

SHORT COMMUNICATIONS

LASER-INDUCED FLUORESCENCE IN POTASSIUM MANGANESE SULPHATE SINGLE CRYSTAL

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A study of the absorption and fluorescence of ions in different crystals provides information not only about the impurity atoms but also on the lattice phonons and their interaction with the electronic energy levels of the impurity ions^{1,2}. Therefore a laser-induced fluorescence study of Mn^{2+} ions in a potassium manganese sulphate $\{K_2Mn_2(SO_4)_3\}$ crystal was made.

Potassium manganese sulphate (KMS) belongs to the Langbeinite family³, some of which are ferroelectric. KMS is not ferroelectric but undergoes a structural phase transition from the space group $P2_13$ at room temperature (RT) to $P2_12_12_1$ at low temperature (191 K). In the high temperature phase Mn^{2+} ions are on the three fold axes⁴. At low temperature they lose this symmetry and are situated in a general position. Raman spectroscopic studies of this phase transition have been made in this laboratory⁵ and in this connection its absorption spectrum was recorded but not studied in detail. There is no information in the literature on the absorption and fluorescence spectra of potassium manganese sulphate. The absorption spectrum of KMS was taken for the present sample at RT. It showed features similar to those of Mn^{2+} ion in MnF_2 and $RbMnF_3$ crystals^{6,7}.

The fluorescence spectrum was excited with the 337.1 nm line of a home made pulsed nitrogen laser (pulse length 8 ns, repetition rate 10 Hz, peak power 100 kW). The crystal was kept in a low temperature optical cryostat, whose temperature could be varied from liquid nitrogen temperature (LNT) to RT. The fluorescence collected at 90° to the incident nitrogen laser beam was collimated, filtered and focussed on the slit of a three prism glass spectrograph. The dispersed fluorescence spectrum of KMS at LNT showed a wide band extending from the red ($\approx 6200 \text{ \AA}$) into the green region ($\approx 5000 \text{ \AA}$). The fluorescence was considerably weaker at room temperature. Similar red fluorescence is reported by others⁸⁻¹⁰. By using a slit in the focal plane of the

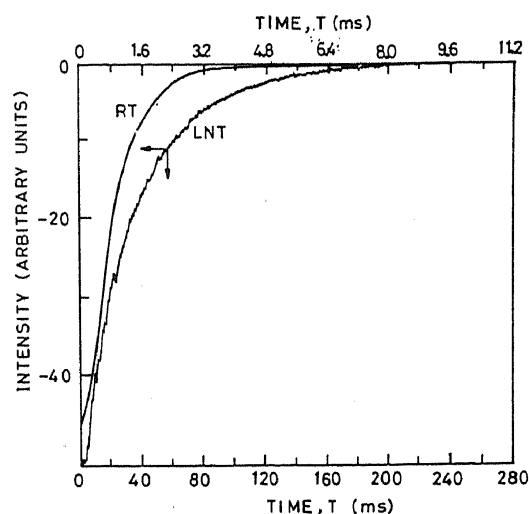


Figure 1. Fluorescence decay in KMS at room temperature (time-scale at the top) and liquid nitrogen temperature (time-scale at the bottom).

spectrograph, the red fluorescence portion of the dispersed spectrum centred around 6100 \AA was focussed on a photomultiplier tube (RCAC31034) whose output was given to a digital storage oscilloscope (DMS6430).

The decay of the red fluorescence recorded at RT and LNT is shown in figure 1. It is clear from the figure that the fluorescence decay times are widely different at LNT and RT. Assuming a single exponential decay, the decay times are found to be

$$\tau_{LNT} = 30 \text{ ms. } \tau_{RT} = 0.8 \text{ ms.}$$

Further work is in progress to measure the fluorescence decay times at various temperatures from LNT to RT and close to the phase transition.

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