Study of the Magnetic Structure of the Noncentrosymmetric Heavy-Electron Metamagnet $CePdSi_3$ under Magnetic Fields

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Noncentrosymmetric f-electron materials have attracted much attention because the absence of inversion symmetry leads to nontrivial and interesting effects upon physical properties. Recently, we have reported that the non-centrosymmetric $BaNiSn_3$-type compound $CePdSi_3$ exhibits successive magnetic transitions, multi-metamagnetic transitions, and weak ferromagnetism, yielding an unusually complex $H-T$ phase diagram [1]. We defined three phases as the Phase III, II and I as elevating temperature. From elastic neutron diffraction experiments at zero field performed in the last April, we found that magnetic peaks indicate a spin density wave (SDW) structure. In addition, the H and K domains coexist in $CePdSi_3$ at zero field.

In order to determine magnetic structures in $CePdSi_3$ under fields in the next step, we performed elastic neutron scattering experiments at BL-09 (CORELLI), SNS in Oak Ridge National Laboratory. A single crystalline sample of $CePdSi_3$ was grown by a flux method in the Institute for Solid State Physics. The sample was mounted on an Al pin such that both the a and c axes set into the equator plane and installed in SlimSam. Temperature was set to 1.9 K, and the magnetic-field was applied from 0 to 25 kOe along the H direction (the a axis).

We have succeeded in observing clear and interesting field dependence of the intensity of magnetic peaks as shown in Figure 1. The K domain disappears by 3 kOe, and only the H domain survives up to 12 ? 13 kOe where the phase changes I′ to IV. Surprisingly, in the field range from 10 to 15 kOe, our results indicate that a magnetic moment turns its direction perpendicular to the magnetic field with keeping the same modulation period. We have reported that a jump appears in the magnetization curve in the same field range [1]. Therefore, this behavior can be interpreted as a spin-flop transition. Finally, all magnetic superlattice peaks disappear above 20 kOe because of the forced ferromagnetism. We are in the middle of elucidation of a mechanism of such magnetic structures in field.

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Referenece

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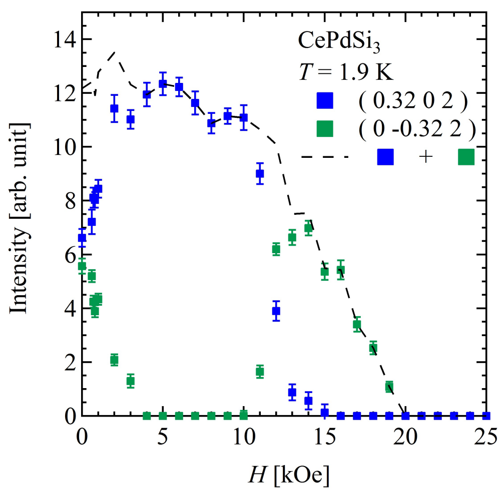

Fig. 1. Figure 1 The magnetic field dependence of the integrated intensity related to two propagation vectors in H- and K- domains. Blue and green indicate the H and K domains, respectively.