MAGNETIC STUDIES OF A LARGE DYSPROSIUM-MANGANESE SINGLE-MOLECULE MAGNET

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Introduction

Large lanthanide cluster chemistry has been a keen focus of chemists due to the unique properties of molecules with *f* electrons. However, most of this research has been directed solely toward lanthanide clusters and not lanthanide-transition metal hybrid clusters. Previous work performed by this group has focused on the class of metallamacrocycles known as metallacrowns, which have interesting magnetic properties, since they combine numerous metal ions in close proximity with one another. Recently, we used metallacrown ligands to synthesize large complexes that contain both paramagnetic lanthanide ions and manganese ions. [1] In this Report, we present the largest lanthanide-manganese cluster synthesized to date, $[Dy_6Mn_6(H_2shi)_4(Hshi)_2(shi)_{10}(CH_3OH)_{10}(H_2O)_2]\cdot 9CH_3OH\cdot 8H_2O$ **1** [H_3shi = salicylhydroxamic acid], which is a rare example of a lanthanide-transition metal complex that behaves as a SMM. [2]

Experimental

Variable temperature, variable frequency AC magnetic susceptibility data were collected at the Condensed Matter Physics laboratory at Los Alamos National Laboratory. DC Magnetic susceptibility data were collected on a Quantum Design PPMS Magnetometer at the National High Magnetic Field Laboratory (Pulsed Field Facility) at Los Alamos National Laboratory.

Results and Discussion

The χT vs. T data indicate an overall antiferromagnetic interaction dominates the cluster. The DC magnetization never saturates at high applied fields, indicating a sizable temperature independent paramagnetism (TIP) is present in **1**. Variable-temperature AC SQUID measurements show that at ~4.0 K the in-phase susceptibility (χ'T) signal begins to decrease and the out-of-phase component (χ") increases dramatically at all frequencies, with the magnitude of χ" being frequency dependent. Even at 1000 Hz a maximum in χ" was not observed due to the 2 K temperature limit of the instrument. Two other lanthanide analogues of this complex have also been prepared. However, these Tb^{III} and Gd^{III} analogues did not show evidence of SMM behavior. This indicates that the magnetic properties of **1** are not solely a function of the manganese ions, nor can they be simply explained by invoking a magnetic phase transition or glassy magnetic behavior. Clearly, the molecular structure and the identity of the lanthanide ion are critical to the observed magnetic properties of these novel metallacrown complexes.

Conclusions

The susceptibility data support the assignment of **1** as a new member of the SMM family, expanding the known members of *f-d* type SMM's. Unfortunately, as a result of the low blocking temperature (<2K), we did not observe hysteretic behavior for **1**.

Acknowledgements

This work was supported by the NSF CHE-0111428 (VLP) and the Petroleum Research Fund ACS PRF 38086-AC3 (MLK). The authors wish to thank Dr. Joe Thompson at Los Alamos National Laboratory (MST-10) for use of his magnetometers.

References

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