Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Strain and Piezoelectric Effects on the Electronic Structure of Coupled $In_xGa_{1-x}As/GaAs$ Self-Assembled Quantum Dots USMAN MUHAMMAD, Purdue University, SHAIKH AHMED, Southern Illinois University Carbondale, GERHARD KLIMECK, Purdue University — $In_xGa_{1-x}As/GaAs$ coupled quantum dot systems have gained much attention for optical and quantum computing applications. Due to strain, originating from the assembly of lattice-mismatched semiconductors, the quantum dot arrays tend to grow in the vertical direction. These vertically stacked quantum dots are strongly coupled through the strain field, which is atomistically inhomogeneous and penetrates deep into the GaAs buffer layer surrounding the dots. Crystal symmetry and atomistic details of interfaces are extremely important in such systems. Also piezoelectric fields must be taken into account to properly model the experimentally observed symmetry breaking and the introduction of a global shift in the energy spectra of the system. In this work, we present a detailed description of strain and piezoelectric potential effects on the electronic structure of closely coupled identical and non-identical quantum dot systems using $sp^3d^5s^*$ nearest neighbor empirical tight binding model. We show that strain causes strong mixing of s- and p- electron energy levels in strongly coupled quantum dot, splits heavy hole and light hole bands and even reverses their order within dots.

Usman Muhammad
Purdue University

Date submitted: 05 Dec 2007 Electronic form version 1.4