Magnetic Anisotropy of a Three-Dimensional Honeycomb Iridate

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Introduction

Honeycomb Iridates offer the possibility of exploring exotic new quantum states (for example quantum spin-liquids) by engineering spin-anisotropic (Kitaev) exchange interactions with frustrated connectivity. We report the magnetic properties of a three-dimensional analogue of the layered honeycomb structure that preserves both the connectivity of the honeycomb lattice and the possibility of highly spin-anisotropic exchange due to the large spin-orbit coupling and interfering Ir-Ir exchange paths.

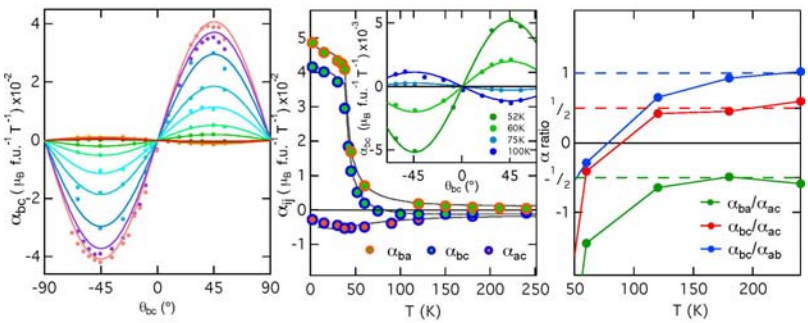

Fig 1. Temperature dependence of the magnetic anisotropy, indicating the reordering of the principal susceptibility components at low temperatures where spin anisotropy of the exchange interactions dominates.

Experimental

Torque measurements of the magnetic anisotropy of ten micron sized single crystals were measured using a piezoresistive micro-cantilever mounted on a cryogenic goniometer.

Results and Discussion

A complete temperature and angular dependence of torque measurements provides evidence for highly spin-anisotropic exchange interactions. At high temperature, the geometry of the octahedral environment and the iridium g-factor anisotropy constrain the susceptibility ratios. Upon cooling, we unambiguously identify a reordering of the principle components of susceptibility and a magnetic transition at 38 K (Fig 1).

Conclusions

Below 38K the torque signal exhibits an abrupt kink with magnetic field. The order of magnitude anisotropy of this kink (H*) with field orientation further highlights the strong orbital character of the coupling (Fig 2).

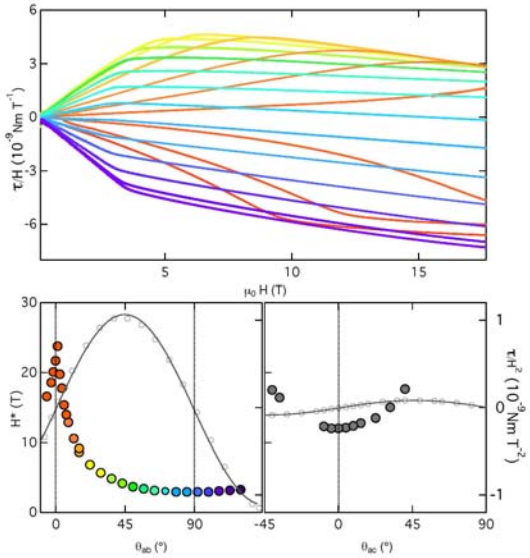

Fig 2. The torque signal divided by the magnetic field fort field orientations between the crystallographic a and b axes

Acknowledgements

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