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EXAFS studies on $YAlO_3$:Ce scintillator prepared by polymer complex method

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Introduction

Synthesizing crystalline materials at rather low temperature is quite significant when fine powders are required, particularly for optical applications. Very recently, we succeeded in the synthesis of yttrium aluminum perovskite doped with cerium ($YAlO_3$:Ce) by a polymer complex method [1]. In this research, the local structure around Y and Ce has been studied by EXAFS in relation to the luminescence property.

Experimental

Three $YAlO_3$:Ce samples were measured. Sample A and B were prepared by a polymer complex method, and C was formed by a conventional sol-gel process. The concentration of Ce was around 1 at%. X-ray excited optical luminescent properties were investigated, and the order of the intensity observed was A, C and B. The peak intensity (at 380nm) for B was about 30% to that of A. The EXAFS data at the Y-K edge were collected both at room temperature and 30K on the BL10B in a transmission mode, and those at the Ce-L edge on the BL9A in a fluorescence mode with a Lytle detector. Since many glitches were observed near the Ce-LIII edge, EXAFS analyses were performed at the Ce-LII edge.

Results and Discussion

The Y-K EXAFS results are almost identical for all the samples. They agree well with the crystallographic data of $YAlO_3$, and confirmed that the atomic arrangement around Y is the same with $YAlO_3$ for all the samples and for both methods. On the contrary, the Ce data indicate quite different structures for each sample. Figure 1 shows the Ce-LII EXAFS. Sample A (strongly luminescent) shows a very similar spectrum to the Y-K EXAFS of $YAlO_3$ [2], which could prove that Ce atoms dominantly occupy the Y sites. On the other hand, sample B (rather weakly luminescent) is close to CeO_2 (Fig.1(d)), indicating that replacement of Ce atoms to the Y site is not successful. Although sample B is still luminescent, this would probably be one reason for the rather weak luminescence. As discussed in the previous report [2], sample C (sol-gel) shows that Ce atoms are almost ideally doped into Y sites, and this is once again confirmed in Fig.1(c). However, for the moment, the relationship between luminescence intensity and the structure (location of Ce atom) is still not clear. We have not yet given a clear explanation of luminescent properties in relation to the structural difference that appears in Fig,1(a) and (c).

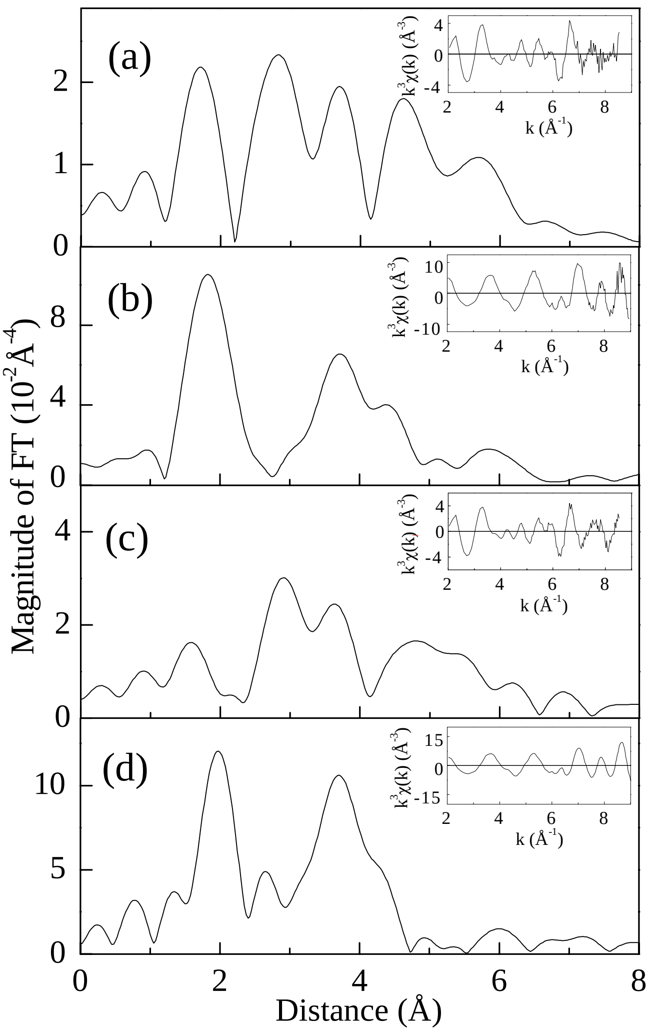

Fig. 1 The Ce-LII EXAFS at room temperature: (a) Sample A (b) Sample B, (c) Sample C (sol-gel method) and (d) CeO_2.

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References

[1] M. Harada et al., J. Mater. Sci. Lett. 20, 741(2001).
[2] X.Guo et al., PF Activity Report, #17, 174 (1999).

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