Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Performance optimization of c-Si1-xGex/Si heterostructure thin film solar cells with step-graded bandgap profile MUHAMMAD KHIZAR, MD. AMIMUAL EHSAN, JAYESH GOVANI, DONGMING MEI, University of South Dakota, South Dakota, USA — In this paper, the performance optimization of c-Si1-xGex/Si heterostructure thin film solar cells along with the effect of step-graded absorber layer is discussed by modeling and simulation. Different cells with 1, 3, 5 and 7μm thick step-graded layers of p-type c-Si1-xGex on top of 20μm p-Si buffer layer are simulated. A comparative study of the thin film solar cell structures with and without a step-graded absorption layer is also performed. Some of the key characteristics such as short-circuit current density (Jsc), open circuit voltage (V_{OC}), and fill factor (FF) are calculated for varying concentration of Germanium (Ge) in c-Si1-xGex graded layer. With the optimized Ge concentration in the step-graded layer, significant enhancement in the overall efficiency of the solar cells has been calculated. The effect of thickness variation of alloyed layer for varying Ge composition $\sim$ 0.1—10% has also been carried out. Finally, the cell performance is calculated on the bases of current density–voltage characteristics curves and external quantum efficiency. We found that the optimized graded cell structure with larger Ge fractions was responsible for a higher magnitude and smaller thickness dependence of the short circuit current density. This is attributed due to the larger absorption coefficient that increases optical carrier generation in the near surface region for larger Ge contents. Further studies for the band-gap engineering of this step-graded absorber layer is still being performed.

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Date submitted: 15 Jan 2013 Electronic form version 1.4