11th International Conference
on Advanced Materials

ICAM2009

Rio de Janeiro Brazil
September 20 - 25

# Electronic states in double quantum wells-wires with potential W-profile: Combined effects of the hydrostatic pressure an electric field

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**Abstract** – A detailed theoretical study of the combined effects of the hydrostatic pressure and in-growth direction applied electric field on the electronic states in GaAs/(Ga,Al)As coupled double quantum wells-wires with potential W-profile is presented. Theoretical calculations have been made in the framework of the effective mass and parabolic band approximations. The results show that the energy for the electronic states is in strong dependence with the hydrostatic pressure and the applied electric field.

The different shape semiconductor quantum well-wires (QWW) have attracted considerable interest because of their application in photodetector and optoelectronic devices [1,2]. The electronic states play an important role in semiconductor systems for transport and optical responses which may be properly manipulated by variable confinement potential, the hydrostatic pressure and external electric field applied.

In this work it is made a study of the combined effects of hydrostatic pressure and in-growth direction applied electric field on the electronic states in GaAs/(Ga,Al)As QWW with potential W-profile. The electron wave functions in the semiconductor is obtained through an expansion in a complete set of trigonometric functions. We use the effective-mass and parabolic-band approximations. Calculations are performed for symmetric and asymmetric QWW heterostructures, for different values of the hydrostatic pressure and external electric field.

Calculated results show that the energy of the electron states presents characteristics features determined fundamentally by the spatial distribution of the electronic wave function within the coupled quantum well-wires with W-profile potential. Moreover, we discuss that the changing the intensity of the external electric field and the applied hydrostatic pressure, we obtain a large range in the donor binding energy in the QWW.

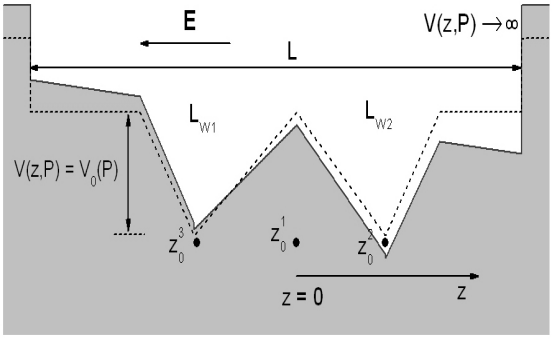


**Figure 1:** Pictorial view of the hydrostatic pressure and growth direction applied electric field dependent confinement potential along the z-direction for the QWW system studied in the present work.

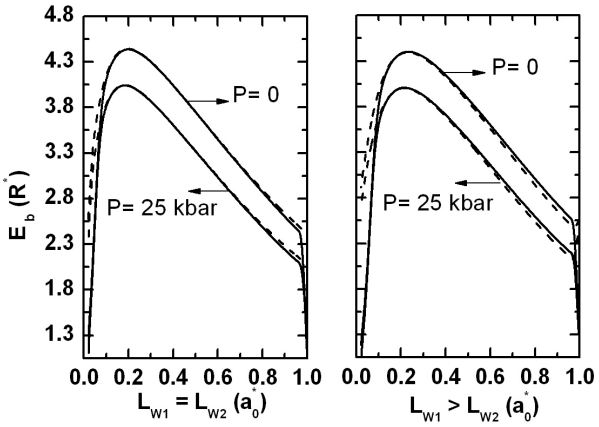


**Figure 2:** Binding energy of a donor impurity as a function of width of the quantum well-wires with W-profile potential in symmetric ($L_{w1} = L_{w2}$) /asymmetric ($L_{w1} > L_{w2}$) GaAs-$Ga_{0.7}Al_{0.3}As$ QWW. For zero electric field case follow the solid lines and dashed lines for the case E= 10 kV/cm.

## References

[1] A. Bilekkaya, Ş. Aktaş, S.E. Okan, F.K. Boz, Superlatt. Microstruct. 44 (2008) 96-105.
[2] E. Kasapoglu, H. Sari, I. Sokmen, Physica B 362 (2005) 56-61.