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InGaN photocell significant efficiency enhancement on Si – an influence of interlayer physical properties

Abstract

Nearly similar molar ratio of in and Ga in indium gallium nitride (InGaN) /Si photocells prefers to match InGaN conduction level energy to Si valance energy band for ohmic contact between two cells. At high temperature fabrication process, InGaN–Si interface shows highly defecting prone. Considering those tussles, InGaN-based/Si-based double-junction tandem solar cell was designed and fabricated. $In_{0.4}Ga_{0.6}N$ cell was fabricated on Si photocell by implementing AlN/SiO_2/Si_3N4 interlayers. Interlayer influence on quantum efficiency of InGaN cell was studied under ideal irradiance AM1.5 solar spectrum at 300°K. Because of insertion of interlayers between InGaN and Si; the gradual efficiency enhancement with respect to the overlayer h-GaN (a = 3.183 nm) plane lattice was found to 8.3%, 5.9% and 5.1% for AlN (a = 3.11 nm), for SiO_2 (a = 4.9 nm) and for Si_3N4 (a = 7.76 nm), respectively. AlN was found to be an excellent and SiO_2 as preferable interlayer compared with Si_3N4. Coherence (in-plane lattice matching) of nano-interlayer appears to reduce photonic electro-migration hurdle between InGaN and Si; therefore, progressive enrichment of efficiency was realized.