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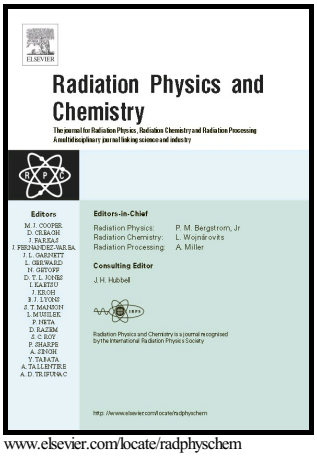

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GAMMA-RAYS INDUCED COLOR CENTERS IN Pb^{2+} DOPED CaF_2 CRYSTALS

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Abstract

Pure and PbF_2 doped CaF_2 crystals were obtained in our crystal research laboratory. The influence of PbF_2 concentration on the color centers induced by γ-and x-rays irradiation were studied. Two broad absorption bands with maxima peaked at 410 and 730 nm appear in the optical absorption spectra; the spectra are quite similar in band structure for all samples and for the both radiation. Different bands showed different responses to the irradiation and to the long-term recovery. The most stable color centers are (F_i^0) and the dimer P-P ($Pb^+(1)$-Pb^{2+}). These absorption bands remain stable even for trace amount of Pb^{2+} ions, so CaF_2:PbF_2 is not a good material for applications in which the new optical absorption bands are undesirable.

1. Introduction

The quality and stability of the optical properties of crystalline materials are influenced by the lattice imperfections (vacancies, interstitials, dislocations) and the purity of the material (undesired or/and desired impurities). Fluorides (MeF_2; Me=Ca, Sr, Ba) single crystals have several applications: as windows from UV and visible to infrared, as optic windows in fusion reactors, scintillators, laser materials etc. In all their applications, these materials are subjected to various types of radiations: laser, γ-rays, x-rays, electrons, ions, neutrons etc. It is important to study the influence of radiation damage on the optical properties of pure and doped crystals. The irradiation induced color centers of fluorides have been studied since 1950^s by many researchers [Smakula, 1949; Messner and Smakula, 1960; Ausin, 1974; Cooke, 2003; Izerrouken, 2010]. Usually, the damage is evaluated by measuring the optical absorption spectra as functions of absorbed dose and as time evolution. The induced color centers in pure CaF_2 by various radiations are characterized approximately by similar absorption bands at 225, 260, 335, 385, 455, 550 and 580 nm [Messner and Smakula, 1960;