# MSc project: improvement of the algorithms of ASA software

ASA (Advanced Semiconductor Analysis) [1] is a program designed by the PVMD group [2] at TU Delft for the simulation of solar cell devices based on thin-film amorphous and crystalline semiconductors. This software is used by leading research institutes around the world to optimize the performance of the next generation of solar cells.

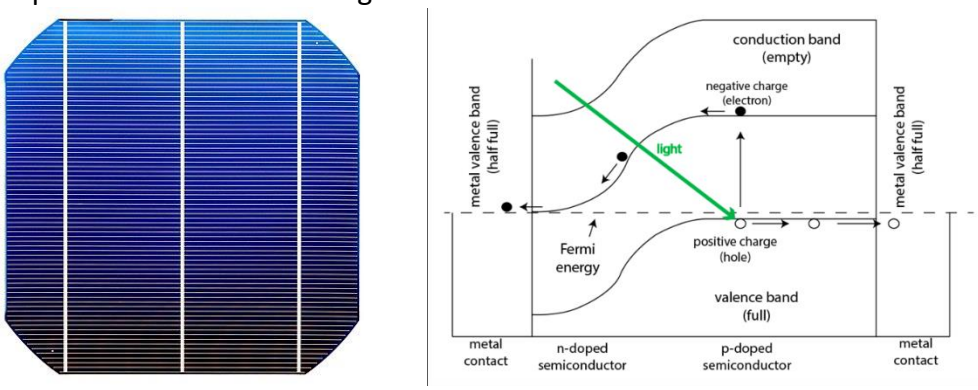


*Figure 1: a) Crystalline silicon solar cell (top view). b) energy band diagram of solar cell junction.*

The ASA software solves numerically the so-called semiconductor drift-diffusion equations (Poisson equation and continuity equations for electrons and holes) in one dimension [3]. As solar cells have a multi-layered structure, with layer thicknesses in the millimeter to nanometer range, there typically are relatively large discontinuities in the material properties (e.g. bandgap) across the interfaces. This makes solving of the equations rather challenging. To do so, the numerical solution algorithm uses the iterative Newton method. However, such methodology does not always guarantee a physically consistent solution or even a convergence of the numerical solution. Accordingly, the implementation of a 'seed solution' is used to achieve a solution within a reasonable computational time. The Gummel method is used to find the initial seed solution, however this method does not always provide an accurate solution of the drift-diffusion equations.

Therefore, the aim of this project is to implement more advanced solver strategies and methods that improve the solution procedure implemented in the ASA software, both in terms of accuracy and speed. The accuracy of the solution can be checked by comparison with measurements of solar cells fabricated in our lab, and by comparing with the solutions given by other commercial software tools, such as TCAD Sentaurus.

For this project we are looking for a mathematics student with affinity for solar cell applications and with experience in programming in C++. For more information, contact Carlos Ruiz Tobon.

[1] http://asa.ewi.tudelft.nl
[2] http://pvmd.ewi.tudelft.nl
[3] B. E. Pieters, J. Krc and M. Zeman, "*Advanced Numerical Simulation Tool for Solar Cells - ASA5,*" 2006 IEEE 4th World Conference on Photovoltaic Energy Conference, Waikoloa, HI, 2006, pp. 1513-1516, doi: 10.1109/WCPEC.2006.279758.