Pulsed-Field Magnetization of the Spin-1/2 Quantum Chain $[Cu(pyz)(3\text{-}CNpyO)_2](ClO_4)_2$

J.L. Manson (Eastern Washington U., Chemistry); J. Singleton (NHMFL-PFF); P.A. Goddard (U. of Warwick, Physics)

Introduction

Combining $Cu(ClO_4)_2$, pyrazine (pyz) and 3-cyanopyridine-N-oxide (3-CNpyO) in aqueous solution leads to the formation of well-formed crystals of the title complex [1]. Its structure, as determined by single crystal X-ray diffraction, consists of Cu-pyz-Cu chains whereby remaining metal-coordination sites are occupied by two 3-CNpyO ligands that are ligated through the oxygen of the N-oxide group and the N-atom of the nitrile. The N-oxide ligands protrude enough to force rather large interchain separations which are also occupied by ClO_4^- anions. Bulk magnetic susceptibility data show a broad maximum at 7 K that we attribute to short-range spin correlations within the chain.

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

At 0.52 K, the magnetization M (**Figure 1**) obtained for a powdered sample of $[Cu(pyz)(3\text{-}CNpyO)_2](ClO_4)_2$ shows pronounced concavity as the field increases. Saturation magnetization (B_{sat}) is achieved at 18.8 T. From the simple mean-field expression, $B_{sat} = zJ/g\mu_B$ [2], we obtain J = 13 K using the experimental B_{sat}, an average $g \approx 2.1$, and assuming two magnetic nearest-neighbors (i.e., z = 2). This J-value is in line with other known Cu-pyz-Cu coordination polymers [3]. Other than the observed saturation field we find no evidence for any other field-induced phase transitions.

Conclusions

We have discovered another spin-1/2 Cu(II) chain polymer based on pyrazine bridges. 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

[1] J.L. Manson, *et al*., unpublished results.
[2] J. Bonner and M. Fisher, *Phys. Rev*. **1964**, *135*, A640.
[3] *e.g*., P. R. Hammar *et al., Phys. Rev. B* **1999**, *59*, 1008.

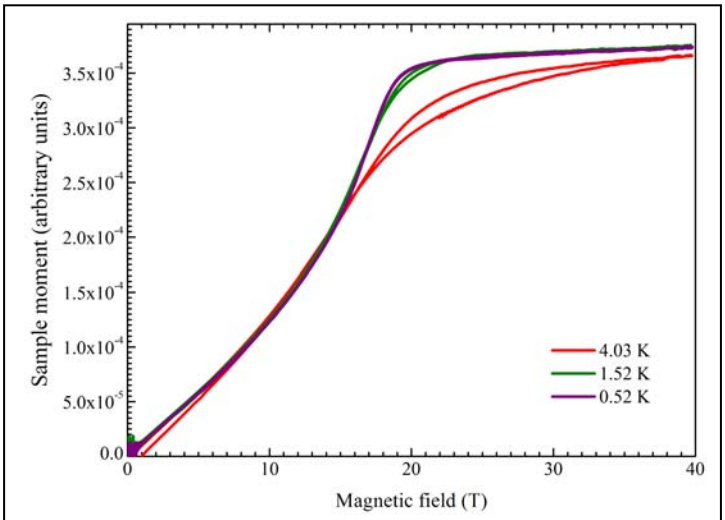

Figure 1. Pulsed-field magnetization data for powdered $[Cu(pyz)(3\text{-}CNpyO)_2](ClO_4)_2$.