Multinary III-V materials for high efficiency multi-junction solar cells

Taewan Kim [1]

[1]Korea Research Institute of Standards and Science (KRISS), Korea, Republic of

III-V multi-junction solar cells grown by metal organic vapor phase epitaxy (MOVPE) and molecular beam epitaxy (MBE) have been studied for achieving the highest efficiency under concentration sun. Triple- and four- junction are popular multi-junction solar cell structures on either Ge or GaAs substrates. In this study, dilute-nitride-antimonide materials grown by MOVPE have been pursued to achieve a 1 – 1.25 eV energy band gap materials, which can be easily integrated into multi-junction solar cells on Ge and GaAs substrates. Several types of bulk dilute-nitride-antimonide films (InGaAsN, GaAsSbN, InGaAsSbN), close lattice matched to GaAs or Ge, are optimized by growth conditions, metal organic sources selection, optical properties, electrical properties, and carrier dynamics studies. The research on the impact of thermal annealing on bulk InGaAsSbN covers luminescence properties and carrier dynamics at variable temperature and solar cell device performances. The optimized dilute-nitride-antimonide materials with band gap energies of 1 – 1.25 eV have been integrated into single hetero- and homo-junction and double-junction solar cell structures.