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L_3 edge XANES of Ce in amorphous Ce_xRu_{100-x}

Y. J. Li, N. Ohnishi, Y. Amakai,[A] S. Murayama,[A] I. Nakai
Department of Electronics and Information Engineering, Tottori University
[A] Materials Science of Engineering, Muroran Institute of Technology

Introduction

The Ce compounds show a wide variety of phenomena such as heavy fermion, valence fluctuation, and Kondo effect due to the instability of 4f electrons. Amorphous alloy system Ce_xRu_{100-x} shows a heavy fermion like behavior at Ce-rich side ($x \geq 47$) and the superconductivity at Ru-rich side ($15 \leq x \leq 40$).

Experiment

Amorphous alloys Ce_xRu_{100-x} with x=15, 47 and 80 (a-Ce_xRu_{100-x}) were fabricated by a DC high-rate sputtering technique. The amorphous structure of the sputtered samples was confirmed by an X-ray diffraction. To investigate valence states of Ce in a-Ce_xRu_{100-x} we measured the x-ray absorption near-edge structure (XANES) at the Ce L_3 edge. The spectra were obtained using the Si(111) monochoromator with a Ni coated mirror at 295k in the BL9A station of KEK-PF.

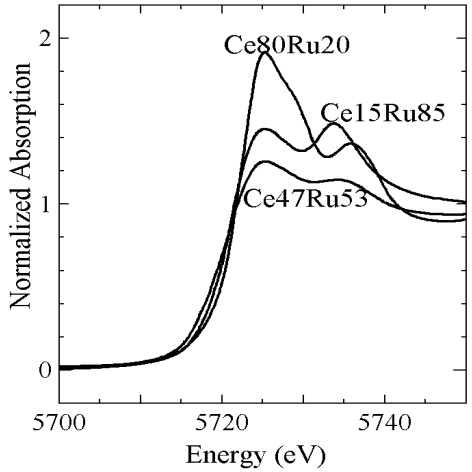

Fig. 1. XANES spectra of amorphous Ce_xRu_{100-x} near the Ce L_3 edge at 295 K.

Results

Ce L_3 edge XANES spectra of a-Ce_xRu_{100-x} (x=15, 47, 80) (background subtracted) are shown in Fig.1. It is obvious that all the spectra are characterized by a main absorption peak at about 5725eV and a satellite peak near 5735eV. These peaks correspond to the excitation with final-state configuration $4f^1$ and $4f^0$. To study configuration of peaks in a-Ce_xRu_{100-x} in details, we apply one arctangent and two Lorentzian functions to the spectra, which represent the continuum absorption and the 2p-5d transitions for the trivalent and tetravalent Ce states, respectively. The fit with eq.(1)

$$\mu(E) = B_0 + B_1 E^{-2.85} + \{0.5 + \frac{1}{\pi}\arctan(\frac{E-E_0}{\Gamma/2})\} + \frac{A_1(\Gamma/2)^2}{(E-E_1)^2+(\Gamma/2)^2} + \frac{A_2(\Gamma/2)^2}{(E-E_2)^2+(\Gamma/2)^2} \quad (1)$$

gives the parameters tabulated in Table.1. Intensity of the spectrum strongly depends on composition. The ratio of the main peak to the satellite peak increases with increasing the Ce concentration. This means that the valence of Ce tends to trivalent with increasing the Ce content.

References

[1] Y. Obi et al., Physica **B378-380** (2006) 857.
[2] Y. Amakai et al., J. Magn. Magn. Mat. **310** (2007) 416.

Table 1. The parameters in eq.(1) obtained from the least square fit.

x	E_0 (ev)	E_1 (ev)	E_2 (ev)	Γ(ev)	A_1	A_2	valence
15	5721.0	5724.6	5734.1	8.1	0.67	0.51	3.44
47	5720.8	5724.5	5734.9	10.0	0.64	0.28	3.30
80	5722.0	5725.5	5736.1	8.4	1.15	0.35	3.23