High-Field Magnetization of Zero-Dimensional Quantum Magnets

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Introduction and Experimental

The zero-dimensional molecular magnets [Fe_3Gd_3 (H_4TBC_8)O_2 $(MeO)_2(MeOH)(HCOO)_2(DMF)_4$] (A), [$Fe_{17}O_{16}$ $(OH)_{12}(pyr)_{12}Br_4]Br_3$ (B), [Mn_6O_2(Me-sao)$_6$(O_2CCPh_3)$_2$($EtOH)_4$] (C) and [Mn_6O_2(H_2N-sao)$_6$(py)$_6$($H_2O)_2$][$ReCl_6$] (D) were studied using an extraction magnetometer in a 65 T short-pulse magnet. The purpose was to examine the *M(H)* characteristic of each material to higher fields than had been previously possible [1.2]. Each of these compounds contains clusters of metal ions held together by non-metal ligands and so they can be referred to as Zero-Dimensional Molecular Magnets [3,4].

Results

The magnetization of each compound showed a plethora of features, including steps in magnetization, sharp slope changes, hysteresis and strongly temperature-dependent *M(H)* characteristics. Examples are shown in Figure 1, with some features attributable to Macroscopic Quantum Tunneling [5]. Note the differing regions of hysteretic behavior observed in compound C, showing that the relaxation processes are strongly influenced by ground-state configuration [3,4].

Conclusions

The experiments revealed previously-unobserved and complex high-field behavior. The field positions and magnitudes of the *M(H)* steps and slope changes are being analyzed in the context of theoretical models and complementary EPR data. The sweep-rate dependent features are being compared with transient state models, and a publication is planned once these tasks are completed to a satisfactory conclusion.

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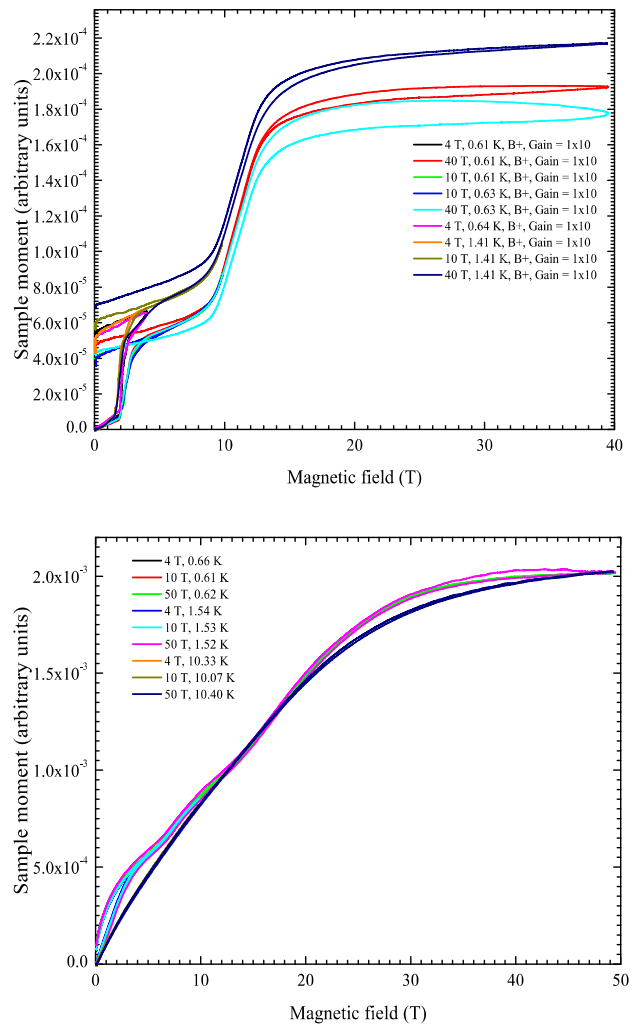

Figure 1 Upper Plot: Pulsed-field M versus H profile for compound C. Lower plot: similar data for compound D. The temperatures of the various curves are shown in the inset keys.

References

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