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# Study of the $KMgF_3$ scintillator radiation damage

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Radiation damages of the $KMgF_3$ scintillator have been studied under irradiation with γ-rays. The $KMgF_3$ scintillator radiation resistance is found to be equal to 100 krad. The $Na^+$ impurity is supposed to be responsible for the $KMgF_3$ radiation damage.

## 1. Introduction

Different kinds of calorimeters based on crystal scintillators and capable of working under high radiation conditions are presently being developed for the use at future hadron colliders. In connection with this, the calorimeters with the readout of scintillation signal by photosensitive gaseous chambers are of great interest [1,2], because these chambers have high radiation resistance (in contrast to the photomultiplier tubes).

Out of the known solid scintillators transmitting their own emission, the $KMgF_3$ crystal emits in the shortest wavelength region (140–200 nm) [3]. Just this property allows one to use a gaseous chamber with a photosensitive TEA vapoure for the scintillation detection [4,5]. Such chamber has a high radiation resistance, since it works with a continuous gas flow. Gaseous chambers with a solid CsI or CsI–TMAE photocathode are promising as well [6,7]: from ref. [7] it follows, that the CsI photocathode can withstand the irradiation up to $10^5$ J/kg of absorbed energy density corresponding to the dose of 10 Mrad.

Due to the low transmission in the VUV region, the $KMgF_3$ crystal can be used only in inhomogeneous calorimeters with the crystal thinckness of about 5 mm. Different types of these calorimeters have been considered in ref. [5]. However, there are no exhaustive data on radiation resistance of $KMgF_3$ itself.

Apparently, the only studies on $KMgF_3$ radiation colouring were performed as long as more than twenty years ago [8–10]. In ref. [8] Hall investigated the production at low temperatures of self-trapped holes ($V_k$-centers), which have an absorption band at the wavelength $\lambda = 340$ nm. And in ref. [9,10] it was shown, that at room temperatures the most strong absorption bands were caused by the production of anion vacancies trapping the electron – F-centers at $\lambda = 280$ nm and their bimolecular states $F_2$-centers at $\lambda = 440$ nm and $F_2^+$ at $\lambda = 565$ nm. It is difficult to estimate the radiation resistance of $KMgF_3$ from these works, because they are devoted to the determination of the coloured centers nature. There are no data in the wavelength region shorter than 200 nm, i.e. in the $KMgF_3$ scintillation region.

The present work fills these gaps, and much attention in it is given to the radition resistance of the $KMgF_3$ scintillation characteristics.

## 2. Experimental procedure

Two types of the $KMgF_3$ samples have been studied, one being produced in the Institute of Crystallography (Moscow) and the other in the Grusdev Fund (Kazan). The crystals were grown by the Stockbarger method in an argon atmosphere. The starting materials consisted of equal parts of $MgF_2$ and KF, each being preliminary recrystallized in the atmosphere activated with HF. The growth rate was 3 mm/h. The samples had a thickness of 4 mm after polishing, which corresponded to the $KMgF_3$ thickness in the proposed calorimeters.

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