Si-SiGe hetero-structure thin-film solar cells using integrated electro-optical modeling MUHAMMAD KHIZAR, DONGMING MEI, Department of Physics, University of South Dakota, Vermillion, SD 57069 — Hetrostructure Si-SiGe thin film solar cells have been designed and optimized using advance electro-optical theoretical modeling and simulation. Some of the key characteristics such as short-circuit current density (Jsc), open circuit voltage (Voc), and fill factor (FF) have been studied for varying concentration of Ge in SiGe buffer layer. The effect of thickness variation of alloyed layer for varying Ge composition ∼0.1—10% has been performed. The improvement in the conversion efficiency of these cells was calculating by tailoring the thickness of p+ doped layer. An approach relying on phenomena of improved absorption of the alloys which leads to a gain in the current was explored. Improved infrared response with higher short circuit current has been obtained for about 25 μm thick structures. With the optimized Ge concentration, and the incorporated structure design parameters, as much as 4-6% enhancement in the overall efficiency of the solar cells has been calculated compared to that of the conventional single crystal Si solar cells. Moreover, the efficiency of these cells can further be improved because Si-SiGe based solar cells have improved absorption characteristics and offer minimum operating temperature sensitivity. It is believed that with better understanding of the band-gap engineering of SiGe when used as buffer and junction layers, the overall conversion efficiency of such devices can further be improved and could play a critical role to develop low cost and high efficiency solar cells technology. This work is supported by DOE grant DE-FG02-10ER46709 and the state of South Dakota.

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