A study on heteropepitaxial growth of GaAs solar cells on Si substrates by MOCVD

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ABSTRACT

This thesis is mainly present a study on heteroepitaxial growth of GaAs solar cells on Si substrates by MOCVD. Si has attracted attention as an alternative substrate because Si substrate is cheap and light-weight compared with Ge or GaAs substrates. The epitaxial growth of III-V semiconductor multilayer structures on Si is a possibility to reduce the costs for high efficiency III-V solar cell devices. Due to the very large difference in lattice constant (~ 4 %) and thermal expansion (> 100 %) a defect free epitaxy of GaAs on Si is challenging. In order to achieve the same performance for GaAs on Si as for the homoepitaxial growth, two step growth process, thermal cyclic annealing (TCA) and intermediate layer (IL) were investigated to reduce the dislocation density. GaAs solar cells were grown by the optimized conditions and were processed into 5.6 mm × 5.6 mm cells by standard processing techniques and measure under solar simulator. A conversion efficiency of 4.02% was obtained from GaAs solar cells on Si substrate without anti-reflection coating under AM1.5 spectrum. A GaAs solar cell with the same structure was grown on GaAs substrate for comparison and its conversion efficiency was 17.92%. The low efficiency for GaAs cells grown on Si substrates might be attributed to large ohmic contact resistance and high dislocation densities.

Keywords : MOCVD、GaAs、Solar cell、Si substrate

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