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

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

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

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Abstract:
$Ge_{1-x}Si_x$ alloys consider as one of the best thermoelectric material at high temperature range as follow from experimental data [1,2]. As well known in the strongly strained germanium single crystal Δ_1- valleys play essential part in transport phenomena. For this reason the follow energetic model for $Ge_{1-x}Si_x$ alloy single crystal have been considered: four L_1-valleys oriented along <111> crystallographic axis, six Δ_1- germanium valleys and six Δ_1-silicon valleys with the same orientation along <100>. The both Δ_1- valleys are 0.18 eV above the L_1-valleys in non-deformed single crystal. The deformation potentials of L_1- and Δ_1- valleys and their occupation numbers have been calculated and their pressure behavior has been analyzed under low (78K) and room (300K) temperatures. At the condition of strong elastic deformation an electron transfer takes place from L_1 to Δ_1- valleys. The hydrostatic pressure don't change the cubic symmetry of crystal but in the strained crystal the contribution of each valley can change significantly which originate no traditional dependences on resistivity in respect of composition *x* and stress *P*. The theory of anisotropic scattering, generalized for the case of strong elastic deformation of single crystal has been used to calculate the resistivity. The intraband mixed scattering of electrons by acoustic phonons and impurity ions and interband nonequivalent 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. The results of the numerical calculation of resistivity as function of straining stress *P*, composition *x* and for temperatures *T=78K, 300K, 450K* are shown on graphics.

References

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