Neutron scattering study on (CuCl)LaTa2O7

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Spin-structure of the square-lattice antiferromagnet is trivial as long as the nearest neighbor interactions are considered. However, inclusion of antiferromagnetic next nearest neighbor interactions induces frustration, leading to non-trivial phases such as spin-liquid state.

We demonstrated from magnetic susceptibility and neutron scattering experiments that (CuCl)LaNb2O7, prepared by topotacic ion-exchange reaction of RbLaNb2O7 with CuCl2, does not show any sign of long range magnetic ordering at low temperatures, indicating spin-disordered ground state [1].Here, the S = 1/2 square lattices are formed by the Cu-Cl layers, which are separated by the nonmagnetic LaNb2O7 perovskite blocks. In contrast, the isostructural compound (CuBr)LaNb2O7 exhibits the long range magnetic order at 32 K. The neutron powder diffraction study at HERMES and 5G gave the spin structure of this material, a collinear type of order with a modulation vector of (pi, 0, pi). Such a spin structure is expected when the next nearest neighbor interaction dominates over the nearest neighbor one.The difference in the ground state between the Cl and Br compounds could be explained in terms of the difference in superexchange interactions between Cu-Cl-Cl and Cu-Br-Cu.

Under the proposal number 7535, we have performed the neutron inelastic and elastic scattering study on (CuCl)LaTa2O7, again isostructural of (CuCl)LaNb2O7. Sicne pentavalent Ta and Nb have nearly the same ionic radii, the two compounds have nearly same lattice parameters. However, (CuCl)LaTa2O7 show the magnetic ordering of the same type of (CuBr)LaNb2O7.This could not be explained by the abovementioned scenario. This observation indicates that the superexchange path via TaO6/NbO6 also contribute to the magnetism.

[1] H. Kageyama et al., J. Phys. Soc. Jpn. 74, 1702 (2005)
[2] N. Oba et al., J. Phys. Soc. Jpn. 75, 1133601 (2006)

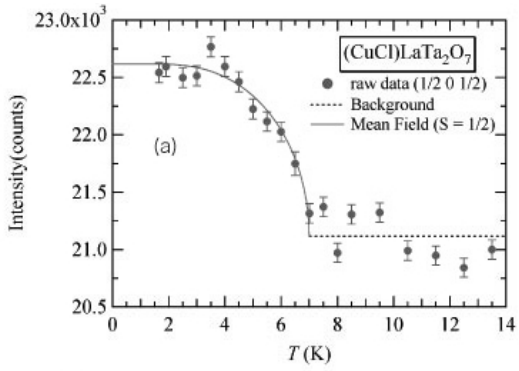

Fig. 1. Temperature dependence of the (1/2, 0, 1/2) magnetic reflection for (CuCl)LaTa2O7