Helimagnetic structure of B20-type MnGe

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A topological spin texture called skyrmion, in which the direction of spin wraps a sphere, stimulates interest in the field of strongly correlated electron systems. The electron moving over the skyrmion spin texture acquires Berry phase proportional to their density, giving rise to an anomalous Hall effect, which is not proportional to the magnetization.

It was anticipated that the crystallization of skyrmion spin textures can be realized in helical magnets with noncentrosymmetric B20 crystal structure. A topological Hall effect, assigned to the outcome of the skyrmion crystal, has already been observed in MnSi. However, the Hall anomaly remains very small and appears in a very narrow temperature region. Very recently, we observe a large topological Hall effect in B20-type MnGe. B20-type MnGe shows an antiferromagnetic M-T curve with TN of 170 K, but its magnetic structure was not known yet. Thus, we investigated the magnetic structure of MnGe. Powder neutron diffraction experiments were performed using HERMES. The powder sample includes a trace of impurity less than 4 % in volume fraction.
Fig. 1(b) shows neutron diffraction patterns around (1 1 0) reflection at various temperatures as substracted by the profile at 270 K. Two new peaks of magnetic origin were discerned at each temperature below TN. The integrated intensity of these reflections decreases with increasing temperature and finally disappears
above TN. Two and four magnetic peaks also appear around (1 1 1) and (2 1 0) reflections, respectively. These magnetic peak positions can be accounted for satisfactorily with an incommensurate helical magnetic structure with the wavevector Qm=delta 0 0. The helical period varies from 6 nm to 3 nm with decrease of temperature (see Fig. 1(c), which is the shortest among the known B20-type helical magnets. This implies that some topological spin texture like skyrmions can appear with the highest density among all the B20-type alloys, which may be relevant to the large topological Hall effect in MnGe.

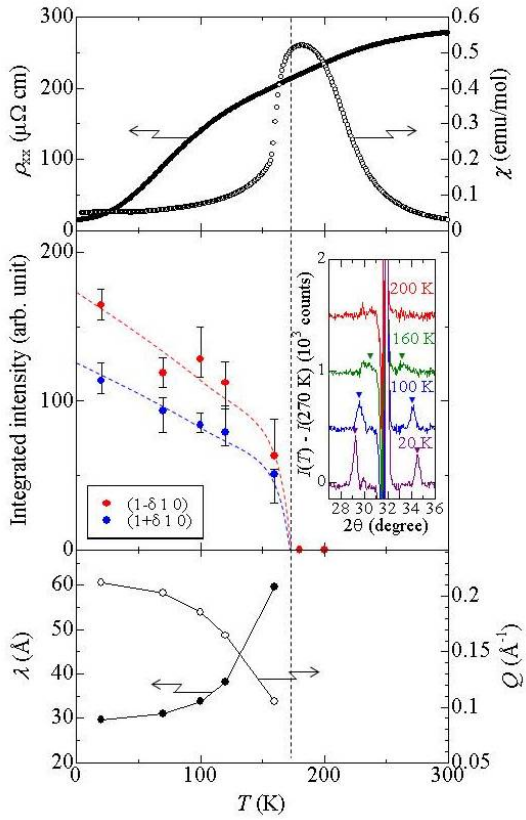

Fig. 1. Resistivity, magnetization, intensities of neutron satellite peaks, and magnetic modulation in MnGe as a function of temperature.