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Thermoluminescence of natural alexandrite

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Natural and synthetic dosimetric materials are used for the determination of the irradiation dose received in the environment as well as in medical and technological activities. Synthetic dosimeters have the advantage of the controlled synthesis and the high levels of reproducibility. However, natural dosimeters find application, **e.g**., in retrospective dosimetry and may be a lower-cost alternative to synthetic ones. Brazil is one of the largest producers of minerals in the world, including alexandrite ($\mathrm{BeAl_2O_4:Cr^{3+}}$). Alexandrite is expected to have potential as a natural dosimeter for ionizing radiation since its composition contains 19.8 wt % BeO and 80.2 wt % $\mathrm{Al_2O_3}$, both oxides being commercially used as dosimeters. The luminescent properties of natural alexandrite were investigated using the thermoluminescence (TL) technique, that is the light emitted by a certain crystal when heated, being a thermally stimulated emission from an energy that was previously stored in the crystal during irradiation, in addition to the incandescence. In addition to the determination of the chemical composition by scanning electron microscopy, energy dispersive spectrometry and X-ray fluorescence. The glow curves were investigated as a function of the irradiation dose from 1 to 10 Gy using a $^{90}\mathrm{Sr}/^{90}\mathrm{Y}$ beta source and by means of several methods, including glow curve fitting and T_m-T_{stop}. From these analyses, the activation energy, **E**, and frequency factor, **s**, associated with each of the glow peaks were obtained. TL analysis as a function of the beta irradiation dose showed that the T_m and **E** values of all the glow peaks were dose-independent as expected for glow peaks that follow a first-order kinetics TL mechanism. The T_m-T_{stop} analysis indicated the presence of at least five peaks at about 355, 405, 435, 530 and 580 K (at 1 K/s). Further, fading due to storage for up to 48 h was also investigated. The results obtained in this work showed that the TL signal varied linearly with the irradiation dose, and that the TL signal was stable at room temperature for up to at least two days after the exposure to irradiation, demonstrating the potential of using alexandrite for dosimetry.