Anomalous magnetic transitions of TbCu2Si2

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Anomalous magnetic behaviors have been reported on a TbCu2Ge2 single crystal [1]; It has the tetragonal ThCr2Si2-type crystal structure (space group: I4/mmm), orders antiferromagnetically below TN=12.3 K and shows an additional magnetic transition at Tt=9.3 K. A one-step metamagnetic transition appears around 17 T along the hard magnetization direction at low temperatures and persists above TN up to Tm=25 K where a broad peak appears in temperature dependence of magnetic susceptibility. Recently it has been reported that the TbCu2Si2 single crystal compound shows very similar magnetic behaviors to those of TbCu2Ge2 [2]; it orders antiferromagnetically below TN=11.9 K and has additional magnetic anomalies at Tt=9.1 K and Tm=25 K. The origin of those anomalies has unknown yet.

In order to investigate those transitions, neutron diffraction study has been performed on the TbCu2Si2 single crystal using the triple axis spectrometer HQR installed at JEARI, Tokai, Japan.

At low temperatures, antiferromagnetic reflections associated with the propagation vector k=(1/2, 0, 1/2) have been observed. This result is agreement with that reported by Pinto et al. [3]. The antiferromagnetic structure is characterized by the propagation vector k and has Tb moments parallel to the [110] directions in the basal plane. Above Tt, no new magnetic reflection could be detected. Temperature dependence of the antiferromagnetic peak (1/2 0 1/2) intensity shows in Fig.1. The intensity decreases gradually with increasing temperature and disappears above TN=12 K. No distinctive anomaly can be seen around Tt. A reorientation of the Tb moments from [110] to [100] in the basal plane at Tt has been proposed from the result of resonant and non-resonant X-ray magnetic scattering [4]. There is, however, no clear evidence for the spin reorientation from this neutron measurement. With respect to the transit1on at Tm, no magnetic reflection could be observed; existence of magnetic correlation could not be found. The origin of transition at Tt and Tm is now puzzling yet. Further study is need.

References

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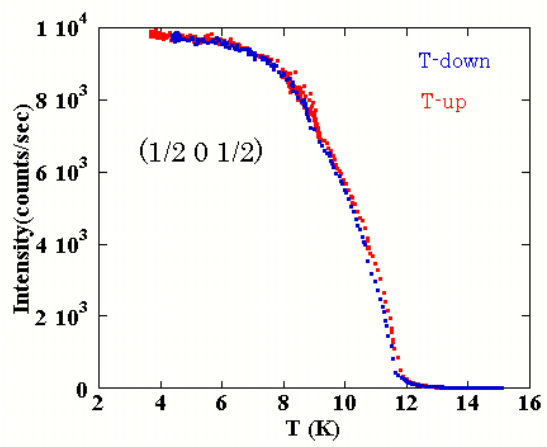

Fig. 1. Temperature dependence of antiferromagnetic (1/2 0 1/2) peak intensity in TbCu2Si2