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DESIGN OF CUIN1–YGAYSE2/SI1-XGEX TANDEM SOLAR CELLS

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In this work, an experimental $Si_{0.73}Ge_{0.27}$ solar cell has been modelled. The photovoltaic characteristics of the $Si_{0.73}Ge_{0.27}$ solar cell are in good agreement to its experimental counterpart. Afterwards, a double junction CGS/$Si_{0.73}Ge_{0.27}$ tandem solar cell with 24.1% efficiency has been designed. The effects of Ge concentration on the CGS/$Si_{1-x}Ge_x$ solar cell performance have been analysed. Additionally, the band gap combination of CuIn1-yGa_ySe/$Si_{1-x}Ge_x$ structure has been studied. Our findings indicate that CuIn1-$_y$$Ga_y$Se/$Si_{1-x}Ge_x$ tandem cell with 0.7<y<1 and 0<x<0.7 can achieve acceptable efficiency, and the optimized CGS/Si device with 26.1% efficiency is proposed. In CGS/$Si_{0.73}Ge_{0.27}$ tandem cell, the current matching is obtained when the CGS absorber thickness of the top cell is 1 µm and the $Si_{0.73}Ge_{0.27}$ absorber thickness of the bottom cell is 1.9 µm. The current matching condition for this device degrades the fill factor, although increases the current, so the device does not achieve maximum output power. An optimal thickness of 1.8-2 µm for CGS layer can adjust the Jsc and FF for the maximum efficiency of 24.3%, it has improved 2% compared to the current matching CGS thickness (1 µm).

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