In this paper we reported the electronic structure computation for a pyramidal quantum dot of GaAs, with base b and height h = b/3 (from the base to the apex), that is immersed in an AlGaAs matrix. In this computation we are not considering any wetting layer that is typical in self-assembled InAs/GaAs quantum dots, but here we consider an AlGaAs/GaAs truncated pyramidal quantum dots, in fact we reported here the energy level structure for the pyramid and the truncated pyramid at h/3 and 2h/3, measured from the bottom of the squared-base pyramid. This computation is performed in the effective mass approximation and the conduction band energy levels are computed by a diagonalization procedure that consist in construct the Hamiltonian Matrix elements (Mij) in terms of a complete set of functions, in this particular case, given the dimensions of the quantum dot and its symmetry, we use the solution of a rectangular parallelepiped of dimensions Lx=Ly and Lz, that in fact are sinusoidal functions. We reported the electronic structure behaviour (wave functions and energy levels) as a function of the size of the base of pyramidal quantum dot. We considered quantum dots with base lengths from 10 to 50 nm. We reported wave function projections in the pane x-y at z = 0, showing the squared geometry of the pyramid and the x-z projection at y=0 for the three cases. In the case of the pyramid there is a well-defined triangular symmetry and for the truncated pyramids we can observe the wave function reflects the correct quantum well geometry. Finally, respect to the energy level behaviour it is found that as the quantum dot base length increases the energy levels decreases as expected. The main advantage of the method proposed here is that this permits us to compute the electronic structure of truncated pyramidal quantum wells as well as other more real (experimental) quantum dot geometries.

Keywords: Pyramidal Quantum Dots, Electronic Structure, GaAs/AlGaAs

Presenting author's email: karelyrod@fisica.uaz.edu.mx