表題：反転対称性の破れたPr5Ru3Al2における磁場誘起相の磁気構造

# Magnetic structure of the magnetic field induced phase in non-centrosymmetric Pr5Ru3Al2

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Non-centrosymmetric materials are of growing interest recently, because of the possibility for a number of novel phenomena, such as parity-mixed superconductivity in metallic systems, bulk Rashba spin splitting of electron bands in polar materials, and non-trivial spiral or helical spin structures in magnetic materials originating from asymmetric spin-spin interactions. Nonetheless, materials that realize such intriguing phenomena are quite limited, and hence, new non-centrosymmetric materials have been actively sought out recently. Pr5Ru3Al2 is one of such new materials without inversion symmetry [1]. In previous our powder neutron diffraction experiment, we determined the helical magnetic structure with long-period incommensurately modulation vector for Pr5Ru3Al2 below the antiferromagnetic ordering temperature 4.2 K [2]. Interestingly, further phase transition was observed above the 0.1 Tesla magnetic field, suggesting a formation of a complex magnetic phase diagram as shown in Fig. 1 (a). In contrast, there is no details of the microscopic magnetic structure under the magnetic field in Pr5Ru3Al2, but such information is definitely necessary to understand the effect of the loss of inversion symmetry on their magnetic behavior.

To investigate the magnetic structure in Pr5Ru3Al2 under the magnetic field, we performed neutron powder diffraction measurements using C-TAX triple axis spectrometer at HFIR, ORNL. The temperature and magnetic field depdence of the powder diffraction data are shown in Fig. 1 (b - e). At 1.5 K at 0 mangetic field as shown in Fig. 1 (d), we found three incommensurate magnetic reflections, which is consistent with our previous neutron diffraction experiment [2]. At 3.2 K at 0 Tesla, additional two peaks are found. It is clarifed there is additional phase near phase boundary at 0 magnetic field. At 0.15 Tesla magnetic field, the observed diffraction patterns are different with those for 0 magnetic field. At both 1.5 K and 3.2 K as shown in Fig. 1 (b) and (c), the strong intensity is observed near 33.4 degree, which is on the nuclear (1 1 0) position. The magnetic field dependece of the magnetization at 1.5 K shows the magnetic plateau like structure with 1 muB/Pr magnetic moment above 0.08 Tesla, which is 1/3 magnetic moment for the full moment of Pr3+ ion. Thus, the possible magnetic structure at 1.5 K at 0.15 Tesla is ferromagnetic structure with some magnetic moment of Pr in the unit cell aligned to the direction of the magnetic field. At 3.2 K at 0.15 Tesla, the reflection near the nuclear position and the additional small incommensurate reflections are observed. In this phase, the complex magnetic structure with the ferromagnetic and the incommensurate magnetic components would be stabilized.

In summary, we measured the magnetic reflections for the noncentrosymmetric Pr5Ru3Al2 under the magnetic field. From the observed magnetic reflections, further magnetic structure analysis is in progress.

[1] E. V. Murashova et al., Mater. Res. Bull. 45 993 (2010).
[2] K. Makino et al., J. Phys. Soc. Jpn. 85, 073705 (2016)

使用施設：JRR-3M，装置：4G:GPTAS
分野：Magnetism

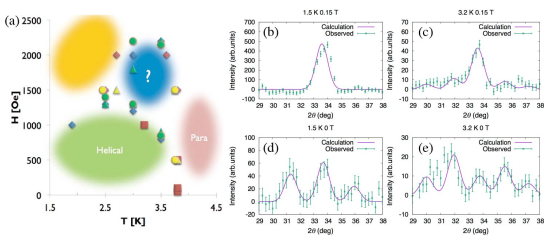

Fig. 1. (a) Phase diagram for Pr5Ru3Al2 determined by the magnetization measurement. Powder neutron diffraction patterns of Pr5Ru3Al2 at 1.5 K and 0.15 Tesla (b), 3.2 K and 0.15 Tesla (c), 1.5 K and 0 Tesla (d), and 3.2 K and 0 Tesla (e).