Weak ferromagnetic superconductor Tb0.47Y0.53Ni2B2C

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" Spontaneous vortex phase " in a ferromagnetic superconductor is one of the issues that have not been confirmed yet. Previously we studied ErNi2B2C (Tc = 10.5 K), but due to the fact that weak ferromagnetic (WFM) transition temperature of the system (TWFM = 2.3K) is lower than its superconducting transition temperature Tc, confirmation of such an exotic state was not conpleted. In order to duly confirm a spontaneous vortex phase, we next choose TbxY1-xNi2B2C as a system that should have a region with TWFM being higher than Tc [1,2]. From the phase diagram, we choose x = 0.47 as a target Tb concentration and grew single crystals of Tb0.47Y0.53Ni2B2C (Fig.1). Magnetization data indicate that the system posses an AF transition at 6K, a WFM one below 4K and a superconducting one below 2K.
To verify the WFM state and to determine the magnetic structure in antiferromagnetic (AFM) and WFM phases, we proposed neutron elastic measurements and performed such experiments from 11th to 15th Aug. 2016 at cold neutron triple axis spectrometer (CG-4C), HFIR in ORNL.
We first measured neutron diffraction profiles at (h 0 1) at 10 K, (the paramagnetic phase), 3 K, (the AFM phase) and 0.25 K, (the WFM phase) (Fig.1). Below TN in addition to the nuclear peaks observed at 10 K, a clear magnetic Bragg peak appeared at (0.450 0 1). But no magnetic peak was observed at (0.550 0 0), indicating that magnetic moments on Tb atoms form a longitudinal spin density wave (SDW) order with a propagation vector of q = 0.550a*. Fig.2 shows temperature dependence of integrated intensity of the (0.45 0 1) peak. We also measured field dependence of the SDW peak under fields parallel to the [0 1 0], and confirmed that it disappeared above 2 T. 2 T is too small to attribute this to saturation of the Tb moments along the field direction and so it was attributed to an occurrence of a magnetic structure transition. To verify the WFM state, temperature dependences of intensities at nuclear Bragg points (0 0 1) and (1 0 1) were measured. But we could not detect the evidence of the WFM order. So as a next step, we would like to propose polarization analysis for the temperature dependence of (0 0 6) peak, since nuclear intensity at this position is relatively weak.

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References
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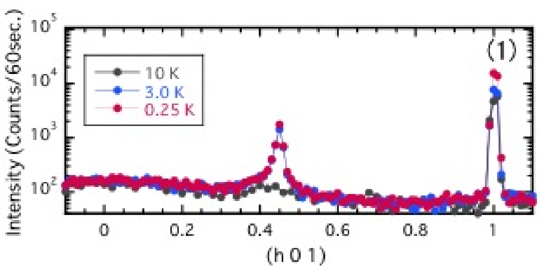

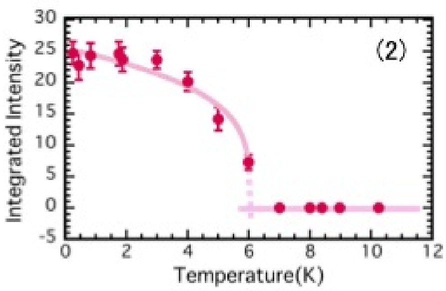

Fig. 1. Temperature dependence of the neutron diffraction profiles at (h 0 1) Fig. 2. Temperature dependence of integrated intensity of (0.45 0 1) peak