Modeling of a gallium phosphide/silicon heterojunction solar cells

Abstract:
Here we use a coupled optical and electrical model to study the performance of heterojunction Si (HJSi) solar cells based on gallium phosphide (GaP)/crystalline Silicon (c-Si) structures in comparison with Si (c-Si)/amorphous Si (a-Si) HIT solar cells. The simulations are based on a numerical drift-diffusion model performed with the Sentaurus TCAD tool. We investigate the impact of highly n-doped indium tin oxide (ITO n+) window layer for the case of flat and textured surface with different ITO thicknesses. Simulation results indicate that GaP used in the top layer of a HJSi solar cell is a good candidate to improve the performance and reach efficiencies in excess of the 25.6% currently reached for a HIT cells with a-Si. We perform a detailed simulation study of a fabricated solar cell structure for various emitter designs, extracting key figures of merit like efficiency, short-circuit current and open circuit voltage; our values are in good agreement with recently reported solar cells. After having validated our simulation approach, different optimization techniques are investigated in order to maximize the performance of the solar cell.
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