

FIELD DEPENDENT PHASE DIAGRAM AND LOW TEMPERATURE MAGNETIC SUSCEPTIBILITY OF FERROMAGNETIC – ANTIFERROMAGNETIC ALTERNATING QUANTUM SPIN CHAIN: $(\text{CH}_3)_2\text{NH}_2\text{CuCl}_3$

M.B. Stone (Condensed Matter Sciences Division (CMSD), Oak Ridge National Laboratory);
W. Tian (The University of Tennessee, Physics); S.E. Nagler, D.G. Mandrus (CMSD, ORNL)

Introduction

$(\text{CH}_3)_2\text{NH}_2\text{CuCl}_3$ or DMACuCl_3 has been suggested to be a quasi-one dimensional $S=1/2$ quantum spin chain with similar magnitude of ferromagnetic and antiferromagnetic exchange interactions [1]. Such a system should show competing behavior between spin-1/2 (AFM) and spin-1(FM) effects and also profound effects as a function of applied magnetic field. It is of particular interest to study the temperature and field dependent phase diagram and thermodynamic properties of DMACuCl_3 .

Experimental

The low temperature AC susceptibility and capacitive torque magnetometry measurements down to 0.25 K with the applied magnetic field parallel to the proposed chain axis a - axis were performed using the 18 T superconducting magnet at NHMFL employing a split coil susceptometer and cantilever magnetometer, respectively.

Results and Discussion

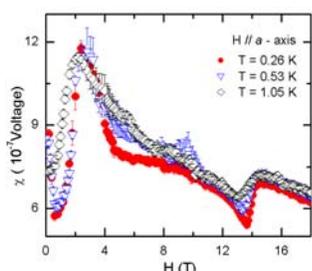


Fig. 1. Field dependent magnetic susceptibility of DMACuCl_3 measured at three temperatures with applied magnetic field along the crystalline a - axis.

The field dependent AC susceptibility measured at $T = 0.25, 0.53,$ and 1.05 K are shown in Fig. 1 (left). Three anomalies were observed consistent with the capacitive torque magnetometry measurements. They indicate that DMACuCl_3 is in a potential magnetic ordered phase below 0.8 K and between 0 T to 0.5 T. DMACuCl_3 undergoes a low field phase transition at approximately 2 T and the saturation field is about 14 T. Fig. 2 (right) depicts the derived phase diagram. A very

unusual second magnetic field induced ordered phase is observed. This intermediate field phase transition may be attributed to the coexistence of FM and AFM interactions in DMACuCl_3 .

Conclusions

Field dependent AC susceptibility and capacitive torque magnetometry were measured at different temperatures. A likely long range order transition is observed at 0.8 K. A very unusual phase diagram is derived. It indicates that DMACuCl_3 consists of a low temperature, low field long range ordered phase, a very unusual second magnetic field induced ordered phase and a ferromagnetic polarized phase above 14 T [2].

Acknowledgements

We acknowledge Dr. T. P. Murphy for his support.

References

- [1] O'Brien, S., *et al.*, Inorg. Chim. Acta., **141**, 83 (1988).
- [2] Stone, M.B., *et al.*, Proc. of 24th Int. Low-Temperature Phys. Conf., in press (2005).

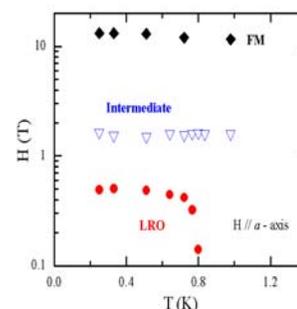


Fig. 2. Magnetic field versus temperature phase diagram of DMACuCl_3 between 0.25 K $< T < 1$ K derived from the AC susceptibility and capacitance torque magnetometry with applied magnetic field parallel to a - axis.