Photoluminescence and Thermoluminescence of Alexandrite ($BeAl_2O_4:Cr^{3+}$)

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The investigation of luminescent properties in alexandrite ($BeAl_2O_4:Cr^{3+}$) in synthetic and natural forms is presented in this work. Alexandrite is a rare and precious mineral that changes color according to the light incident on it. Moreover, in the synthetic form it is used technologically as active medium for laser with properties superior to its main competitors, ruby and Nd: YAG. In the literature we find references to its photoluminescent properties, especially to its laser applications in the medical field. However, reports on its thermoluminescent properties are rare. Results of photoluminescence measurements for natural and synthetic alexandrite are presented, where the samples are excited by the 488 nm line of an Ar^+ laser, at different temperatures. Results indicate anomalous behavior of Cr^{3+} transition depending on the measurement temperature. A simple model to explain the phenomena is suggested. In addition, the work also proposes thermoluminescence investigations of natural alexandrite to understand the effects of ionizing radiation and heat treatment on these crystals. Optically stimulated luminescence (OSL) measurements were also carried out to complement the characterization of TL through the studies of the traps for optical stimulation. Luminescence was stimulated with blue LEDs (470 nm) provided by an automatic reader. Irradiation was performed with a $^{90}Sr/^{90}Y$ beta source, and the emitted light was measured with a photomultiplier tube, protected with suitable optical filters. Measurements were performed with the same equipment, Risø TL/OSL-DA-15 reader, to evaluate the thermal and optical stability of the defects related to OSL and TL. Initial measurements show that alexandrite samples from the same block of mineral exhibit the TL peaks at the same temperatures and probably Cr^{3+} ions have an important part in the process.