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Quartz investigation under fast proton irradiation by luminescense method

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Experimental studies of the quartz luminescence during high-energy hydrogen ions bombardment are presented. The influence of observation angle and ion energy on shape of light-spectrum was investigated. Two experimental series were carried out as with rigid connection between incident and observation angles as without this ones (true indicatrix). It was shown that the optical spectrum shape depended from ion energy and observation angle. The possibility of application of these results for distant monitoring quartz irradiation processes was proposed.

Представлены результаты экспериментальных исследований люминесценции кварца при бомбардировке высокоэнергетичными ионами водорода. Исследована зависимость формы оптического спектра от угла наблюдения и энергии ионов. Проведено две серии экспериментов: при наличии жесткой связи между углом падения пучка на мишень и углом наблюдения, и без этой связи (реальная индикатриса). Показано, что форма оптического спектра зависит от энергии ионов и угла наблюдения. Предлагается применение этих результатов для дистанционной диагностики процессов в кварце под облучением.

An increasingly keen interest in the behavior of some dielectrics under irradiation with charged particles has been shown in recent years. This is of particular urgency for the materials widely used as insulators and windows in thermonuclear facilities [1]. The main reason for the change in the properties of materials under irradiation lies in the formation and dynamics of radiation defects of various types. Luminescence is also an accompaniment of defect formation. The optical radiation arises during the rearrangement of the system under the action of a particle moving in the substance. This rearrangement may manifest itself in an immediate formation of defects or in a generation of quasi-particles that may propagate in the solid. The decay of the quasi-particle may also result in the defect formation. For both channels of particle energy dissipation, the relaxation processes may lead to the electromagnetic wave generation. In both cases, it is the particle that serves as an energy source. The process of electromagnetic radiation generation is much influenced by the dynamics of defect formation in the medium, particularly, by the spatial distribution of defects of various types and the existing dynamic equilibrium between them. Consequently, the characteristics of luminescence (intensity, spectral distribution, angular distribution, etc.) should depend on the sort and energy of projectiles, on the value of the absorbed dose of radiation, on the distribution of energy losses by the charged particle in the substance.

One of the materials most widely employed for both optical and insulating elements in thermonuclear facilities is quartz. It is also widely used in microelectronics (e.g., as one of the components of MOS), in space vehicles, etc. [2, 3]. Despite all the importance of the issue, the investigations