Pressure-induced release of magnetic frustration in a quasi-kagome lattice YbAgGe

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The heavy-fermion antiferromagnet YbAgGe with the ZrNiAl-type structure undergoes two magnetic transitions at T_{M1} = 0.8 K with a propagation vector $\vec{k}_1$ = [0, 0, 0.324] and T_{M2} = 0.65 K with $\vec{k}_2$ = [1/3, 0, 1/3].[1, 2] A tail in the specific-heat $C(T)$ extended above T_{M1} was attributed to effects of magnetic frustration inherent to the quasi-Kagome lattice of the Yb sublattice.[1] Recently, an anomalous phase diagram of YbAgGe under pressures has been constructed from the $C(T)$ and resistivity measurements.[3, 4] For $P > 0.5$ GPa, the two transitions at T_{M1} and T_{M2} merge to one transition at T_M.[3] For $0.5 < P < P^* = 1.6$ GPa, T_M remains constant, while T_M increases linearly above P^*. The magnetic entropy at T_M rises for $P > P^*$, while the Kondo temperature does not change.[4] These findings suggest that the sudden rise of $T_M(P)$ for $P > P^*$ is a consequence of the release of the magnetic frustration.

In the present work, in order to determine magnetic structures at ambient pressure, we performed neutron diffraction experiments. Measurements were preformed on a single crystalline sample prepared by the Bridgman method. It was cooled down to 35 mK with a ^{3}He-^{4}He dilution refrigerator.

Fig. 1 shows the temperature dependence of the integrated intensity of the magnetic peaks at $\mathbf{Q}$ = (2/3, 0, 1/3) and (1, 0, 0.327). The intensity of the peak at (1, 0, 0.327), which includes background contribution, appears at 0.82 K ($> T_{M1}$) and shows a maximum at 0.65 K (= T_{M2}). Below the temperature, the intensity of the peak at (1, 0, 0.327) rapidly decreases, while the intensity of the peak at (2/3, 0, 1/3) starts increasing at 0.65 K (= T_{M2}) and saturates below 0.6 K. Between 0.6 K and 0.65 K both the peaks were observed, indicating that the transition at T_{M2} is of first order.

In $T_{M2} < T < T_{M1}$, the magnetic structure was determined by the model proposed by the group theory. This structure has a distorted 120° one on the c plane, where the moments are modulated along the c-axis. This magnetic structure is characteristic feature of the magnetic frustrated compounds. We are now in progress to analyse the data to determine the magnetic structure below T_{M2}.

References

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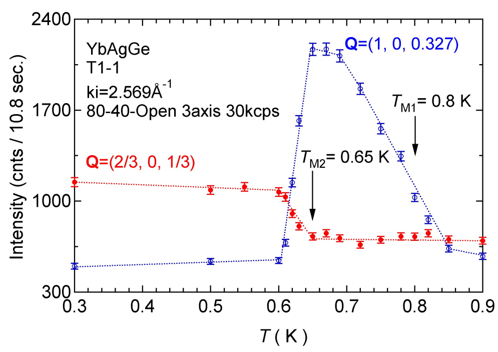

Fig. 1. T dependence of the integrated intensity of the magnetic peaks at $\mathbf{Q}$=(2/3, 0, 1/3) and (1, 0, 0.327). The dotted lines are guides to the eye.