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XAFS-study of the site doped Eu^{2+} as a luminescent center in $(Sr, Ba)_3MgSi_2O_8$

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Red, green and blue phosphors with high luminance under vacuum-ultra-violet (VUV)-light excitation are investigated widely for application for plasma display panels. We found that (Sr, $Ba)_3MgSi_2O_8:Eu^{2+}$ is one of the brightest blue-phosphors under VUV-light excitation. However, the luminance degradation occurs after thermal annealing in air. In order to clarify mechanisms of the thermal degradation, we performed XAFS measurements for (Sr, $Ba)_3MgSi_2O_8:Eu^{2+}$ annealed at various temperatures and for various hours in air.

We measured Eu L_3-edge XAFS of 2-mol%-Eu-doped (Sr, $Ba)_3MgSi_2O_8:Eu^{2+}$ with fluorescence mode by using Lytle detector. In addition, we tried to measure Eu K-edge XAFS of 10-mol%-Eu-doped (Sr, $Ba)_3MgSi_2O_8:Eu^{2+}$ with transmission mode.

When the annealing temperature increases, the luminance of $Sr_{2.9}MgSi_2O_8:Eu_{0.1}$ decreases. For example, $Sr_{2.9}MgSi_2O_8:Eu_{0.1}$ annealed at 600 °C for 1 h becomes about 10 % as high as the pristine one in luminance. Figure 1 shows the K-edge absorption spectra of Eu in the pristine and the 600°C-annealed $Sr_{2.9}MgSi_2O_8:Eu_{0.1}$. When the annealing temperature increases, the K-edge absorption peak of Eu^{2+} around 6971 eV decreases, instead, the K-edge absorption peak of Eu^{3+} around 6980 eV increases. The correlation between the thermal degradation of the luminance and the XAFS result implies that one of the mechanisms of the thermal degradation is due to thermal oxidation of Eu^{2+} into Eu^{3+}.

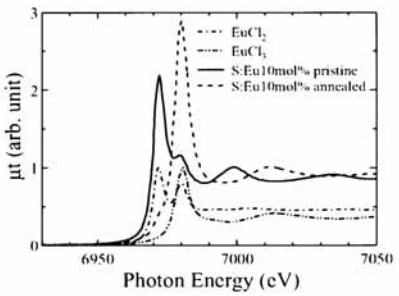

Fig 1. K-edge absorption spectra of Eu in the pristine (solid line) and the 600°C-annealed (dotted line) $Sr_{2.9}MgSi_2O_8:Eu_{0.1}$ (S:Eu 10mol%). The annealing time is 1 h. As references, K-edge absorption spectra of Eu in $EuCl_2$ (dash-dotted line) and $EuCl_3$ (dash-dotted-dotted line) are also shown.

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Subject Title X-ray fluorescence analysis of bronze ware from China and Japan

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The previous experiments, we verified of Chinese and Japanes mirror have determined that they can be divided into some groups according to the distribution of Sb/Sn and Ag/Sn. This time we have mainly analyzed triangular-rim mirror with figures of deities and sacred animals. which the manufactured place has been debated whether it is China or Japan.

We have found that triangular-rim mirror with figures of deities and sacred animals is divided into two groups. The first group showed (1) Sn/Sb ratio from 0.0007 to 0.01 and Ag/Sn ratio from 0.002 to 0.003, and the second group showed (2) Sn/Sb ratio from 0.01 to 0.02 and Ag/Sn ratio 0.06. The first group showing (1) ratio result has been thought to be of Chinese make from the style of its design. We have determined from the results of the present experiment that the ratio of mirrors of this group belongs to the area of distribution of late Western Han period ～ Three Kingdoms and Western Jin period, and we have also found that the ratio is very close to that of the mirror with figuresof deities and sacred animals of Three Kingdoms and Western Jin period.

The second group showing (2) ratio result has been thought to be of Japanese make copying (1). Comparing the results of the present experiment to that of the past, we have determined that the group of mirrors of this Sb/Sn and Ag/Sn ratio belongs to the area of distribution of the Japanese Tumulus period.

The present experiment shows that the production area of the material used for triangular-rim mirror with figures of deities and sacred animals can be divided into two big groups and anticipate that there are two kinds of mirrors, one using material produced in China and the other using that of Japan.