

Proceedings of SPIE, 7597: 759721
Physics and Simulation of Optoelectronic Devices XVIII
SPIE--The International Society for Optical Engineering
January 2010

Numerical Simulation on High-efficiency GaInP/GaAs/InGaAs
Triple-junction Solar Cells

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Abstract

In this paper, the high-efficiency GaInP/GaAs/InGaAs triple-junction solar cells are investigated numerically by using the APSYS simulation program. The solar cell structure used as a reference was based on a published article by Geisz et al. (Appl. Phys. Lett. 91, 023502, 2007). By optimizing the layer thickness of the top and middle cells, the appropriate solar cell structure which possesses high sunlight-to-energy conversion efficiency is recommended. At AM1.5G and one sun, the conversion efficiency is improved by 2.3%. At AM0 and one sun, the conversion efficiency is improved by 4.2%. At AM1.5D and one sun, the conversion efficiency is improved by 1.3%. Furthermore, based on the optimized structures, this device can achieve efficiencies of more than 40% at high concentrations. For the triple-junction solar cell under AM1.5G solar spectrum, the conversion efficiency reaches 40.2% at 40 suns. For the device under AM0 solar spectrum, the conversion efficiency reaches 36.2% at 30 suns. For the device under AM1.5D solar spectrum, the conversion efficiency reaches 40.2% at 50 suns.