Study on preparation and luminescent properties of $(Sr_{1-x}Ca_x)S$: Cu, F thin film phosphors

2005

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Inorganic electroluminescence displays (ELDs) are being developed rapidly by recent development of the materials for ELDs. However, more research and development are necessary for the improvement of color purity, life time, etc. of ELDs. In this paper, the basic study on the preparation, structural and luminescent properties of blue-emitting $(Sr_{1-x}Ca_x)S$ solid solution thin film phosphors is described. SrS: Cu, F and CaS: Cu, F phosphors show blue emissions with peaks at about 475 nm and 420 nm, respectively. Therefore, in this study, the optimization of the color purity of the blue emission was tried by using the $(Sr_{1-x}Ca_x)S$ solid solutions the host material. It was shown by the measurement of X-ray diffraction that the $(Sr_{1-x}Ca_x)S$: Cu, F solid solution phosphors and thin film phosphors with nearly the same compositional ratio of Sr and Ca as the starting mixture ratio of SrS and CaS could be obtained successfully. It was also shown in luminescent properties that the luminescence spectra of the phosphors and thin film phosphors move depending on the mixture ratio, and the blue emission with a peak at 453 nm could be obtained at $x = 0.5$. However, in the solid solution thin film phosphors, several emissions in longer wavelength region between 520 to 560 nm in addition to the emission in blue region also appeared. The emission with a peaked around 560 nm is considered to be due to the associated center by Cu^+ ions formed by promotion of incorporation of Cu^+ ions into the host.

Thin-film EL devices with double insulating layer structure by using the above mentioned solid solution thin film phosphors as the emitting layer in the device were fabricated. In the case that the emitting layer was SrS: Cu, F thin film, blue emitting EL with luminance and CIE color coordinates of 31 cd/m^2 and (0.16, 0.23), respectively, were obtained. Whereas, in $(Sr_{0.5}Ca_{0.5})$ S: Cu, F thin film, the thin-film EL device showed green emission with a peak at about 520 nm. This emission is thought to be due to the associated center. It is thought, moreover, that as defect concentration is high in the solid solution, the excitation of blue center can not be carried out sufficiently. It is concluded from the above results that the optimization of Cu^+ ion concentration and the decrease of the defect density are very important to fabricate the $(Sr_{1-x}Ca_x)S$: Cu, F solid solution thin-film EL devices with high performance.