World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Investigating the Energy Gap and Wavelength of $(Al_xGa_{1-x}As)_m/(GaAs)_n$ Superlattices in Terms of Material Thickness and Al Mole Fraction Using Empirical Tight-Binding Method

Authors : Matineh Sadat Hosseini Gheidari, Vahid Reza Yazdanpanah

Abstract : In this paper, we used the empirical tight-binding method (ETBM) with sp3s* approximation and considering the first nearest neighbor with spin-orbit interactions in order to model superlattice structure (SLS) of $(Al_xGa_{1-x}As)_m/(GaAs)_n$ grown on GaAs (100) substrate at 300K. In the next step, we investigated the behavior of the energy gap and wavelength of this superlattice in terms of different thicknesses of core materials and Al mole fractions. As a result of this survey, we found out that as the Al composition increases, the energy gap of this superlattice has an upward trend and ranges from 1.42-1.63 eV. Also, according to the wavelength range that we gained from this superlattice in different Al mole fractions and various thicknesses, we can find a suitable semiconductor for a special light-emitting diode (LED) application.

Keywords : energy gap, empirical tight-binding method, light-emitting diode, superlattice, wavelength
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020