-carrier diffusivity and diffusion length, back-surface recombination velocity.

5. Show the calculation of the photocurrent.
6. Perform a calculation of the dark current for the cell, justifying the equations and parameter values you use.
7. Plot an I-V curve and a P-V curve for the Schottky-barrier cell.
8. List the short-circuit photocurrent, the open-circuit voltage, the fill-factor, and the conversion efficiency.
9. Include series resistance in your simulation and re-do the previous two questions.
10. Comment on the perfomance of your cell with respect to that of the best experimental CdS/GIGS cell .
11. Please include your code.