Magnetic structure of TbCoSn

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RTX (R: rare earths, T: transition metals, X: metalloids) compounds crystallize in the epsilon-TiNiSi-type orthorhombic structure. Their magnetic property is characterized by
1. relatively lower antiferromagnetic ordering temperature TN below 20 K,
2. highest TN not at R=Gd but at Tb,
3. multi-step metamagnetic transitions in the ordered state along the easy axis of magnetization,
4. incommensurate magnetic structures in the series.[1]
Recently, it has been revealed that RRhGe (R=Tb and Dy) compounds also possess successive magnetic transitions below the Neel temperature from the magnetic and specific heat measurements. Our interest is in the role of crystalline electric field (CEF) effect and determination of magnetic structures in the series. In the present report, we show preliminary experimental results on TbCoSn.

Single-crystalline TbCoSn ingots were grown by a Czochralski method using a tetra-arc furnace in purified Ar atmosphere. The magnetic and specific heat measurements were performed by a SQUID magnetometer and a PPMS, respectively. The neutron diffraction measurements were performed at T1-1:HQR spectrometer installed at JRR-3M.

The magnetic susceptibility shows that antiferromagnetic ordering takes place at 20.2 K. Below TN, an anomaly indicative of another magnetic transition is observed at 4 K for the three principal axes. The specific heat measurement also indicates the two magnetic phases down to 1.8 K. The temperature dependence of the magnetic susceptibilities is well accounted for the three principal axes by the CEF calculation based on the point charge model. It is noted that the easy axis of magnetization is the a-axis in TbCoSn while it is the b-axis for other isostructural TbTX compounds. The sign of second order CEF parameter appears to be a dominant factor to determine the magnetic anisotropy.

The variation of magnetic reflection at (0 0.25 0) with temperature is displayed in Fig.1. This also supports the existense of low temperature phase below 4 K. A further data acquisition is needed to determine the magnetic structure of the compound.

References
[1] Y.Andoh, M.Kurisu, and S.Kawano, Journal of Magnetism and Magnetic Materials, 177-181 (1998) pp.1063-1064.

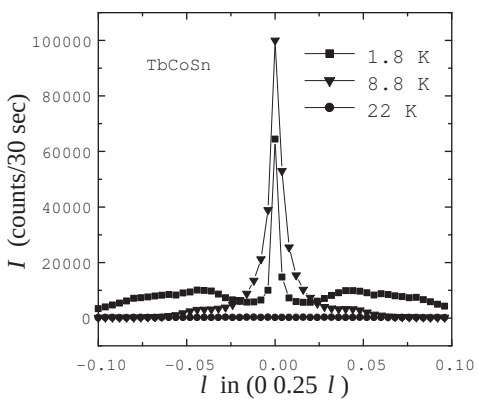

Fig. 1. Magnetic reflection at (0 0.25 0).