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Luminescence and structural properties of Fe3+ doped ZnAl2O4: the influence of charge imbalance

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Introduction
Keeping in mind that the unit cell of spinal ZnAl2O4 is made of tetrahedral and octahedral sites, of which upon doping shows different characteristics. Zn2+ occupies the tetrahedral sites, while Al3+ occupies the octahedral sites. When doped with Fe3+, ZnAl2O4 is characterized by two broad emissions with maxima around 485 and 730 nm [1]. To maintain electrical neutrality, charge balancing should be taking into consideration when doping ZnAl2O4, since charge imbalance can lead to charge defects within the material, which can create non-radiative luminescence centers in the material. We have prepared sets of ZnAl2O4 doped Fe3+ phosphors. To investigate the effect of charge imbalance on the luminescence properties of the phosphors, Fe3+ was used to substitute Zn2+ in one instance and Al3+ in another instance. The site occupancy of the Fe3+ ion was investigated.

`Results`

The two sets of phosphors are represented by the general formula ZnAl(2-x) Fe_xˆ(3+)O4 (Fe3+ substituting Al3+) and Zn(1-x)Fe_xˆ(3+)Al2O4 (Fe3+ substituting Zn2+). The structure, morphology and the elemental compositions of the phosphors were determined using X-ray diffraction, field emission scanning electron spectroscopy and energy dispersive X-ray spectroscopy, respectively. The elemental composition, chemical and electronic states of the phosphors were analyzed using X-ray photoelectron spectroscopy. Both photo-luminescence (PL), and cathodoluminescence properties of the phosphors were also studied. The luminescence studies showed that the ZnAl(2-x) Fe_xˆ(3+)O4 phosphors have superior luminescence than the Zn(1-x)Fe_xˆ(3+)Al2O4 phosphors, as expected. The band gaps of the phosphors were determined from the diffuse reflectance data.

1. Reference [1] N. Pathak, S.K. Gupta, K. Sanyal, M. Kumar, R.M. Kadama and V. Natarajan. Dalton Trans. 43 (2014) 9313.

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Yes

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N/A

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