Magnetism and superconductivity in $RENi_2B_2C$

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$RENi_2B_2C$ (RE is a rare earth or Y) has been studied intensively since a series of the materials exhibit various physical properties such as superconductivity, magnetic order, or their microscopic coexistence with substituting the *RE* site. For instance, one of them, $ErNi_2B_2C$, has attracted much attention because it exhibits the coexistence of the superconductivity and weak ferromagnetism. Recently, we have made $Lu_{0.5}Tb_{0.5}Ni_2B_2C$ as another promising candidate in which the superconductivity and weak ferromagnetism coexist. In order to understand the magnetically ordered state in this system in detail, we performed a neutron diffraction measurement.

The single crystal sample of $Lu_{0.5}Tb_{0.5}Ni_2B_2C$ was prepared, and the magnetic transitions at 9.5 K and 5.5 K were confirmed by a magnetization measurement. The sample was cooled down to 0.7 K using a 1K cryostat. The experiment was carried out at the 4G spectrometer (GPTAS), and neutrons with a momentum $k_i = 2.67$ Å^{-1} were used. $(h0l)$ was selected as the scattering plane.

The neutron magnetic diffraction profiles in the $(h01)$ direction at 0.7 and 15 K are shown in Fig. 1(a). At 0.7 K, a clear magnetic Bragg peak is observed at $Q = (0.44, 0, 1)$, which corresponds to the propagation vector for the SDW state. In the case of the pure $TbNi_2B_2C$ system in the SDW state, the higher-order peaks are also observed at the $3q$, $5q$ and $7q$ positions in addition to $q = 0.55a^*$. However, any other magnetic peaks were not observed in the present study, indicating clear difference from the pure system. The temperature dependence of the integrated intensity for the Bragg peak at $Q = (0.44, 0, 1)$ is displayed in Fig. 1(b). The SDW phase appears below ∼9.5 K. The q position of the observed peak is not shifted with temperature. More detailed studies will be planned.

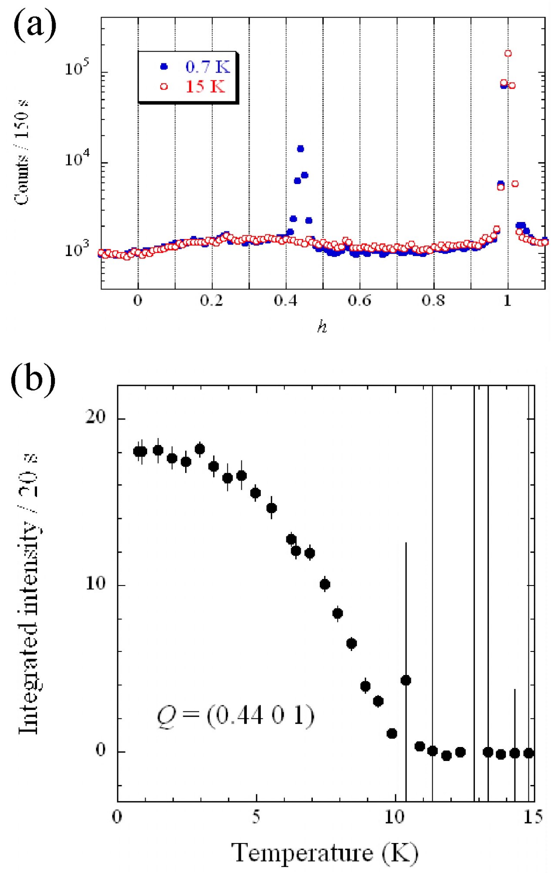

Fig. 1. (a) Neutron magnetic diffraction profiles in the $(h01)$ direction at 0.7 and 15 K. (b) Temperature dependence of the integrated intensity of the magnetic Bragg peak at $Q = (0.44, 0, 1)$.