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Measurement of spin, orbital and total magnetic form factor of 3d-4d alloy Pd_3Co by X-ray magnetic diffraction

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Introduction

Transition metals are applied to materials of high-density magnetic-recording media. Pd/Co multilayer artificial lattice, which is composed of 3d and 4d transition metals, shows perpendicular magnetic anisotropy. The aim of this research is to study magnetic properties of Pd-Co alloy system through the magnetic form factor measured by the X-ray magnetic diffraction (XMD) measurement of Pd_3Co crystal.

Pd_3Co has the Cu_3Au type crystal structure, which shows order-disorder type structural transformation. The sample crystal in this study is known to be in the disorder state by the preliminary experiment.

Experiments

The XMD experiment has been performed on the beamline 3C. Elliptically polarized white X-ray beam was irradiated on the sample and the Bragg angle at the sample was fixed to 45°. The diffracted X-rays were measured with a pure-Ge SSD. Magnetic field of 2.15T was applied to the sample with an electromagnet.

The angle α between the incident X-ray direction and the sample magnetization is important parameter in the XMD measurement. The experimental configuration of α of 135°, 0° and 90° enables us to measure the spin, orbital and total magnetic form factor (μ_S (k), $\mu_L(k)$ and $\mu_{total}(k)$), respectively.

Results and Discussion

The measured spin, orbital and total magnetic form factor are shown in Fig. 1, Fig. 2 and Fig. 3 respectively. We have obtained magnetic form factors for ~20 reciprocal lattice points. In each figure the data points of the form factor seem to be fitted well with a monotonic decreasing curve. So the next step of the data analysis would be to estimate the values of spin, orbital and total magnetic moments of Pd_3Co by applying the theoretical curves of dipole approximation for $\mu_S(k)$, $\mu_L(k)$ and $\mu_{total}(k)$. Moreover, in the near future we have a plan to study distribution of the spin, orbital and total magnetic moments in real space by using Fourier transform of the form factors.

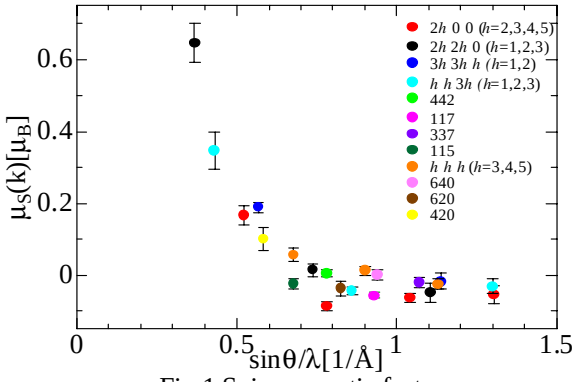

Fig.1 Spin magnetic factor

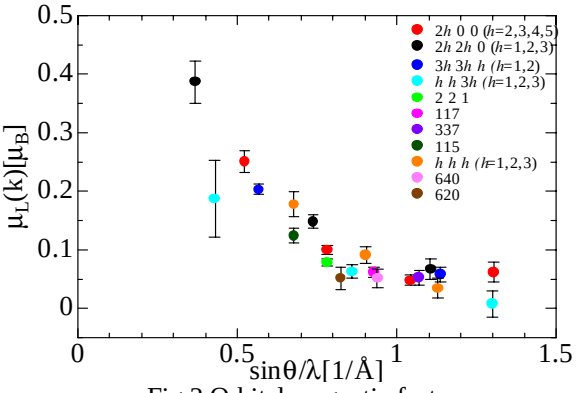

Fig.2 Orbital magnetic factor

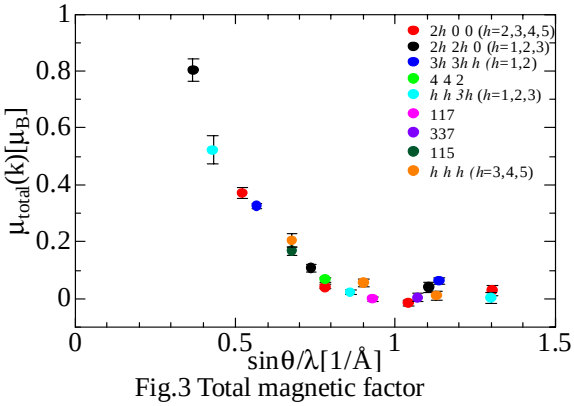

Fig.3 Total magnetic factor

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