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Change in Surface Conductivity of Elastically Deformed p-Si Crystals Irradiated by X-Rays

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Based on experimental data, it has been suggested the equation that describes the dependence of surface conductivity ($\lambda = 1 / R$) of p-Si crystals (irradiated and non-irradiated) on the value of uniaxial elastic load:

(1)

(2)

where a, l – the size of the sample, D – absorbed dose.

In equation (1), it is taken into account that the concentration of holes in the impoverished region of the surface layer (thickness w) depends not on the (y) coordinates only, but also on the applied mechanical stress (σ). It is determined by two components: $p(y, \sigma)=p_1(y)-p_2(\sigma)$ under a constant dose of X-radiation, where $p_1(y)$ – is a component that corresponds to a change in carrier concentration in case of distance change from the semiconductor; $p_2(\sigma_{\text{мех}})$ – is a component that shows by how much the concentration of holes is being reduced due to their capture on dislocations during mechanical stress. In addition, hole mobility (μ_p) is not constant value. It depends on the mechanical stress. Therefore, the change in surface conductivity of irradiated p-Si crystals under the action of mechanical stresses is mainly determined by shift of three parameters: β_1, β_2 and μ_p.

Resistance of irradiated samples slightly varies under compression. This is caused by the reduction process in change (growth) factor β_2 due to impeded dislocation motion. Thus, mutually competing changes in parameters β_2 and μ_p are commensurate under compression of irradiated silicon samples. Resistance reduction under load increase is related to the decrease in the longitudinal effective mass of heavy holes and a corresponding increase in their mobility under compression. It is displayed by corresponding mobility increase μ_p in the surface conductivity formula.