High Field Magnetization Study of Sr_3CuIrO_6

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Introduction

Materials that contain Ir^{4+} (a 5d cation) have recently been found to show novel magnetic ground states, for example the "j_{eff}=1/2" state observed in Sr_2IrO_4 [1]. The bonds between Ir^{4+} and neighboring spins may have very large magnetic exchange anisotropy [2]. We have recently studied the magnetization (*M*) of Sr_3NiIrO_6 and found that is shows colossal magnetic hysteresis with 40 T coercive field [3]. This large coercive field could result from the large exchange anisotropy between the Ni^{2+} and Ir^{4+} ions. In light of this finding, we studied a nearly isostructural compound Sr_3CuIrO_6 in high magnetic fields. Sr_3CuIrO_6 contains chains of alternating Cu^{2+} and Ir^{4+} along the c-axis and these chains are arranged in a quasi hexagonal configuration.

Experimental

We measured extraction magnetometry of single crystalline Sr_3CuIrO_6 in a 65 T capacitor-driven short pulse magnet and in the 100 T multi-shot magnet, and calibrated the pulsed-field data against magnetization measurements in a Vibrating Sample Magnetometer (VSM) in a 14 T Physical Properties Measurement System (PPMS) by Quantum Design.

Results

Figure 1 shows *M* vs. magnetic field curves measured along the spin-chain direction ([101]) using pulse magnet and PPMS. *M* increases sharply up to 0.2 T and increases smoothly thereafter. Above 15 T, *M* show small variation in field which results. No discernible magnetic anomaly was observed up to 60 T.

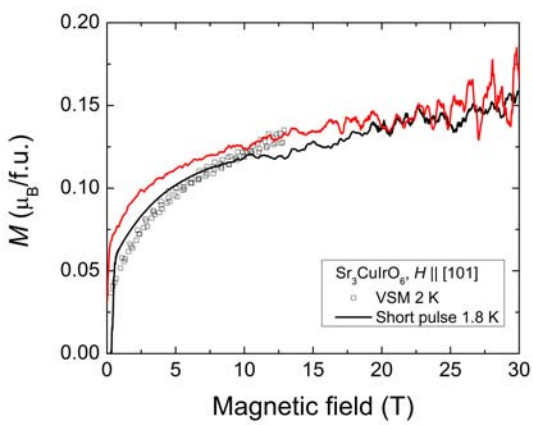

Fig. 1. *M* as a function of magnetic field at low temperatures. Black and red solid lines show data show rising and falling fields in pulsed magnetic fields, respectively. Symbols show data taken in DC magnetic field.

Conclusions

Sr_3CuIrO_6 exhibits strong magnetic anisotropy and spin-chain direction is the hard axis. Even at 60 T, magnetization reaches only up to 0.3 μ_B/f.u. which is much smaller than the expected magnetic moment 2 μ_B/f.u. (from Cu^{2+} and Ir^{4+}). In addition, our preliminary study shows no sign of magnetic transition up to 92 T. Compared to Sr_3NiIrO_6, Sr_3CuIrO_6 has a structural distortion to a monoclinic structure and oxygen octahedral cage that surround Ir^{4+} is distorted and modifies the electronic and magnetic properties significantly. [4]

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References

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