INFLUENCE OF GAMMA -RAYS IRRADIATION ON THE PHYSICAL-MECHANICAL PROPERTIES OF MONOCRYSTALLINE p-Si

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Investigations of structural defects in silicon introduced with high energy particles or γ–rays have achieved remarkable progress in recent years. Radiation in the room temperature forms numerous vacancies and matrix interstitials in silicon, that can take part in the formation of stable complexes. At present, there is extensive information on changes in the electrophysical properties of irradiated silicon, but further complete studies are required to establish a firm understanding of their microscopic mechanisms. This information is necessary to create new semiconducting materials and equipment based on Si with controllable parameters. There is very little information about the relationship between the electrophysical properties of neutrons-irradiated silicon and the characteristics of the internal friction temperature spectra [1]. Obtained results show wide application possibilities of the internal friction in the investigations of radiation defects.

In the experiment boron doped monocrystalline silicon grown by Czochralski method in [111] direction was used. Double-side polished plates with (111) orientation and 0,5-1 mm thickness and rods: 0,8x0,8x30mm^3 with [111] direction were prepared for the investigations. The investigated samples are characterized with resistivity 200ohm.cm and dislocation density ~10^4cm^{-2}.

Electrophysical characteristics of p-Si:B monocrystals

p-Si:B (111)	Resistivity, ohm·cm	Holes concentration, cm^{-3}	Holes mobility, cm^2·V^{-1}·sec^{-1}
Initial state	200	$8\cdot10^{13}$	450
After γ–rays irradiation, $2\cdot10^{17}$cm^{-2}	235	$6\cdot10^{13}$	445
After annealing at 300 ^{0}C, 0,5hrs	130	$1\cdot10^{14}$	455

Electrophysical characteristics were determined in the constant magnetic field of 0.5 Tesla induction on the Ecopia HMS-3000 device by Hall effect measurements. Optical absorption spectra of IR irradiation were studied on Cary 660 FTIR Spectrometer. Dynamic mechanical characteristics were determined by internal friction method at torsion oscillations frequency ~1Hz and in the ranges of $5\cdot10^{-5}$-10^{-3} strain amplitude. The samples were irradiated at room temperature with γ-rays from a ^{60}Co source (E=1,25MeV) to a fluence of $2\cdot10^{17}$cm^{-2} photons (Irradiation by γ-rays from ^{60}Co was conducted on the Agat-Metrology radiation device at Georgian National Agency for Standards and Metrology).

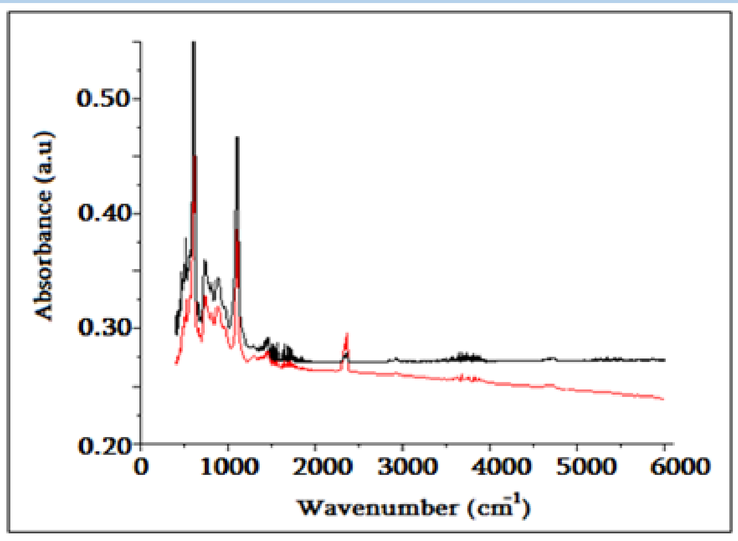
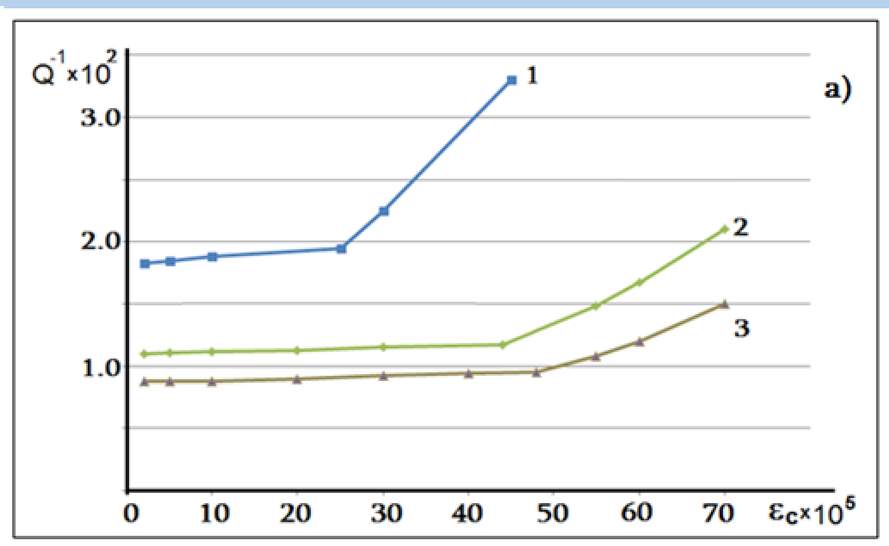


Fig.1.IR irradiation optical absorption spectra of Si plates with (111) orientation 1-initial, 2- after γ-rays irradiation



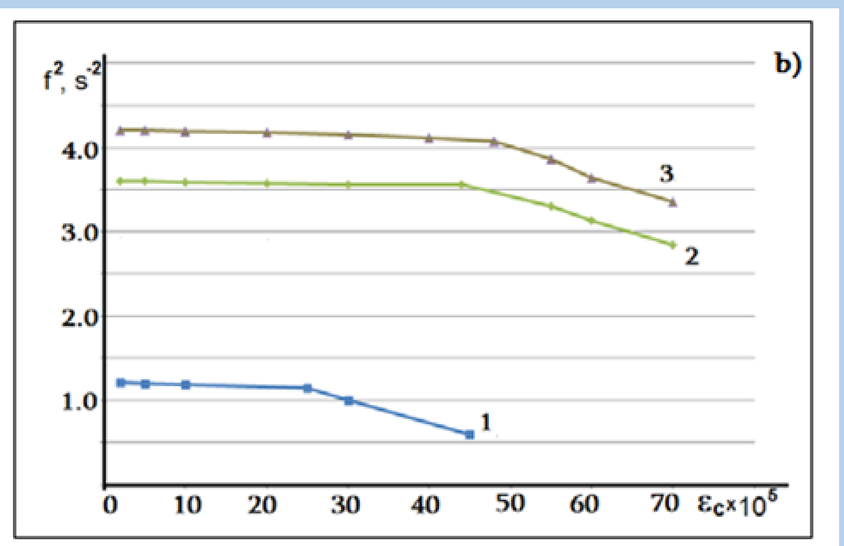


Fig.2. Amplitude dependences of internal friction (a) and shear modulus (b) of monocrystalline Si [111] in initial state (1), after γ-rays irradiation (2), after thermal annealing at 300^{0}C, 0,5 hrs (3).

Changes of electrophysical characteristics and IR irradiation optical spectra stipulated by γ-irradiation and thermal annealing of monocrystalline Si have revealed transformations in the structure of radiation defects. It is supposed, that as a result of transformation high thermally stable complexes containing vacancies and oxygen atoms have been generated.