Possible Spin-State Transitions In A Cobalt(II) Coordination Complex

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Introduction

Transition metal complexes exhibiting spin-crossover phenomena are plentiful in the literature and these generally contain Fe(II) or Fe(III) ions in octahedral coordination geometries [1]. Such a transition originates from subtle changes in Fe-*L* bond lengths which are enough to modify the electronic structure [2]. Generally speaking, spin-state transitions may be responsible for a portion of the interesting physics recently found in some doped Fe-pnictides [3]. Herein, we demonstrate possible related phenomena in simple Co(II) coordination complexes which highlights the need for sizeable orbital contributions to the magnetic moment.

Experimental

Magnetization studies were provided by a 60 T short-pulse magnet located at the Pulsed Field Facility, National High Magnetic Field Laboratory, Los Alamos, NM. The susceptometer was placed within a ^{3}He cryostat providing temperatures down to as low as 0.5 K. The field *B* was measured by integrating the voltage induced in a ten-turn coil calibrated by observing the de Haas–van Alphen oscillations of the belly orbits of the copper coils of the susceptometer.

Results and Discussion

Pulsed-field magnetization measurements obtained on blue powders formed during the reaction of $CoCl_2$ and aminopyrimidine are shown in Figure 1. Aside from the clear hysteresis observed between up and down field sweeps there are indications for possible spin state transitions. Also, the low temperature data taken at 0.61 and 1.65 K show a sharp kink near 3 T which may be attributed to a metamagnetic phase transition. As the temperature increases to 3.97 K an additional kink showing more hysteresis than the feature near 3 T appears.

Conclusions

The data are consistent with a change from $J = 1$ (with a ferromagnetic groundstate exhibiting hysteresis) to $J = 3/2$. Complimentary measurements on oriented single crystals will allow us to investigate the *g*-factor and exchange anisotropies. Work is continuing along these lines as well as ESR measurements and density-functional theory.

Acknowledgements

Work at EWU was supported by the NSF under Grant No. DMR-1005825 and work at the NHMFL was performed under the auspices of the NSF, the DoE project "Science in 100T," and the State of Florida.

References

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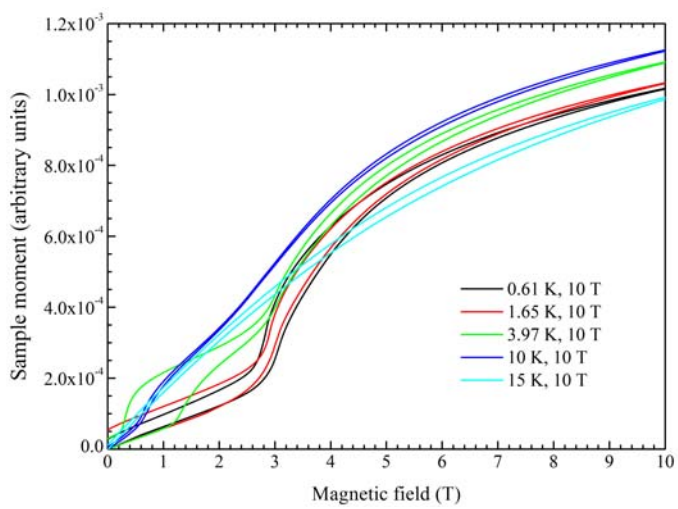

Figure 1. Pulsed-field magnetization data for a powdered Co(II) complex.