TIME EVOLUTION OF RADIATION-INDUCED LUMINESCENCE IN TERBIUM-DOPED SILICATE GLASS

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Abstract

A study was made on two commercially available terbium-doped silicate glasses. There is an increased interest in silicate glasses doped with rare-earth ions for use in high-energy particle detection and radiographic applications. These glasses are of interest due to the fact that they can be formed into small fiber sensors; a property that can be used to increase the spatial resolution of a detection system. Following absorption of radiation, the terbium ions become excited and then emit photons via 4f-4f electronic transitions as they relax back to the ground state. The lifetime of these transitions is on the order of milliseconds. A longer decay component lasting on the order of minutes has also been observed. While radiative transitions in the 4f shell of rare-earth ions are generally well understood by the Judd-Olfelt theory, the presence of a longer luminescence decay component is not. Experimental evidence that the long decay component is due, in part, to the thermal release of trapped charge carriers will be presented. In addition, a theoretical model describing the time evolution of the radiation-induced luminescence is discussed.