ON Mn\(^{2+}\) \([{}^4T_{1g} (\text{G}) \rightarrow {}^4A_1 (\text{S})]\) TRANSITION IN CaS: Mn: Ce PHOSPHOR

LUMINESCENCE of Mn\(^{2+}\) in cubic crystal lattices has been studied by various workers. Ibuiki and Langer\(^1\), and Langer and Ibuiki\(^2\) observed fine structure of 5860 Å band in the spectrum of cubic ZnS : Mn\(^{2+}\) at 77° K. During the course of the study of the effect of rare earth metals on Mn doped alkaline earth sulphides, similar observations have been made by us in the spectrum of CaS : Mn : Ce phosphor at liquid nitrogen temperature. The results obtained therein have been presented briefly in this note.

CaS : Mn : Ce phosphors were synthesised following standard methods. Samples were prepared keeping the concentration of Mn at an optimum value (0-01\% by weight) and varying the Ce concentration (0\% to 0-02\% by weight). The mixture was heated in a muffle furnace for half an hour at 900° C along with activated carbon and sodium thiosulphate flux. Mercury 3650 Å was used for exciting the sample. The fluorescence spectra were recorded on fortpen films using a Hilger double prism spectrograph. Spectral densities were measured with a Moll recording microphotometer. The microdensitograms in the 5800 Å region are shown in Fig. 1. As the concentration of Ce increases an additional band develops at 6600 Å.

As seen in the figure, the band shows a structure at liquid nitrogen temperature. The band resolves into five components at 6199 Å, 6001 Å, 5803 Å, 5618 Å and 5281 Å. A similar structure was observed by Langer and Ibuiki\(^2\) in the case of ZnS : Mn\(^{2+}\). A tendency of the band peaks to shift towards the shorter wavelength side along with a reduction of intensity is observed by increasing the Ce concentration.

At room temperature Mn\(^{2+}\) ion emits a bright orange fluorescence with a peak at 5800 Å. The ground state of Mn\(^{2+}\) is a \(4S\) arising from the \(d^9\) configuration. In the cubic CaS lattice, Mn\(^{2+}\) substitutes for Ca\(^{2+}\) which is confirmed by X-ray analysis. The band at 5850 Å arises due to the \(^4T_{1g} (\text{G}) \rightarrow ^4A_1 (\text{S})\) transition. The broadening of the band is due to phonon emission coupled with electronic transition. At liquid nitrogen temperature the strength of this coupling is reduced and transitions to different vibrational levels of the ground state are resolved. The mean spacing of 570 cm\(^{-1}\) between the lines gives the phonon frequency in the ground state. The spacing between the first two components is about 1140 cm\(^{-1}\). It means that \(v' = 0 \rightarrow v'' = 1\) transition is not observed. However, the nature of the energy levels involved in the transition can be understood only by a rigorous analysis of electron phonon coupling. Work in this direction is in progress.

In the CaS lattice Ce\(^{3+}\) takes the interstitial position. As the concentration of Ce increases, the energy gets transferred from Mn\(^{3+}\) (\(T_{1g}\)) to Ce\(^{3+}\) which explains the band observed at 6600 Å for higher concentration of Ce. This also explains the reduction in the intensity of the band as the Ce concentration is increased. The intensity fall due to such energy transfer affects mostly the bands in the longer and shorter wavelength side of the 5800 Å region. This can be explained on the basis of the variation of the transition probability by Franck-Condon principle. Shift of the band towards higher wavenumber side by increase in the Ce concentration indicates the reduction of crystal field effect on Mn\(^{2+}\). (The band at 5800 Å shifts by an amount 66 Å when the Ce concentration is 0-015\%.)

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HELIUM-NEON LASER INDUCED CHANGES IN ERYTHROCYTES

Helium-Neon (He-Ne) laser has been used in the fields of medicine and biology. These laser radiations interact with blood and other tissues and may change the functioning of the cells. Hemolysis of erythrocytes has been reported when they are exposed to the radiations from high power lasers. This type of interaction with He-Ne laser has not been reported so far. In this communication we report the induced changes in erythrocytes by this laser irradiation at various intervals of time.

The assembly for the laser irradiation of erythrocytes is shown in Fig. 1. Radiations from 2 mW He-Ne laser were used to irradiate the blood sample, 1 mm thickness, kept in a petri-dish, 20 mm diameter. A parallel beam of the same diameter was used, which was obtained by lenses L₁ and L₂. Thick black rubber was placed at the bottom of the petri-dish to absorb the transmitted laser radiations, to avoid the interaction of the scattered radiations with the blood samples. The energy losses due to mirror, lenses and transmission through the sample amounted to 30% and were subtracted from the total dose. In order to avoid the effect of any non-uniformity in exposure, the blood sample was mixed gently during the irradiation process.

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Fig. 2 (a, b). Erythrocytes prior to exposure. These cells have normal shape and show the absence of crenation and aggregation.

Fresh human blood was drawn in a syringe containing sodium citrate as an anticoagulant and was divided into three parts: part 1 was used as control, parts 2 and 3 were used as samples 2 and 3, respectively. Sample 2 was exposed for 15 min and sample 3 for 30 min. After each exposure, microscopic slides were prepared and observed under Leitz microscope at magnification of 1000. The hemoglobin contents of