Magnetic structure study of the multi-step metamagnet $CeIr_3Si_2$

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$CeIr_3Si_2$ crystallizes in the orthorhombic $ErRh_3Si_2$-type structure (Imma, No. 74), which is a derivative of the hexagonal $CeCo_3B_2$-type. The lattice parameters are a = 7.1765 Å, b = 9.7274 Å and c = 5.5971 Å. The results of electrical resistivity, specific heat and magnetic susceptibility measurements reveal that $CeIr_3Si_2$ is a Kondo-lattice compound showing two successive magnetic transitions at T_{N1}=4.1 K and T_{N2}=3.3 K[1]. Below 3.3 K, the isothermal magnetization of polycrystalline sample displays mult-step metamagnetic transitions at 0.6 T, 0.9 T and 1.2 T. Recent study of a single-crystal $CeIr_3Si_2$ has revealed that the metamagnetic transitions at 0.6 T and 1.2 T occurs when the magnetic field H applyed along the b-axis while that at 0.9 T occurs when $H//c$-axis[2]. We need to obtain the magnetic structures between each transition field in order to study the origin of multi-step metamagnetism of $CeIr_3Si_2$. Thus we have been carrying out the elastic neutron scattering of powder and single-crystal samples.

In order to search magnetic reflections, elastic scans were performed in three scattering planes of (HK0), (H0L) and (0KL). At 1.5 K, we observed four magnetic Bragg peaks at Q =(0 4/3 ±2/3) and Q =(0 5/3 ±1/3). Temperature dependence of the peak at Q =(0 4/3 −2/3) was shown in Fig. 1(a). The observed magnetic reflections agree with those observed in the previous measurement using a powder sample. These non-integer Q's indicate that the lattice parameters of b- and c-axis below T_{N2} becomes three time as large as those above T_{N1}.

Figure 1(b) shows the temperature dependence of integrated intensity at Q=(0 4/3 −2/3) and Q=(0 5/3 −1/3). The intensities of all magnetic reflections display a maximum at 2.7 K in spite of no further phase transition down to 0.5 K. This behavior may indicate the cluster glass-like transition at T_{N2} possibly due to partial disorder between Ir and Si rigands.

References

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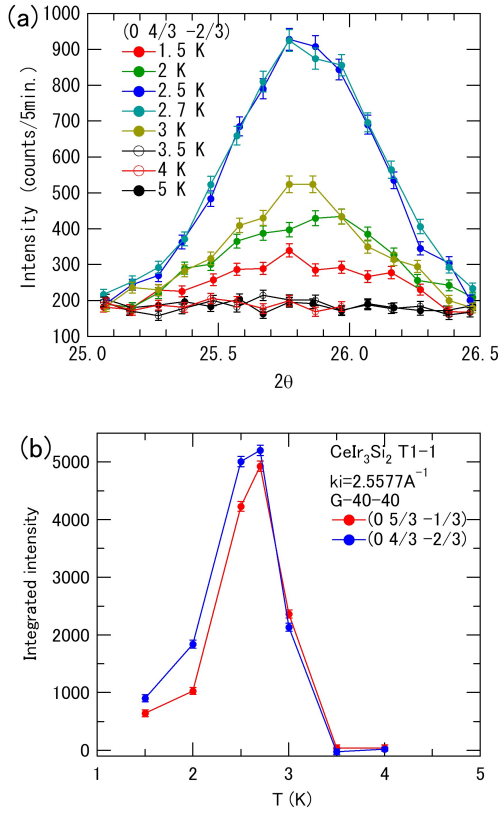

Fig. 1. (a)Temperature dependence of magnetic reflection at (0 4/3 -2/3). (b)Temperature dependences of integrated intensity at (0 4/3 -2/3) and (0 5/3 -1/3).