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NOTE

Efficient Luminescence of Pr^{3+} and Tb^{3+} in Compounds with α-$LiFeO_2$ Structure

The efficient luminescence of the Eu^{3+} ion in compounds with α-$LiFeO_2$ structure has been described in the literature (*1*, *2*). In the course of a study on these compounds we observed accidentally that Pr^{3+} and Tb^{3+} show also efficient luminescence in these host lattices. This is reported in this note.

Samples were prepared as described before (*1*, *2*). Starting materials were Na_2O_2 and 99.9% pure Ln_2O_3. The firing atmosphere was N_2. Samples were checked by X-ray analysis. Optical measurements were performed using a Perkin–Elmer MPF 2A spectrofluorimeter.

Our not-intentionally activated $NaLaO_2$ sample showed green Pr^{3+} emission under short-wavelength uv excitation (see Fig. 1). Obviously the starting material La_2O_3 contained a small amount of Pr^{3+}. Green Pr^{3+} emission is quite exceptional. It has been shown that its occurrence is related to the position of the $4f$–$5d$ absorption band of this ion in the ultraviolet spectral region (*3*). In good agreement with the model proposed before, we observed the maximum of the $4f$–$5d$ excitation band at about 275 nm. As a consequence the (mainly green) emission from the $^3P_0$ level cannot be quenched by a radiationless transition from this level to the 4000 cm^{-1} lower $^1D_2$ level from which the red Pr^{3+} emission originates. From the fact that we could excite the emission of the Pr^{3+} impurity effectively in spite of its low concentration we may conclude that the quantum efficiency of the Pr^{3+} emission must be relatively high.

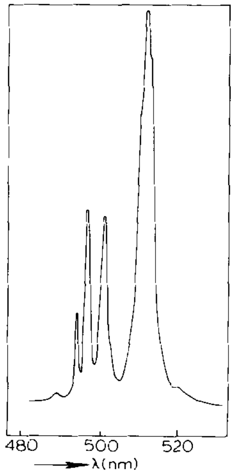

FIG. 1. Emission spectrum of $NaLaO_2$ containing Pr^{3+} as an impurity at 77°K under 275-nm excitation. In addition there is some emission in the red which contributes less than a few percent to the total intensity.

Our not-intentionally activated $NaGdO_2$ sample showed emission due to Eu^{3+} and Tb^{3+} ions which are obviously present as impurities in the starting material Gd_2O_3. The emission depends strongly on the excitation wavelength. Upon short-wavelength uv excitation (around 250 nm) strong Eu^{3+} luminescence is present due to excitation into the Eu^{3+} charge-transfer band. This is not surprising in view of the earlier work (*1*, *2*). This emission consists mainly of $^5D_3$ and $^5D_2$ emission in the blue and green spectral region, which can be connected with the low Eu^{3+} concentration(*4*). Upon excitation into the Gd^{3+} absorption peaks ($^8S_{7/2} \rightarrow {}^6P_J$ and ^6I_J), however, mainly Tb^{3+} luminescence is observed (from the $^5D_3$ level). Obviously the Gd^{3+} excitation energy migrates through the lattice until it becomes

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trapped at the Tb^{3+} ions from which luminescence occurs (*5*, *6*). As is to be expected these phenomena do not show pronounced temperature dependence in the temperature region of observation (4–300°K).

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