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Physical-Mechanical Characteristics of Monocrystalline Si1-xGex(X 0,02) Solid Solutions

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Abstract : Si-Ge solid solutions (bulk poly- and monocrystalline samples, thin films) are characterized by high perspectives for application in semiconductor devices, in particular, optoelectronics and microelectronics. In this light complex studying of structural state of the defects and structural-sensitive physical properties of Si-Ge solid solutions depending on the contents of Si and Ge components is very important. Present work deals with the investigations of microstructure, electrophysical characteristics, microhardness, internal friction and shear modulus of Si1-xGex(x≤0,02) bulk monocrystals conducted at a room temperatures. Si-Ge bulk crystals were obtained by Czochralski method in [111] crystallographic direction. Investigated monocrystalline Si-Ge samples are characterized by p-type conductivity and carriers concentration 5.1014-1.1015cm-3, dislocation density 5.103-1.104cm-2, microhardness according to Vickers method 900-1200 Kg/mm2. Investigate samples are characterized with 0,5x0,5x(10-15) mm3 sizes, oriented along [111] direction at torsion oscillations ≈1Hz, multistage changing of internal friction and shear modulus has been revealed in an interval of strain amplitude of 10-5-5.10-3. Critical values of strain amplitude have been determined at which hysteretic changes of inelastic characteristics and microplasticity are observed. The critical strain amplitude and elasticity limit values are also determined. Tendency to decrease of dynamic mechanical characteristics is shown with increasing Ge content in Si-Ge solid solutions. Observed changes are discussed from the point of view of interaction of various dislocations with point defects and their complexes in a real structure of Si-Ge solid solutions.

Keywords : Microhardness, internal friction, shear modulus, Monocrystalline
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