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THE LUMINESCENCE OF Eu^{2+} IN CaF_2 CRYSTAL

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It is found that two different luminescent Eu^{2+} centers exist in CaF_2:Eu^{2+} crystal. The crystal color and luminescent stability are described.

1. INTRODUCTION

The luminescence of RE ions in CaF_2 crystal has been studied extensively during the past few years[1-4], but few papers on the luminescence of Eu^{2+} in CaF_2 crystal have been found. In this paper, we report the luminescence of the Eu^{2+} ions in Eu^{2+}-implanted CaF_2 crystal and discuss the crystal color and luminescent stability which connect with the presentation of two luminescent centers of the Eu^{2+} ions.

2. EXPERIMENTAL

The experimental techniques were described in Ref. 6.

3. RESULTS AND DISCUSSION

We observed the luminescence of europium ions which were implanted into the CaF_2 crystal with dose of $1X10^{15} cm^{-1}$ and energy of 100kV. The emission spectrum shows that the Eu^{2+} emission consists of two emission bands (see Fig. 1), one is around 420nm and the other around 680nm. We can conclude certainly that the two emission bands of Eu^{2+} are not caused by the same Eu^{2+} luminescent center, according to the differences of the excitation spectrum (see Fig. 2). The emission band around 420nm is due to the Eu^{2+} which replaces the Ca^{2+} lattice site, this was verified by the Eu^{2+} luminescence in CaF_2:Eu^{2+} doped during growing up[5]. The emission around 680nm is due to the Eu^{2+} which is situated in the interstice of the CaF_2 crystal lattice. Fig. 1 also shows the emission spectrum of the

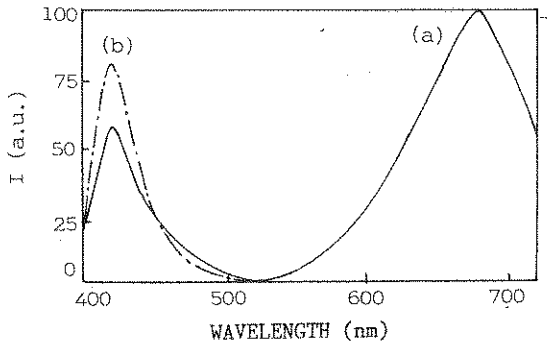

FIGURE 1
Emission spectra of CaF_2:Eu^{2+} at RT
(a) Before annealing
(b) After annealing in vaccum ($7X10^{-5}$ torr) at 600°C for 30 minutes.

Eu^{2+}-implanted CaF_2 after annealing in vaccum ($7X10^{-5}$ torr) at 600 °C for 30 minutes. It is shown that the emission band around 680nm decreases remarkably, even disappears. This means that the Eu^{2+} in interstice of the CaF_2 crystal lattice has migrated into the Ca^{2+} lattice site.

The implantation of Eu^{2+} makes the CaF_2 crystal colored, so the crystal presents a very weak color of pink. The perfect crystal is damaged by the implantation process. The measurement of longitudinal optical phonon line in Raman spectrum may show the changes of the crystal symmetry. In our experiment, we measured the CaF_2 LO-phonon line before and after the implantation, this means that the crystal symmetry is damaged. The color of Eu^{2+}-

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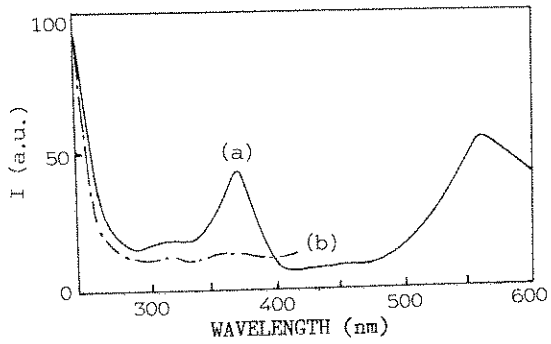

FIGURE 2
Excitation spectra of CaF_2: Eu^{2+} at RT
(a) 680nm emission
(b) 420nm emission

-implanted CaF_2 shows the influence of the crystal field or environment on the Eu^{2+} in the interstice of the CaF_2 crystal lattice. The peak of the longer wavelength absorption band of the Eu^{2+}-implanted CaF_2 crystal is in the visible region (peak at 580nm) which corresponds to the color condition. Similarly, after annealing in vaccum at 600°C for a shorter-time, the color of the sample disappears, this means that the luminescence of the Eu^{2+} in the interstice of the CaF_2 crystal lattice is instable.

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