

INFLUENCE OF THE TYPE AND CONCENTRATIONS OF PRIMARY DAMAGES OF STRUCTURE OF CRYSTALS OF QUARTZ ON ADDITIONAL DEFECTS PRODUCTION UNDER OF γ -RAY AND NEUTRONS

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Spectra of the absorption (SA) and photo-luminescence (PL) of nominally pure crystals of quartz irradiated by protons with energy 18 MeV with fluence $4 \cdot 10^{14}$ (I type sample), 10^{15} (II type sample) and 10^{17} (III type sample), as well as I, II and III type samples exposed consequent influence of gamma-quanta source of ^{60}Co and neutrons of WWR-SM reactor before and after annealing in the 200-600 °C region, It is established that before additional γ -irradiations in the SA of all types of samples exists the band 215 nm (E2-centres) and bands with the maximums at 550 and 650 nm are observed exist in spectrum PL ($\lambda_p = 337$ nm), intensities of which increase with growing of the proton fluence. The band 650 nm relates with luminescence of non-bridged atom of the oxygen (NAO), existing stably in amorphous phase (AF) of the quartz. It is proposed that appearance of the band 550 nm are connected with the formation of nano-clusters of silicon (NC).

It is shown that in the samples of all types after definite values of doses of γ -quanta near and in volume of the nucleus of amorphous phase, directed by protons, by un-percussion way additional E'-centres and NAO are created. The values of the dose gamma-rays, under which begins creation of additional E'-centres, decreases with growing of the fluence of primary irradiation. Efficiency of the creation E'-centers near the nucleus of the amorphous phase is maximum.

It is established that in I type samples, additionally irradiated by dose of gamma-rays 10^{10} R, intensity of the band 650 nm is more than those of 550 nm. In the II and III type samples additionally irradiated by dose gamma-rays 10^{10} R after influence of the neutron fluence 10^{16} and $5 \cdot 10^{16} \text{ cm}^{-2}$, the inverse picture is observed and the intensities of the bands are larger than in III type samples. We suppose that this is conditioned by the increase of the probability of the formation under neutron irradiation with the growing of the concentrations of the primary damages of the crystal structure.

It is shown that in I type samples, additionally irradiated by dose of gamma-rays 10^{10} R , intensity of the bands 550 nm and 650 nm decrease with growing of the annealing temperature and bands are disappeared at 500° C.

In II and III type samples, caused to consequent influence of gamma-rays and neutrons, at 200 and 300°C intensities of the bands increase. Besides in III type samples intensity of the band at 650 nm becomes larger than that of the band 550 nm. Starting from 400°C intensities of the bands decrease and at 500°C bands disappear. The nature of the physical processes, which causes the increase of the intensities of the bands of 550 and 650 nm after annealing at 200 and 300°C, is not understood definitively. On basis of the comparison of SA and luminescence of the samples

before and after annealing we believe that contribution of the re-absorption luminescence by the center of colours in the increase of the intensities of the bands 550 and 650 nm at 200 and 300°C. Seemingly, of the occurred luminescence at 550 and 650 nm, of AF and NC.