FIELD DEPENDENT PHASE DIAGRAM AND LOW TEMPERATURE SPECIFIC HEAT OF FERROMAGNETIC – ANTIFERROMAGNETIC ALTERNATING QUANTUM SPIN CHAIN: $(CH_3)_2NH_2CUCL_3$

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);
Y. Takano, B. Andraka (University of Florida, Physics)

Introduction

We investigated the temperature and magnetic field dependent specific heat of $(CH_3)_2NH_2CuCl_3$ or $DMACuCl_3$, which has been proposed to be a quasi-one dimensional S=1/2 quantum spin chain along crystalline *a* - axis 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 show profound effects as a function of applied magnetic field.

Experimental

The low temperature specific heat for 0.25 K < T < 3 K was measured at the National High Magnetic Field Laboratory (NHMFL) DC Field Facility with magnetic fields applied perpendicular to the proposed chain axis, *a* – axis, for fields up to H = 5 T using a heat pulse calorimeter.

Results and Discussion

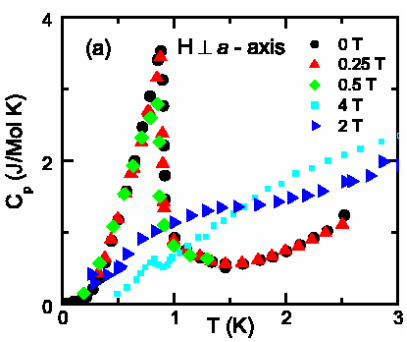

Fig. 1. Low temperature specific heat of $DMACuCl_3$.

The low temperature specific heat of $DMACuCl_3$ measured with several applied magnetic fields is shown in Fig. 1 (left). A peak at T ≈ 0.9 K is observed in the zero field specific heat associated with a transition to magnetic long range order. The peak intensity decreases rapidly with increasing magnetic field, and disappears at H ≈ 2 T indicating that the long range order can be suppressed by applying 2 T magnetic field. Similar to the capacitive torque magnetometry and AC susceptibility measurements, a peak appears at T ≈ 0.8 K when applying higher field such as H = 4 T indicating that there is a second magnetic induced phase in the intermediate field range. Fig. 2 (right) depicts the derived phase diagram based upon the temperature and field dependent specific heat and magneto-caloric effect measurements.

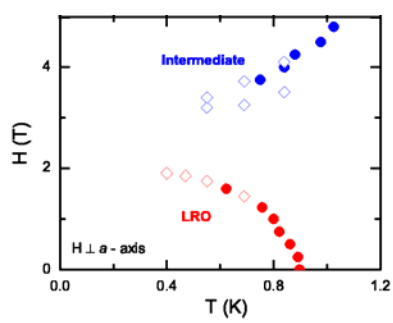

Fig. 2. Magnetic field versus temperature phase diagram of $DMACuCl_3$ derived from field dependent specific heat (filled circles) and magneto-caloric measurements (open circles) with applied magnetic field perpendicular to *a* - axis.

Conclusions

The temperature dependent specific heat was measured under several applied magnetic fields. The long range order transition is observed at 0.9 K. A very usual phase diagram is derived indicating the significance of 3D interactions in $DMACuCl_3$ [2].

Acknowledgements

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

References

[1] O'Brien, S., *et al.*, Inorg. Chim. Acta., **141**, 83 (1988).
[2] Tian, W., *et al.*, in preparation.