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THE INTERACTION BETWEEN Mn AND DIFFERENT Sm CENTERS IN ZnS

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Two kinds of Sm centers in ZnS are identified. The interactions between Mn and these two kinds of Sm are found different. In the emission spectra of ZnS:Mn,Sm appeares a new sharp line(about 2 cm^{-1}). It would come from the Mn-Sm associated center.

1. INTRODUCTION

We found that the excitation energy can be transfered from Mn to Sm in ZnS:Mn,Sm[1]. In order to deeply understand the energy transfer process and interaction between Mn and different Sm centers in ZnS, we have investigated the photoluminescence of single crystal and powder of ZnS:Sm and ZnS:Mn, Sm in the temperature range 2k-77k.

2. EXPERIMENTAL

The photoluminescence spectra are measured with a SPEX-1403 spectrometer. The excitation spectra are measured with a MPF-4 spectrophotometer. A Xe lamp and an argon ion laser are used as the excitation source. For the decay time, an N_2 laser pumped dye laser is used to excite the sample, the wavelengths available being 337nm and 530nm with a duration of about 10ns. The luminescence decay is measured by a TCH - 1000 transient recorder.

3. EXPERIMENTAL RESULTS AND DISCUSSION

The characteristic emission lines of Sm ions come from the transitions of $^4G_{5/2} - {}^6H_{5/2}$, $^4G_{5/2} - {}^6H_{7/2}$ and $^4G_{5/2} - {}^6H_{9/2}$.

From the emission spectra of $^4G_{5/2} - {}^6H_{9/2}$ trasition of Sm in ZnS (Fig.1), it is found that there are two groups of lines: lines 1,2,6,7 belonging to groupI and lines 3,4,5 belonging to group II. While the lines of group I possess a relatively large width of the order of 20cm^{-1} which are weakly temperature dependent, the lines of group II are rather sharp (about 5cm^{-1} at 2k) and are significantly broadened as the temperature increases. Feom time resolved spectra it is found that the I-- lines have the decay time of 400us and II-lines have that of 200us. In addition, these two groups of lines also have different excitation spectra(Fig. 2). These e perimental results prove that two groups of lines come from two different luminescence centers: group I come from center I and group II comes from center II. In order to identify the nature of these two kinds of centers, we measured the emission spectra

of single crystal and powder of ZnS:Sm (Fig.1). We found that the intensities of the II-lines are very strong in ZnS:Sm powder. We know that the crystal has cubic structure and powder has hexagonal structure mainly. It seems that centerI is relative to the cubic structure and center II to the hexagonal one.

When ZnS powder is doped with both Mn and Sm, the intensities of II-lines are stronger than that in ZnS:Sm and increase with the concentration of Mn. In Fig.2 are shown the excitation spectra of the emission bands of Mn and two kinds of Sm centers. In the excitation spectrum of Sm in ZnS:Mn,Sm five additional bands are found for emission of Sm. In ZnS:Sm these excitation bands are practically absent. In fact they are corresponding to the excitation of Mn ions in ZnS:Mn. It means there exists the energy trasfer from Mn to different Sm. On the other hand, the relative excitation intensities of various Sm centers are different. The intensity of excitation bands of center II is stronger than that of center I. It seems that the interaction between Mn and two kinds of Sm centers is different. In emition spectra of ZnS:Mn,Sm appeares a new sharp line(at 15367cm^{-1}). More detailed studies show that the new line has different quenching temperature and polarization in comparison with those from Mn and Sm ions. It would come from the Mn-Sm associated center.

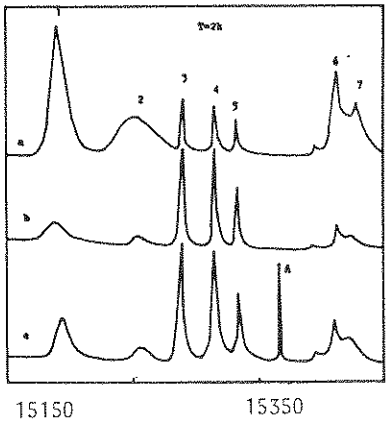

FIGURE 1
Emision spectra of $^4G_{5/2}$-$^6H_{9/2}$trasition of Sm in (a) ZnS:Sm single crystal, (b) ZnS:Sm powder, (c) ZnS:Mn,Sm

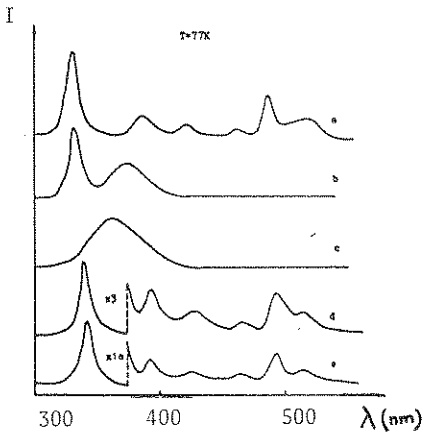

FIGURE 2
Excitation spectra of (a) Mn in ZnS:Mn, (b),(c) and (d), (e) the II- and I-lines of Sm in ZnS:Sm and in ZnS:mn,Sm

REFERENCES

1. Xu Wu, Zhang Xinyi and Xu Xurong, J. Lumi. 31/32 (1984) 808.