Optically-Stimulated Luminescence in Al_2O_3:C

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Abstract

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Luminescence is the emission of "cool light" from a material, that is, light created by a cause other than incandescence. A familiar example is the "glow-in-the-dark" materials that give off a dim delayed glow after exposure to a strong light source. Other solid materials acquire luminescence as a result of being exposed to radiation other than visible light, such as x-rays, beta or gamma rays, or cosmic rays. The radiation either creates new electrically-charged defects in the crystal structure or acts to charge existing defects. When the solid is later stimulated by heat or exposure to some particular color of light, the electrically-charged defects "discharge," creating luminescence light in the process. These processes are complex and even now are not well understood theoretically, making them a good subject for research. Nevertheless, this type of radiation-induced luminescence has some very important practical applications. For example, in the dating of rocks and pottery, and radiation dosimetry.

The goal of the present experiment is to study optically-stimulated luminescence in Al_2O_3:C, a material that has recently emerged as an important tool in radiation dosimetry. Samples will be irradiated with x-rays and then illuminated by green light (532 nm) from a small (Nd:YAG) laser pointer. The resulting luminescent light, which is expected to have a wavelength of 410 nm with a bandwidth of about 50 nm, will be observed in a sensitive photodetector connected to an oscilloscope or voltmeter. The intense green light needs to be blocked from the detector in order to see the weaker blue luminescence light. This will be done with specialized filters or by utilizing the pulsed nature of the green laser light.

Samples and filters have recently been received, and samples have been irradiated using an small x-ray machine. The initial observations seem to show that the blue light is weaker than expected, and so improvements to the sensitivity of the setup are being pursued.

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