Large Magnetic Hysteresis in Eu_2NiIrO_6

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Introduction

Eu_2NiIrO_6 is a double-perovskite material that contains chains of alternating Ni^{2+} and Ir^{4+} ions in oxygen cages alternating along the c-axis. We have previously shown giant magnetic hysteresis in Sr_3NiIrO_6, which is a different structure but also contains chains of alternating Ni^{2+} and Ir^{4+} ions [1].

Experimental

We measured extraction magnetometry of polycrystalline Eu_2NiIrO_6 in a 65 T capacitor-driven short pulse 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. Magnetization vs temperature data were measured with a Quantum Design SQUID magnetometer at Rutgers.

Results

Fig. 1 shows magnetic hysteresis loops of Eu_2NiIrO_6 polycrystals measured in pulsed and DC fields. We find that at ~1.5 K the hysteresis loop extends up to 20 Tesla with a coercive magnetic field of 6 Tesla. Fig. 1b shows that a net magnetization appears below 110 K, and magnetic hysteresis develops below 100 K.

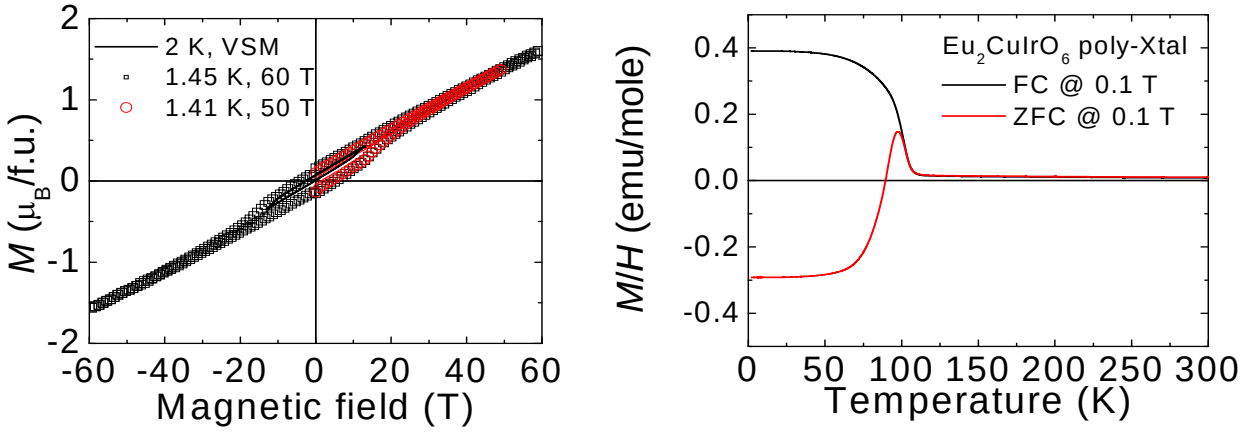

Fig. 1 a) Magnetization M measured in an extraction magnetometer in 50 and 60 T pulses at ~1.5 K, and in a VSM at 2 K. b) Magnetic susceptibility measured in a SQUID in 0.1 T under zero-field-cooled (ZFC) and field-cooled conditions (FC) showing a ferromagnetic-like transition just below 100 K.

Conclusions

Large magnetic hysteresis loops may be a general feature of overlapping Ni^{2+} and Ir^{4+} d orbitals. Ir^{4+} has recently shown to exhibit unusual electronic behavior that breaks Hund's rules because the extended 5d orbitals lead to competition between spin-orbit coupling and crystal-electric fields [2]. In overlap with with 3d orbitals, Ir^{4+} is creating very strong magnetic anisotropy.

Acknowledgements

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References

[1] J. Singleton, *et al* "Giant magnetic hysteresis in Sr_3NiIrO_6", NHMFL annual report (2013).

[2] B. J. Kim *et al,* Phys. Rev. Lett. 101, 076402 (2008)