THERMOEMF OF $GE_{1-X}SI_X$ SINGLE CRYSTALS UNDER HYDROSTATIC PRESSURE

Chernysh V.V.[1], Burdeynyi V.M.[2], Melnyk M.D.[2]

[1]*Eduardo Mondlane University, Maputo, Mozambique*
[2]*Vinnytsia National Tecnical University, Ukraine*

Keywords:
Energy structure, deformation potential, Ge-Si alloy, diffusion thermoemf.

Abstract:
The energetic structure of the conduction band of Ge and Si are well known [1} and at the atmospheric pressure the four lowest L_1 germanium conduction band valleys are occupied by electron in pure Ge. In pure Si at the same conditions are occupied Δ_1 silicium valleys. Under strong elastic pressure the Δ_1 valleys of Ge must be involved in consideration. For this reason energy structure of strained $Ge_{1-x}Si_x$ alloy single crystal must involve four L_1 and six Δ_1-germanium valleys and six Δ_1- silicium valleys. Under sufficiently high pressure practically all electrons will be localized in both type of Δ_1-valleys. Under these condition the Δ_1-valleys becomes accessible for direct experimental measurement [2,3] e, consequently, theoretical considerations of transport phenomena is no purely artificial. In this communication we try to analyze the thermoemf under high hydrostatic pressure. The theory of anisotropic scattering has been used to calculate diffusion thermoemf. The intraband scattering of electrons by acoustic phonons and impurity ions and interband non-equivalent electron scattering between L_1- and Δ_1 – valleys as well as interband equivalent f – and g - scattering between Δ_1- valleys have been considered [4-7]. Particular cases strainless crystals and strongly strained crystals are considered as well as the case of band crossover of L_1- and Δ_1 – valleys.

References

1. Anatychuk L.I., *Physics of Thermoelectricity, v.1*, Institute of Thermoelectricity, Kyiv, Chernivtsi, 1998, 376p.
2. W. Fawcett , E.G.S. Paige *Negative differential mobility of electrons in germanium J.Phys. C: Solid St. Phys*., 1971, Vol. 4. p 1801 -1821.
3. Ahmad C., Adams A. and Pitt G. *Temperature dependence of the electron mobility in the* Δ_{1c} *minima of Germanium . J. Phys. C: Sol. State Phys*., 1979, v.12, N 10, p L379 - L383.
4. V.Chernysh , V.Burdeynyy , F.Tomo. *Peculiarity of Piezoresistance in L_1-Δ_1 Model of Germanium, Proceedings of SPIE , Vol.4425*, p. 362-368, 2001, USA.
5. Chernysh V.V., Cuamba B.C., *Thermoemf in L_1-Δ_1 model of Germanium, J. of Themoelectricity*, 2007, v.3, p.29-44.
6. Chernysh V.V., Cuamba B.C., *Thermoemf in L_1-Δ_1 model of Germanium under high hydrostatic pressure, J. of Themoelectricity*, 2009, v.1, p.30-40.
7. Chernysh V.V., A.G.Samoilovich *and investigations of transport phenomena in elastically deformed germanium, J. of Thermoelectricity*, v.3, 2006, p.14-24.