THERMOLUMINESCENCE AS ONE OF THE METHODS FOR DETERMINATION OF THE CRYSTAL LATTICE STRUCTURE OF QUARTZ. L. L. Kashkarov, G. V. Kalinina , S. N. Shilobreeva. Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, 119991, Kosygin str. 19, Moscow, Russia , *leokash@mail.ru*

Introduction: Research of radiation-induced processes of structural and chemical reworking of the silicates, occurring under influence of an ionizing radiation, is now one of the important scientific problems. In a basis of these researches representation about radiation-induced structural changes of a crystal lattice of irradiated samples, formation in it of a different sort of micro-defects lays. As consequence, repeatedly accelerated diffusion leading redistribution of the elements concentration in the crystal volume, is observed [1, 2]. In the works of authors [3, 4] for the first time it has been shown radiation-stimulated redistribution of the implanted into quartz of the iron atoms that was caused by the subsequent irradiation of the accelerated protons. Thus, iron atoms or are undergoing diffusion in the crystal volume, or enter chemical interaction in a near-surface layer of quartz with formation of a chemically modified compound. Radiation-stimulated diffusion for greater depths can be treated as segregation of iron atoms on some centers such, for example, as oxygen vacancies of quartz. In view of these processes, it is important to perform an experimental definition of a degree of radiation-induced crystal lattice destruction. One of high-sensitivity methods of registration of structural changes of quartz is the method of thermoluminescence (TL) analysis. In work [5] at research of the TL- luminescence of quartz precise dependence of the TL-parameters on capacity of shock loading has been received. In the present work the results of TL-parameters measurement for the quartz of different crystal structure are presented. Enough high sensitivity to TL-storage, allowed to use this mineral for development of a TL-research technique of structural changes and destructions of the crystal lattice, occurred under action of nuclear irradiation, are discussed.

Samples and technique: TL-measurement was spent for a number of quartz samples: Qu-1 fusion, with amorphous structure and Qu-2 natural rock crystal. As have shown the optical analysis, the Qu-1 contained the microcrystallite inclusions, and Qu-2 were represented as the transparent, colorless monocrystals. Measurements were spent on the installation, allowing to register the very low levels of the TL-luminescence by a technique described in [6]. It was registered natural (TL_{NAT}) and artificially induced (TL_{IND}) when the samples were exposed to X-rays of energy E = 55 keV.

Results and discussion: From comparison of the TL glow curves for the studied quartz samples it is follows: 1) TL_{NAT} - intensity for both sample groups of quartz in the low (≤ 250 ^{o}C) temperature interval is approximately identical and lays at a level of 1×10^{-3} relative units, that corresponding to a background thermoluminescence (TL_{BAC}). However, at ~ 300 ^{o}C it is observed peak of the TL_{NAT} -luminescence, approximately on the order of magnitude exceeding a background luminescence in this temperature interval. This TL_{NAT}-luminescence is adequating to the trapped electrons, accumulated during all history of existence of the given samples. 2 TL_{BAC} was measured at repeated heating of the samples after measurement their TL_{NAT}, that specifies a minimum level of the TL-luminescence which can be registered on used installation. 3) TL_{IND} it is characterized by following features: For the samples of amorphous quartz Qu-1 on a glow curves it is observed, at least, five peaks in the low-temperature ~ (50-250) ^{o}C intervals and several peaks in the region of ~ (250-400) ^{o}C. Evaluation of the activation energies according for these peaks gives the values from ~ 1.1 eV up to ~ 1.8 eV. Single-peak in TL_{IND} glow curve for the samples of Qu-2 corresponds to the activation energy of ~ 1.2 eV.

Conclusion: Difference of the glow curves for TL_{IND} in Qu-1 and Qu-2 samples, and evaluation of the activation energy allow us to identify some crystal structural characteristics. It is apparently, that in fused quartz specific glow curves are caused by inclusions of microcrystals. Corresponding degrees in heterogeneity of structure in these samples as a whole can be estimated due of these data. Carrying out of the special calibration experiments on revealing of the activation energy levels at implantation of quartz by accelerated nuclei will enable for carrying out of a quantitative estimation of a degree of destruction the quartz crystal lattice, that arising under influence of nuclear particles of different charge and energy.

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