Strain analysis and electronic structure of short-period strain-balanced GaAs$_{1-x}$N$_x$/InAs$_{1-x}$N$_x$ superlattices lattice-matched to InP(001) L. BHUSAL, A. ALEMU, A. FREUNDLICH, University of Houston —

A theoretical strain analysis and investigation of the electronic band structure in the vicinity of the Γ-point of GaAs$_{1-x}$N$_x$/InAs$_{1-x}$N$_x$ short period superlattices strain-balanced to (001) InP is performed. Conditions for strain balancing to create nearly zero strained superlattice on InP is developed by minimizing the total strain energy of the system. A six-band Kane Hamiltonian and a band anti-crossing model, modified for the strain effects are used to describe the electronic states of the highly strained zincblend GaAs$_{1-x}$N$_x$ and InAs$_{1-x}$N$_x$ ternaries. The evolution of the conduction band minima and valence subbands maxima of GaAs$_{1-x}$N$_x$ and InAs$_{1-x}$N$_x$ as a function of the nitrogen composition ($x<0.05$) indicate the occurrence of a type I band alignment for the superlattice involving the $m_j = \pm 3/2$ valence subbands and a type II band alignment for the one that involves the $m_j = \pm 1/2$ valence subbands. Room temperature operating wavelengths, as characterized by the energy gap between the first electron miniband and hole minibands, of these short period superlattices are predicted to extend beyond 3 $\mu$m for $x =0.05$.

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Date submitted: 14 Sep 2005

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