

XANES Studies on Valence fluctuation in $\text{YbIn}_{1-x}\text{Sn}_x\text{Cu}_4$ ($x=0\sim 1.0$)

Koichi HIRAOKA*¹, Tao ZHUANG¹, Makio KURISU¹, Tatsuo KAMIMORI¹, Kensuke KONISHI¹,
Ikuo NAKAI²

¹Ehime Univ., Matsuyama, Ehime 790-8577, Japan

²Tottori Univ., Tottori, Tottori 680-8522, Japan

1 Introduction

YbInCu_4 is known as a valence phase transition material at $T_v=42\text{K}$ [1]. Yb valence changes from +2.9 to +2.7 above and below T_v [2]. The valence transition in YbInCu_4 is very sensitive to substitution effects. In this report, we investigate substituting effects of Sn for In on the temperature variation of Yb valence in $\text{YbIn}_{1-x}\text{Sn}_x\text{Cu}_4$ by measuring Yb-L_{III} edge XANES spectra.

2 Experimental Details

Single crystal samples of $\text{YbIn}_{1-x}\text{Sn}_x\text{Cu}_4$ ($x=0, 0.3, 0.7, 0.9, 1.0$) were made by self-flux method. They were crushed into powder, and the powdered samples were used. The XANES spectra were obtained by a transmission mode at the facilities of XAFS beam line BL-9C in PF-KEK. The temperature dependences of XANES spectra were measured in the temperature range from 11 K to 300 K.

3 Results and Discussion

Figures 1 and 2 show the Yb-L_{III} XANES spectra of $\text{YbIn}_{1-x}\text{Sn}_x\text{Cu}_4$ ($x=0, 0.3, 0.7, 0.9, 1.0$) at 11 K and 300 K, respectively. The envelope of XANES spectrum is composed of divalent and trivalent Yb profiles. The spectrum considerably changes between $x=0.3$ and 0.7 . The result shows that the ratio of $\text{Yb}^{2+} : \text{Yb}^{3+}$ increases with increasing the Sn content x . The Yb valence varies from +2.85 for $x=0.3$ to +2.49 for $x=1.0$ at 11 K. The effect of temperature change on the Yb valence is less remarkable than that of the Sn substitution, suggesting that the valence of Yb ion is fluctuating in the whole temperature range.

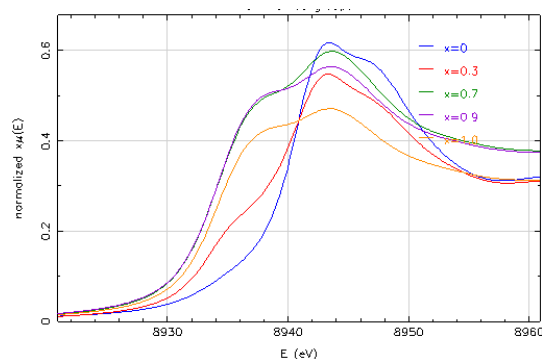


Fig. 1 Yb-L_{III} edge of $\text{YbIn}_{1-x}\text{Sn}_x\text{Cu}_4$ ($x=0, 0.3, 0.7, 0.9, 1.0$) at 11 K.

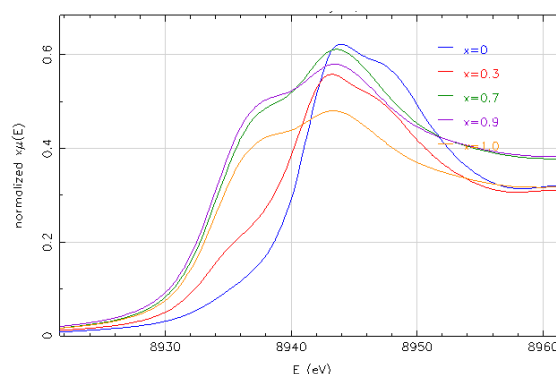


Fig. 2 Yb-L_{III} edge of $\text{YbIn}_{1-x}\text{Sn}_x\text{Cu}_4$ ($x=0, 0.3, 0.7, 0.9, 1.0$) at 300 K.

References

- [1] I. Felner and I. Nowik, Phys. Rev. B 33, 617 (1986).
- [2] H. Sato *et al.*, Phys. Rev. Lett. 93, 246404 (2004).

*hiraoka@eng.ehime-u.ac.jp