Magneto-Elastic Behavior of Two-Dimensional Organic-Inorganic Hybrid Perovskites with Ferroelasticity

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Multiferroic properties show that two or more ferroic orders such as ferromagnetism, ferroelectricity, and ferroelasticity are co-exist.[1] For example, magnetelectric effect, in which the polarization is induced by applying magnetic field or the magnetization is induced by applying electric field, has been reported in both theoretically and experimentally. On the other hand, the cross-correlation between ferroelasticity and ferromagnetism or ferroelectricity has been rarely studied. In this study, we investigate the cross-correlation between ferroelasticity and ferromagnetism using two-dimensional organic-inorganic hybrid perovskites with a layered structure of organic ammonium cations and metal halide ions.

Previously, we found that the magnetization shift, characterized by a vertical shift in the origin of the hysteresis, was observed when cooled in a magnetic field from above magnetic critical temperature in perovskite-type compound $(PEA)_2Fe^{II}Cl_4$ (PEA = 2-phenylethylammonium) with ferroelasticity and canted antiferromagnetism (Fig. 1).[2] We synthesized a series of hybrid perovskites, $(PEA)_2M^{II}Cl_4$ (M = Mn, Ni, Cu) to investigate the effect of magnetization shift due to differences in the transition metals. X-ray crystal structure investigations show that they have a similar structure to that of the iron compound (Fig. 2). In $(PEA)_2Cu^{II}Cl_4$, ferroelastic domains were observed by polarized microscopy observation. Magnetic properties exhibit ferromagnetic behavior below 9.4 K. In this presentation, we report magnetic and elastic properties of $(PEA)_2M^{II}Cl_4$, and discuss the magneto-elastic behavior.

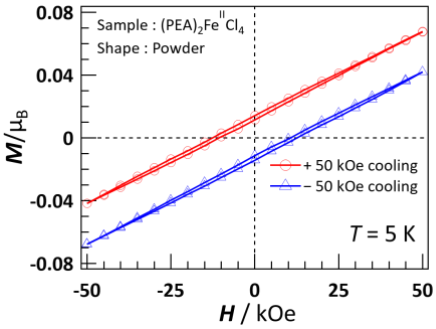

Figure 1. M vs H plots of $(PEA)_2Fe^{II}Cl_4$ after field cooling in + 50 kOe (red) and – 50 kOe (blue).

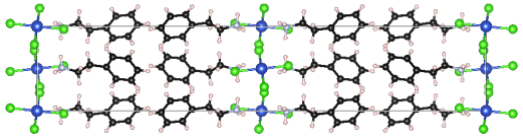

Figure 2. The crystal structure of a series of metal substituted $(PEA)_2M^{II}Cl_4$ viewed along b-axis.

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