INVESTIGATION OF LiAl4O6F:Mn PHOSPHORS AS RED-EMITTING LIGTH CONVERTERS

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Ceramic samples of $LiAl_4O_6F$ phosphors doped with 1.0 mol.% manganese ions synthesizing by high-temperature solid-state reaction technique has been investigated as possible red-emitting light converters. Encouraging results are found.

Keywords: Phosphor-Converted LED, Red-Emitting Mn^{4+} Phosphor

1. Introduction

In the LED lighting technology, currently Eu^{2+} doped nitrides are typically employed as red-emitting phosphors. However, they have two important drawbacks. The first is linked to high fabrication temperature and pressure, so that are difficult to produce industrially. Secondly, Eu^{2+} doped phosphors show a rather broad emission band with a tail into the deep red and near-infrared spectral range, where human eyes are not sensitive. To overcome these problems we report an in-depth investigation of several ceramic samples of $LiAl_4O_6F$ phosphors doped with 1.0 mol.% Manganese ions as possible red-emitting light converters. They have been synthesized by high-temperature solid-state reaction technique. In particular, we have studied the influence of the synthesis conditions (MgF2 flux during the synthesis) on the emission spectrum and on luminescence kinetics.

2. Experimental setup and results

The time-resolved luminescence studies were performed in the temperature range of 10–290K. Photoluminescence and photo-excitation spectra were measured at room temperature.
At 290K the phosphors show bright red luminescence, with a spectrum formed by a narrow band at 661 nm and a broader peak in the range 675–720 nm, with a relative intensity depending on amount of the MgF2 flux used in the synthesis These two bands show a strong difference in the decay times: the band at 661 nm has a decay time of 240 μs, the other one of several ms. At 10K the intensity of luminescence increases, while the decay times slightly decrease and the spectra become better resolved with some additional fine structure.

3. Discussion

The fast and narrow emission band at 661 nm has been interpreted as the zero-phonon-line of the emission of Mn^{4+} located in the strongly distorted octahedral sites, for which the pure electronic transition becomes partially dipole-allowed. The slow and broad-band component spectrally overlapped with the fast one in the $LiAl_4O_6F$:Mn phosphor synthesized without MgF_2 flux can be due to the presence of some impurities, e.g. Fe^{3+}. The more intense "slow" broad-band deep red emission observed in phosphors synthesized with the use of MgF_2 flux has been attributed to luminescence of Mn^{2+} ions entering the octahedral sites.

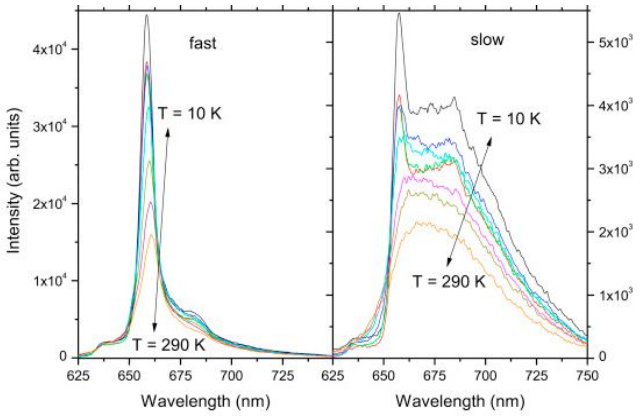

Fig. 1 Time-resolved emission spectra of the in the temperature range of 10÷290 K.

7. Conclusion

Mn:$LiAl_4O_6F$ phosphors are results a promising materials to develop high efficiency red-emitting light converters without rare earth elements.

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