Effect of Mn-doping on the properties of Mn, Mg-codoped γ -AlON green phosphor

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Recently, narrow-band emitting phosphors attract particular attention for the application in white LED backlight in 8K-LCD TV, mobile phone, or tablet PCs. γ -AlON: Mg^{2+}, Mn^{2+} is a promising candidate showing high color purity in green, small thermal quenching and high internal quantum efficiency under blue light irradiation [1, 2]. However, γ -AlON:Mg^{2+}, Mn^{2+} has a quite low absorption efficiency due to spin-forbidden transition of $3d^5$ electrons in Mn^{2+}. It is necessary to improve luminescence property to be used in w-LED application.

In this study, we varied Mn concentration in γ -AlON:Mg^{2+}, Mn^{2+} phosphors. The influence of Mn was investigated using PL, CS-SEM, CL, EPMA, XRD, and ICP. The PL result shows that Mn^{2+} gives emission band centered at 512nm with 33nm FWHM. The intensity is gradually increased until 30 mol% Mn and then decreased due to the secondary phase generation (Fig. 1). Cross-sectional SEM images indicate that many small voids exist inside of the phosphor at 1mol% of Mn, and then their size grows with Mn doping to 30 mol% (Fig. 2). We consider the huge voids are attributed to the evaporation of Mn during sintering at high temperature. It should be noted that the concentration quenching of γ -AlON:Mg^{2+}, Mn^{2+} phosphor is weak comparing with other rare-earth doped phosphors.

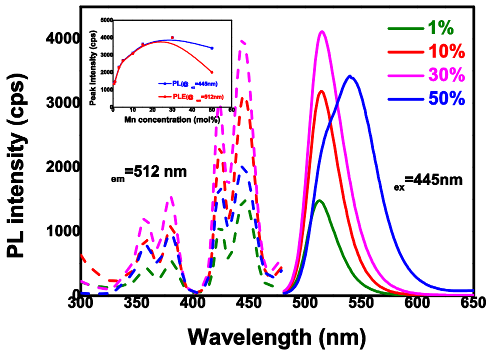

Fig 1. PLE and PL spectrum of 1, 10, 30, 50 mol% Mn-doped γ -AlON:Mg^{2+}, Mn^{2+}. PL intensity as a function of Mn doping amount is inset.

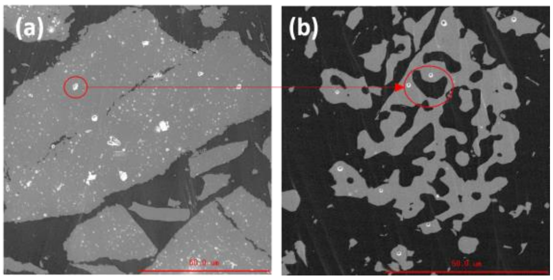

Fig 2. Cross-sectional SEM images of (a) 1mol% (b) 30 mol% Mn doped γ -AlON:Mg^{2+}, Mn^{2+}phosphor

[1] R. J. Xie et al, Appl. Phys. Lett. 92, 201905 (2008).

[2] T. Takeda et al, J. Sol. Stat. Chem. 194, 71 (2012).