7A/2009G565

Angler dependent of XMCD study $Fe_{49.7}Rh_{47.4}Pd_{2.9}$ alloy

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Introduction

FeRh alloy has an ordered CsCl structure and undergoes a transition from antiferromagnetic (AF) to ferromagnetic (FM) phase around 350K [1]. This transition has an isotropic Negative Giant Magnetro-resistance, and an entropy change without the crystallographic structure change. Therefore a technical application that makes best use of such a characteristics is paid attention now. The transition temperature decreases as replacing small amount of Pd atoms from Rh in FeRh.

XMCD (X-ray Magnetic Circular Dichroism) can separately measure a spin and orbital magnetic moment. These moments are calculated by the orbital and spin sum rules.

In this report, we measure the XMCD spectra and angular dependence of spin and orbital moment of Fe in $Fe_{49.7}Rh_{47.4}Pd_{2.9}$.

Experimental

The $Fe_{49.7}Rh_{47.4}Pd_{2.9}$ alloy was made Plasma Arc Melting method [2].

The sample was set under a magnetic field of 0.2T along to the X-ray direction. An incident angle of X-ray changes in 0, 5, 10, 20, 30, 40, and 45 degrees. The measured temperature is room temperature and 50 °C. To obtain XMCD spectra, the magnetic field was switched alternatively. The absorption coefficient is obtained by the electron yield method. Fe L_{III} and L_{II}-edge XMCD measurements were carried out at BL-7A and BL-11A.

Results and discussion

XMCD orbital and spin sum rules of transition from *2p* to *nd* show as follows [3] [4];

$$m_{spin} + m_T = 2\frac{\int_{LIII}(\mu_+ - \mu_-)d\omega - 2\int_{LII}(\mu_+ - \mu_-)d\omega}{\int_{LIII+LII}(\mu_+ + \mu_-)d\omega}n_h\mu_B$$

$$m_{orb} = -\frac{4}{3}\frac{\int_{LIII}(\mu_+ - \mu_-)d\omega + \int_{LII}(\mu_+ - \mu_-)d\omega}{\int_{LIII+LII}(\mu_+ + \mu_-)d\omega}n_h\mu_B$$

where m_{spin} and m_{orb} is spin and orbital magnetic moment, m_T being in proportion to anticipated value of inner atomic magnetic dipolar operator, n_h is hole number, and μ_B is Bohr magneton

Figure 1 shows spin magnetic moment at room temperature and 50 °C as a function of the sample angle. Here, $Fe_{49.7}Rh_{47.4}Pd_{2.9}$ is polycrystal and term of m_T can be neglected.

From this figure, the result at room temperature is almost same 50 °C. The spin magnetic moment seems to increase as the sample angle.

Figure 2 shows the orbital magnetic moments at room temperature and 50 °C as a function of the sample angle. The orbital moments also seems to slightly increase as the angle. Spin moment is almost ten times larger than the orbital moment at two temperatures
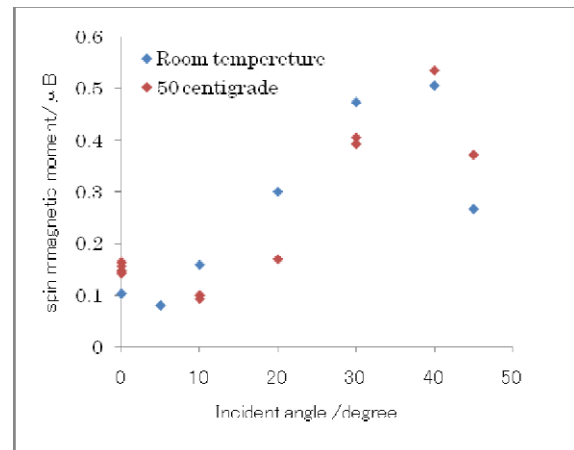

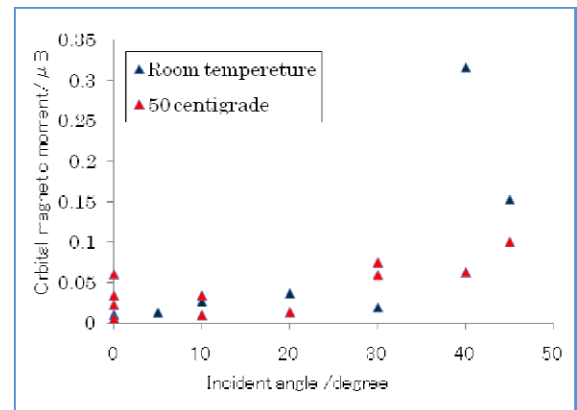Figure 1: degrees vs. spin magnetic moments in room temperature and 50 centigrade.

Figure 2: degree vs. orbital magnetic moments in room temperature and 50 centigrade

References

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