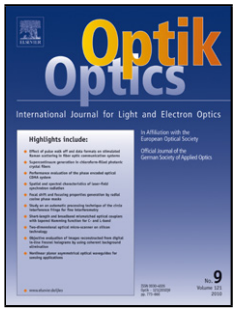

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Role of non-uniform Ge concentration profile in enhancing the efficiency of thin-film SiGe/Si Solar Cells

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Abstract:

In this paper, graded Ge mole fraction aspect is proposed as a new way to achieve the dual benefit of improved Si/SiGe-based solar cell photoconversion efficiency and suppressed degradation related-dislocation effects. Our purpose resides mainly on decreasing the defect density at the Si/SiGe interface through shifting the Ge concentration gradually with the SiGe absorber layer thickness. Further, a careful mechanism analysis based on investigating numerically the impact of the proposed graded Ge content paradigm on reducing the degradation related-dislocation effect is performed. The advantage of using a SiGe layer with graded Ge concentration instead of a thin-film SiGe alloys is presented. Moreover, the impact of the proposed SiGe layer thickness on the solar cell conversion efficiency is carried out. It is found that the proposed feature brings the opportunity of reducing the lattice mismatch at the Si/SiGe interface, which can in turn improve the Si/SiGe-based solar cell conversion efficiency. In addition, increasing the Ge content progressively suggests the band-gap modulation aspect that enables improving the solar cell optical absorption and the total resistance. Therefore, the proposed design pinpoints a new path toward avoiding recombination losses through suppressing the degradation related-dislocation effects, which makes it potential alternative for providing high-efficiency Si-based solar cells.

Keywords: mole fraction**,** interfacial defects, Si/SiGe, lattice mismatch, efficiency, degradation.