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Ferroelastic behavior and canted antiferromagnetism in the Two-Dimensional Organic Inorganic Perovskite like Compound

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Multiferroics, materials with more than one ferroic order(ferroelastic, ferroelectric, ferromagnetic, ferrotoroidic), have recently been actively studied academically and industrially as potential multi-dimensional data storage devices due to the coupling of the existing ferroic orders within one material. However, coupling of ferroelasticity and ferromagnetism has hardly been reported in molecular based magnet.

The Organic-Inorganic perovskite-like compounds $(C_2H_4NH_3)_2FeCl_4$ was reported to be Multiferroics having ferroelasticity around 300 K and canted antiferromagnetism below 100 K; therefore, it is possible that magnetic properties were controlled by applying mechanical stress because of coupling these ferroic orders. However, strong coupling of these ferroic orders was not observed in this compound because the spin canted axis is different from the axis that can be switched by applying mechanical stress. In addition, it is difficult to apply mechanical stress to this compound due to highly deliquescence in the air. To overcome these problems, more stable organic inorganic perovskite $(C_6H_5C_2H_5NH_3)_2FeCl_4$ was synthesised and measured single crystal X-ray diffraction (SCXRD), differential scanning calorimetry (DSC), polarization microscopy, and magnetic susceptibility measurements.

These measurements revealed that $(C_6H_5C_2H_4NH_3)_2FeCl_4$ showed ferroelasticity below 433 K because of structural phase transition of *I4/mmm* to *Bbcm*. Actually, Polarization microscopy confirmed that ferroelastic domain structures were controlled by changing temperature and applying mechanical stress. Magnetization measurements as a function of temperature and field confirmed canted antiferromagnetism below T_c = 98 K with an estimated canting angle of 0.53° along *a* axis. In addition, switching spin canting direction by applying uniaxial stress with heating was observed. This result shows coupling ferroelasticity and canted antiferromagnetism in molecular based magnet.

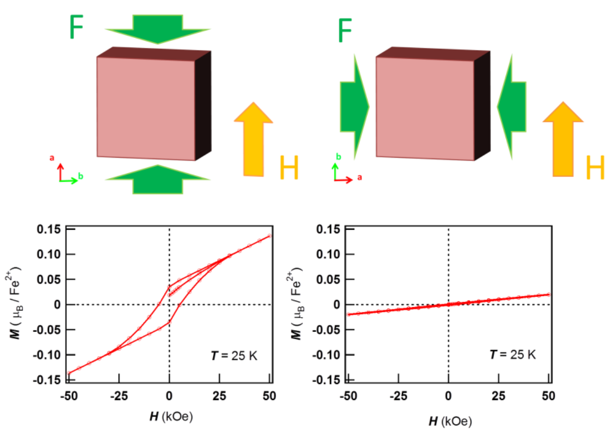

Figure 1. Isothermal magnetization of virgin sample and the sample after applying stress along *b*-axis

[1] T.Suzuki *et al.*, *J.Phys. Soc. Jpn.*, **1988**, *52*, 1669-1675.

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