Magnetization Study of 1D Spin Chain Compound NH_4CuCl_2COOH

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Introduction

A new pseudo-1D system with Cu ions, NH_4CuCl_2COOH, was synthesized and studied under high magnetic field. This is a new system crystallizing with C2/c symmetry. The material is made of 1D chain of edge-sharing CuO_2Cl_4 octahedra running along the c axis (Fig. 1 left). The system reminds of $LiCuVO_4$ but may have more complex magnetic behavior resulting from additional frustration paths due to the presence of a carboxylic group.

Experimental

We measured extraction magnetometry of powder samples in a capacitor-driven short-pulse magnet up to 60 T. The pulsed field data were calibrated against Vibrating Sample Magnetometry (VSM) data in a PPMS to 13 T.

Results

Left figure on Fig. 1 shows 60 T short-pulse magnetization data of a powder sample. At 1.5 K, magnetization increases linearly in field up to ~ 15 T and then suddenly changes its slope and increases linearly up to 60 T. The magnetization value at 60 T is ~ 0.3 μ_B/Cu^{2+}. This value is much smaller than the expected magnetic moment of Cu^{2+} spin (S = 1/2, 1 μ_B/Cu^{2+}). At elevated temperatures, the sudden slope change at 15 T is smeared out and the whole curve follows a Brillouin function.

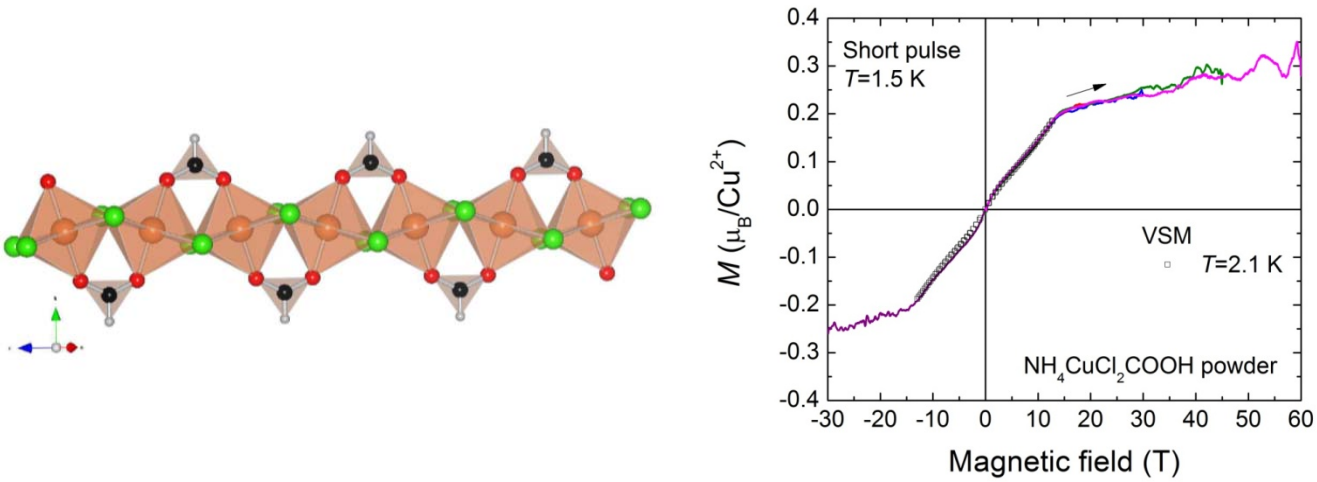

Figure 1. Left) Crystal structure of NH_4CuCl_2COOH. Cu ions (orange) are interconnected by Cl ions (green) and forms a chain along the *c*-axis. Right) Magnetization versus magnetic field up to 60 T for the powder sample (solid lines). Magnetization data taken using the VSM is shown in symbols.

Conclusions

Magnetic saturation is not achieved even at 60 T. This implies that the system displays a strong magnetic frustration or reduced magnetic moment due to the nature of low dimensional spin-chain. One needs to keep in mind that carboxylic group such as copper acetate monohydrate can be as strong as 300 cm^{-1}.The measured value is much less than the theoretical one and may show strongly anisotropic behavior. Currently, a density-functional-calculation is being pursued to gain more insight to this system.

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