Magnetic phase diagram under low temperature and high pressure in RVO3

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RVO3 (R: rear earth or Y) shows various physical properties coupled with the spin and orbital states. [1] The orbital state is strongly coupled with the lattice distortion, i.e. Jahn-Teller distortion. Hence the pressure effect for the orbital state interests us, and the pressure-temperature phase diagram of the V 3d-orbital state was investigated by x-ray diffraction under high-pressure and low-temperature. [2] It elucidated that the C-type orbital ordering (C-OO) is stabilized as compared with the G-type orbital ordering (G-OO) by applying hydrostatic pressure. The spin state coupled with the orbital state is also an important problem for this system. Therefore, the spin state in TbVO3, of which the ground state of 3d-orbital changes from the G-OO to the C-OO by applying pressure, was investigated under high-pressure and low-temperature using a hybrid anvil cell.

In order to determine the magnetic ordering, the magnetic scattering was measured by using the triple-axis spectrometer TOPAN. The temperature dependence of the magnetic peak intensities was measured at several pressures as shown in the figure. At ambient pressure (0 GPa), the magnetic peak at (0 1 0) reflecting the C-type spin ordering (C-SO) was observed below the magnetic transition temperature. With increasing pressure, the C-SO phase is suppressed and finally disappears. On the other hand, the magnetic peak at (0 1 1) reflecting the G-type spin ordering (G-SO) appears above 1.0 GPa, and the magnetic transition temperature remarkably increases with applying pressure. As compared with the orbital phase diagram [2], it becomes clear that the G-SO phase corresponds to the C-OO phase and the C-SO phase appears in the G-OO phase. Namely, we could clearly determine the changing the spin state when the orbital ordering of the ground state is changed by applying pressure. The result indicates a strong coupling between the spin state and the orbital state in RVO3 system.

[1] S. Miyasaka et al., Phys. Rev. B 68 (2003) 100406.
[2] D. Bizen et al., J. Magn. Magn. Mater. 310 (2007) 785.

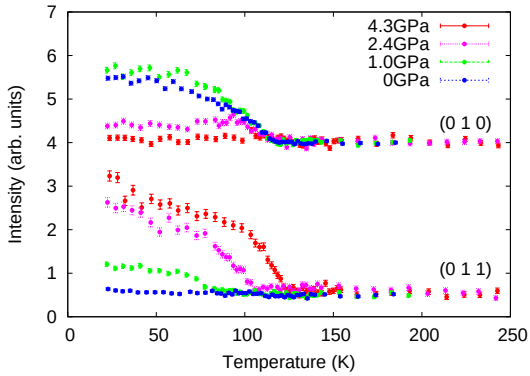

Fig. 1. Temperature dependence of the magnetic peak intensities at (0 1 1) and (0 1 0), which correspond to G-OO and C-SO, respectively.