表題：メイプルリーフ格子物質 $MgMn_3O_7 \cdot 3D_2O$ の磁気構造

Magnetic Structure of Maple Leaf Compound $MgMn_3O_7 \cdot 3D_2O$

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Geometrical frustration in a magnetic material prevents the conventional Néel order and induces a non-trivial magnetic state at low temperatures. Particularly the two-dimensional (2D) triangular lattice has been extensively studied since the pioneering work on the quantum spin liquid in the Heisenberg antiferromagnet. A consensus is that the ground state is the ordered state with 120 degree structure but is very close to quantum criticality. Kagome lattice in is a depleted triangular lattice by a factor of 1/4, which leads to the coordination number of z = 4 and results in more frustration. Accumulative studies have been reported both in experiment and theory. Meanwhile, a regular depletion of the triangular lattice by a factor of 1/7 yields another translationally invariant lattice [1] as shown in Fig. 1(a). The z is 5, which is smaller than triangular lattice and larger than kagome lattice, and the lattice is called maple leaf lattice. Even though theoretical study[1] was reported in this interesting lattice, experimental study has not been reported. Very recently our collaborator found the maple leaf lattice in a mineral $MgMn_3O_7 \cdot 3H_2O$ for the first time. Mn^{4+} ions carrying spin S = 3/2 form the maple leaf lattices in Mn_3O_7 layer, and they are separated by Mg ions and crystal water as shown in Fig. 1(b). There are three Mn-Mn bonds, triangular J_t, dimer J_d, and hexagonal J_h. The classical phase diagram exhibiting various phases including spin vector chirality 1 (SVC1), SVC2, positive vector chirality (PVC), negative vector chirality (NVC), and triangular ferromagnetic cluster (TFC) is obtained by our molecular field calculation. Magnetic susceptibility and heat capacity show double T_N at 15 K and 5 K. The magnetic state below T_N should be investigated. Then, we performed the powder neutron diffraction experiment in order to reveal the ground state of $MgMn_3O_7 \cdot 3H_2O$. Neutron diffraction experiment was performed on High-Resolution Powder Diffractometer ECHIDNA installed at ANSTO. We used the orange cryostat for achieving low temperature. We used 2.3 g of the sample. We chose the neutron wavelength of 2.4395 Å. Figure 1(c) shows the neutron diffraction patterns at 1.7 and 10 K. We found that the peak at 33 deg. enhances below 5 K, which is the magnetic transition temperature of the sample. Then, we identified that the peak is the magnetic one. It is indexed by the (4/3 1/3 0), which indicates the magnetic propagation vector is (1/3 -2/3 0). We note the peak becomes small but remains at 10 K as shown in Fig. 1(d). We observed that it remains up to 60 K, which indicates that it comes from a small amount of the impurity. In fact the other peaks are indexed by the sample. Further investigation of the magnetic peaks are needed for the magnetic structure analysis. [1] D. Schmalfuβ *et al.*, Phys. Rev. B **65**, 224405 (2002).

使用施設：JRR-3M，装置：5G:PONTA
分野：Magnetism

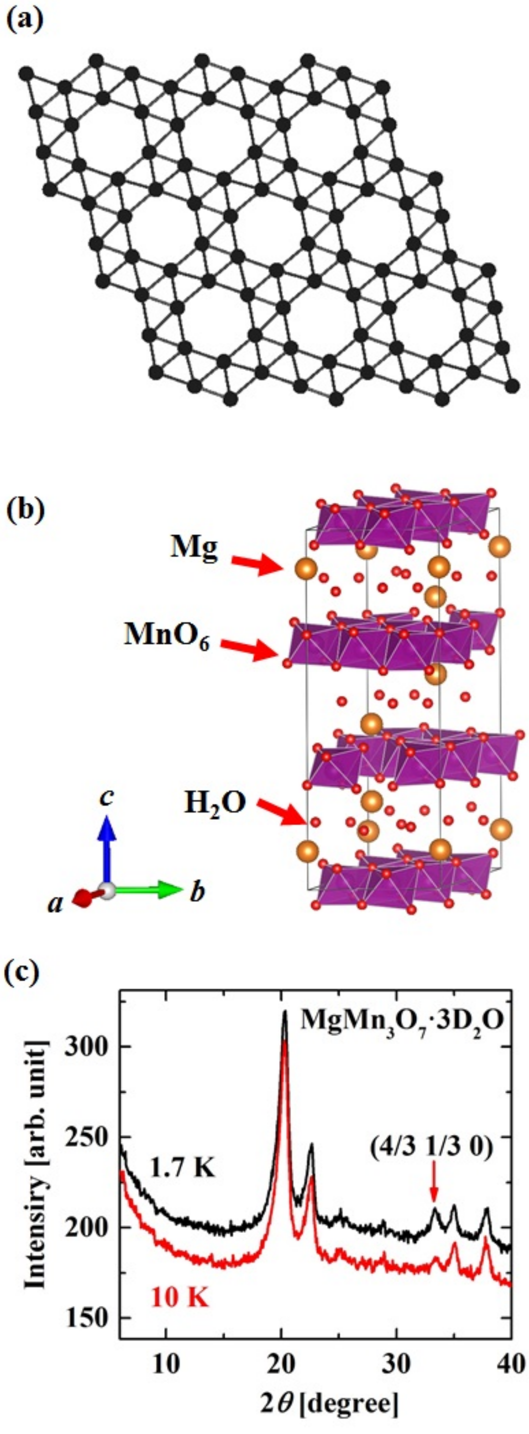

Fig. 1. Fig.1 (a) Maple leaf lattice. (b) Crystal structure of $MgMn_3O_7 \cdot 3H_2O$. (c) Neutron diffraction profiles at 1.7 and 10 K.