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# Computer-simulation with Different Types of Bandgap Profiling for Amorphous Silicon Germanium Thin Films Solar Cells

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Amorphous silicon alloy (a-Si) solar cells and modules have been receiving a great deal of attention as a low-cost alternate energy source for large-scale terrestrial applications. Key to the achievement of high-efficiency solar cells using the multi-junction approach is the development of high quality, low band-gap materials which can capture the low-energy photons of the solar spectrum. Several cell designs have been reported in the past where grading or buffer layers have been incorporated at the junction interface to reduce carrier recombination near the junction. We have investigated profiling the composition of the a-SiGe alloy throughout the bulk of the intrinsic material so as to have a built-in electrical field in a substantial portion of the intrinsic material. As a result, the band gap mismatch between a-Si:H and a-$Si_{1-x}Ge_x$:H creates a barrier for carrier transport. Previous reports have proposed a graded band gap structure in the absorber layer not only effectively increases the short wavelength absorption near the p/i interface, but also enhances the hole transport near the i-n interface. Here, we modulated the GeH4 flow rate to control the band gap to be graded from 1.75 eV (a-Si:H) to 1.55 eV (a-$Si_{1-x}Ge_x$:H). The band structure in the absorber layer thus became like a U-shape in which the lowest band gap was located in the middle of the i-layer. Incorporation of this structure in the middle and top cell of the triple-cell configuration is expected to increase the conversion efficiency further.

**Keywords:** Computer-simulation, a-SiGe:H, bandgap profiling