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LUMINESCENCE AND CHARGE TRANSFER BANDS OF THE Sm(3+) AND Eu(3+) IN $Mg_3BO_3F_3$

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The excitation and emission spectra and the charge transfer bands of the Sm(3+) and Eu(3+) in $Mg_3BO_3F_3$ have been investigated under UV radiation and CR excitation. The charge transfer bands of Sm(3+) and Eu(3+) which center around at 43.5 and 34.2 $X10^3 cm^{-1}$, respectively are observed at room temperature

1. INTRODUCTION

The magnesium fluoroborate material studied has composition $Mg_3BO_3F_3$. The luminescence of the rare earth activators in the system $Mg_3BO_3F_3$ has not been reported. In the past investigation of charge transfer band was mainly made on oxides doped with Eu(3+) ion[1,2].

In this paper we report the luminescence properties of the host lattice, Sm(3+) and Eu(3+) and charge transfer bands presenting in the excitation spectra of the Sm(3+) and Eu(3+) emissions in the magnesium fluoroborate.

2. EXPERIMENTAL

Samples discussed were prepared by solid—state reaction. An appropriate amount of MgO, MgF_2, B_2O_3 (or H_3BO_3), and Sm_2O_3 or Eu_2O_3 compounds were mixed and fired at 1100°C for 2 hours. The white powder samples obtained were checked by x-ray powder diffraction analysis and have the hexagonal structure of r-$Mg_3BO_3F_3$. The luminescence properties of samples were measured by the YF-2 cathode-ray measurement system and MPF-4 type fluorespectrophotometer.

3. RESULTS AND DISCUSSION

It is found that a strong emission band peaking at 388 nm is the emission of the host lattice under the excitation of the short wavelength UV radiation. Main emissions of the Sm(3+) and Eu(3+) ions in $Mg_3BO_3F_3$ are respectively located at 651 nm of the Sm(3+) $^4G_{5/2}$-$^6H_{9/2}$ transition and at 613 nm corresponding to the $^5D_0$-$^7F_2$ transition of the Eu(3+) under UV radiation and cathode-ray excitation. The decay time to 10% initial brightness value is about 80 ms for the Sm(3+) and Eu(3+) doped samples under CR excitation.

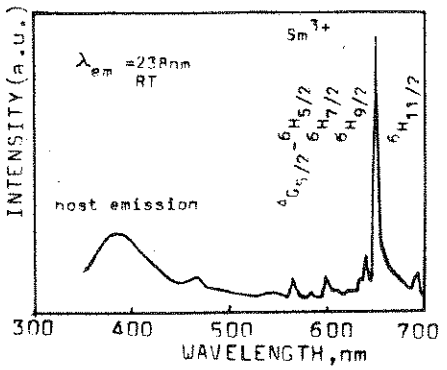

FIGURE 1
Emission spectrum of $Mg_3BO_3F_3$:Sm^{3+} phosphor

The fluorescence spectrum of $Mg_3BO_3F_3$:Sm(3+) involves a emission band of the host lattice situated in the blue-violet region and some characteristic emissions of Sm(3+) where the energy levels of Sm(3+) transition were marked, as in Fig. 1. The excitation spectrum of the Sm^{3+} 615 nm emission in $Mg_3BO_3F_3$ is shown in Fig. 2. The excitation and emission

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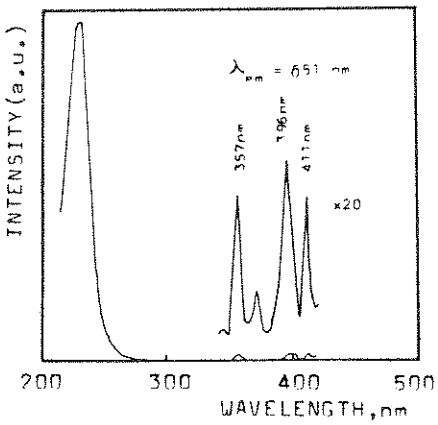

FIGURE 2
Excitation spectrum of Sm^{3+} emission in $Mg_3BO_3F_3$

spectra of the Eu^{3+} in the magnesium fluoroborate phosphor are shown in Fig. 3. All measurements were performed at room temperature.

Both the excitation spectra of the Sm(3+) and Eu(3+) emission in the magnesium fluoroborate contain an intense charge transfer band (CTB) and some narrow lines of the Sm(3+) and Eu(3+) 4f-4f transitions. The energy positions of the charge transfer bands of the Sm(3+) and Eu(3+) ions in $Mg_3BO_3F_3$ are located at 43.5 and 34.2 ($X10^3 cm^{-1}$), respectively. The difference value ($9.3X10^3$ cm^{-1}) between the CTB positions of the Sm(3+) and Eu(3+) in magnesium fluoroborate very coincides with that one obtained by Jørgensen[3]

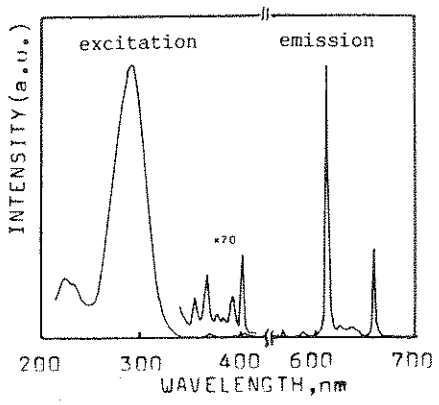

FIGURE 3
Excitation(left, λ_{em}=613 nm) and emission(right λ_{ex}= 295 nm) spectra of Eu(3+) in $Mg_3BO_3F_3$.

and Blasse[4] in other compounds.

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