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

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Introduction

In recent years perpendicular magnetic anisotropy has been found on Co/Pd multilayer artificial lattice that is composed of 4d noble metal and 3d transition metal. This multilayer artificial lattice is expected to be applied to high-density magnetic-recording media. The origin of the perpendicular magnetism is thought be caused by spin-orbit interaction on the interface region. Therefore it is important to study magnetic interaction between Co and Pd. As a part of this study we are studying magnetic properties of an alloy of Pd_3Co.

In this study we apply the X-ray magnetic diffraction (XMD) method to a single crystal of Pd_3Co. By this method, the spin and orbital magnetic form factor can be independently measured. The aim of this study is to reveal the magnetic properties of this compound through the spin and orbital moment distribution in real space obtained by the XMD experiment.

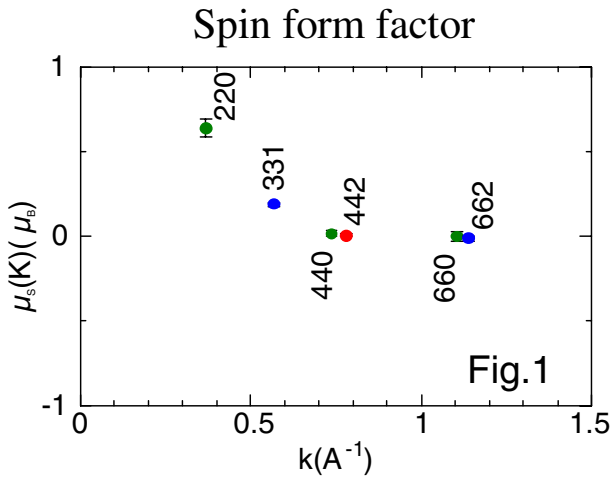
Pd_3Co has the same crystal structure as Cu_3Au and is thought to show order-disorder transformation of the Cu_3Au type [1]. The sample of this study is in the disordered state.

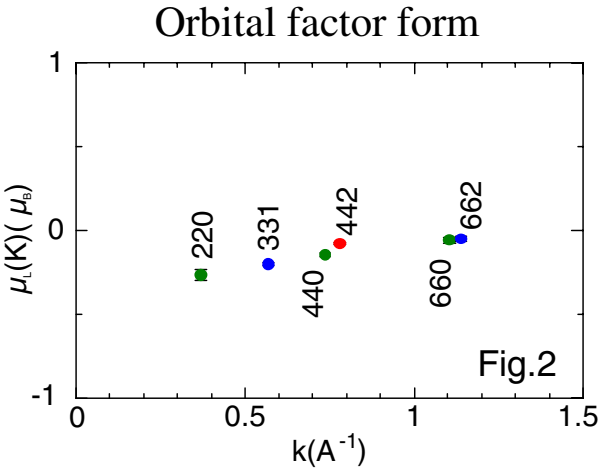
Experiments

White beam of elliptically polarized synchrotron radiation from the bending magnet of BL3C was irradiated on the sample crystal. The diffraction intensity was measured with the 90 degree scattering angle by a pure-Ge SSD. Magnetic field of 2.15T was applied to the sample crystal with an electromagnet. The sense of the magnetic field direction was reversed alternatively every 10 seconds. We measured the diffraction intensity I_+ and I_-, where I_+ and I_- are the intensities for one sense and the reversed sense of the magnetization direction respectively. We obtained relative intensity change, $(I_+ - I_-) / (I_+ + I_-)$, which is called flipping ratio. When the angle between the directions of magnetization and the incident X-rays was 135 degree, the spin magnetic form factor was selectively measured (S configuration). When the angle between these directions is 0 degree, the orbital magnetic form factor was selectively measured (L configuration).

Results and Discussion

The obtained spin and orbital magnetic form factors are shown in Fig. 1 and Fig. 2, respectively. The reciprocal lattice points of the magnetic form factor are $h\ h\ 0$ (h=2,4,6), $2h\ 2h\ h$ (h=2) and $3h\ 3h\ h$(h=1,2). In the disordered state the reflection is forbidden for the reciprocal lattice of mixed indices of even and odd number. In the near future we will obtain distribution of the spin and orbital magnetic moment in real space after measuring form factors for more reciprocal lattice points.





References

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