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RADIATION-INDUCED LONG-LIVED LUMINESSCENCE OF POTASSIUM CHLORIDE (KCl)

Abstract

Potassium chloride (KCl) is a commonly available material characterized by strong luminescence signal induced by ionizing radiation. Irradiated KCl crystals have the ability to store the information about the absorbed dose of radiation. The information can be obtained by optically stimulated luminescence (OSL) and thermoluminescence (TL) methods. These features make KCl a potential detector for dosimetry applications. So far, no systematic research has been conducted on the OSL properties of pure (not doped) KCl crystals. The aim of this work is to study dosimetric properties of potassium chloride using the OSL method. The following features were investigated: repeatability of the OSL signal, sensitivity to radiation and sensitivity changes of the material, dose response of the OSL signal, signal stability after irradiation, the influence of thermal treatment and humidity on the OSL signal. The studies confirm a complicated mechanism leading to the OSL phenomena in KCl crystals. This seemingly simple material is characterized by complex luminescence kinetics, which manifests by inverse fading and the OSL regeneration phenomena. These effects are associated with self-renewal of OSL signal during subsequent OSL readouts (regeneration) and increase of luminescence signal with time after irradiation (inverse fading). Another purpose of this work are experimental studies of the phenomena and an attempt to explain the responsible physical mechanisms. The OSL characteristics were complemented by thermoluminescence (TL) and spectrally resolved thermoluminescence (SR-TL) measurements, which provide additional information relating the trap states and recombination centers existing in the material.

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