Materials Science

NW10A/2007G037

Local structure change of phase transition in FeRh

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Introduction

FeRh, in the ordered CsCl structure, was found to undergo a transition from antiferromagnetic (AF) to ferromagnetic (FM) phase by heating above room temperature [1]. Simultaneously, at this transition, an isotropic lattice expansion, Giant Negative Magneto-resistance, and entropy changes occurs without change in the crystallographic structure. Therefore, a technical application that makes best use of such a characteristic is paid attention now.

On the other hand, such AF-FM phase transition in FeRh also brings to mind questions of a more fundamental nature. Is it the lattice driving the magnetic transition or vice versa? In this report we analyzed geometrical local structure change by the AF-FM phase transition by extend X-ray absorption fine structure (EXAFS), in order to reveal the relation between the geometric structure and the magnetic structure.

Experimental

The $Fe_{50.4}Rh_{49.6}$ alloy was made by the Plasma Arc Melting (PAM) method. To obtain the ordered crystallographic structure the heat treatment was applied at 1273 K for 24 h and then the samples were slowly cooled down.

Rh *K*-edge EXAFS measurements were carried out at NW10A in PF-AR KEK at the temperature range of 50-470 K with a transmission mode. The sample is ground to the foil about 20μm thickness.

Result and Discussion

Figure 1 shows Fourier transform (FT) of *k*-weighted EXAFS functions. It was reported that the volume change of AF-FM phase transition in FeRh was so small as about 1% [2] and the lattice constant change was about 0.01Å, therefore, no prominent change of spectrum by phase transition was observed.

Figure 2 shows the result of the curve-fitting for first and second peak of FT. (a) shows the distance of 1st nearest neighbour atom Fe from central atom Rh. The expansion starts rapidly from about 250 K, and is finished at 350 K. (b) shows the temperature dependence of Debye-Waller (DW) factor. The DW factor synchronizes with the lattice expansion, but that of 1st Rh-Fe and 2nd Rh-Rh shows different behaviour. It seems that a change of magnetic moment according to a phase transition is expected to be related to the behaviour of the DW factors. More detailed investigation of this behaviour is under progress.

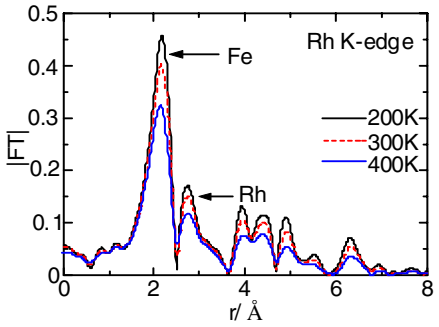

Fig. 1. Fourier transformed EXAFS functions for Rh *K*-edge in FeRh.

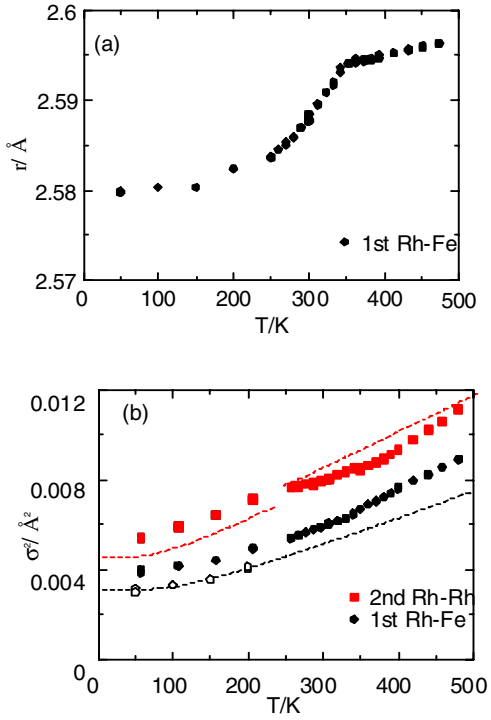

Fig. 2. Results of the fitting for Rh *K*-edge in FeRh. (a):distance of 1st nearest neighbour atom (Rh-Fe). (b):Debye-Waller factor of 1st (Rh-Fe) and 2nd (Rh-Rh). Broken line is the result of Einstein fitting (below 250K).

Reference

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