Unraveling the Phase Transitions Of A Room Temperature Magneto-Dielectric Hybrid Framework Material: $(C_2H_5)_3CH_3FeBr_4$

P. Jain, V. Zapf, E.D. Mun, C. Beckner, R. McDonald, K.A. Modic (NHMFL, LANL)

Introduction

Multiferroics, materials with coexisting ferroic orders, are rare materials and have attracted lot of interest due to their applications in data storage, sensors, transducers etc. Much attention has been focused on perovskite based oxide materials; however, a new class of multiferroic materials based upon inorganic-organic frameworks has recently emerged[1-3]. One such material, $(C_2H_5)_3CH_3FeBr_4$ (TIB), was shown to possess elusive and much sought after magnetodielectric coupling[4]. In this project we have tried to identify the mechanism of this coupling along with unraveling new phase transitions.

Results and Discussion

The magnetization isotherms, *M*(*H*), of a polycrystalline sample of TIB were measured in capacitor-driven millisecond pulsed magnets up to 60 T and down to 1K. The *M*(*H*) curves taken in pulsed fields at selected temperatures are shown in the left figure 1 (a-c). The observed *M*(*H*) at 20 K is linear in field (not shown), while *M*(*H*) for lower temperatures shows saturation above 11T (Fig 1a). In addition, below 4 K, *M*(*H*) shows a meta-magnetic transition at ~2.5 T.

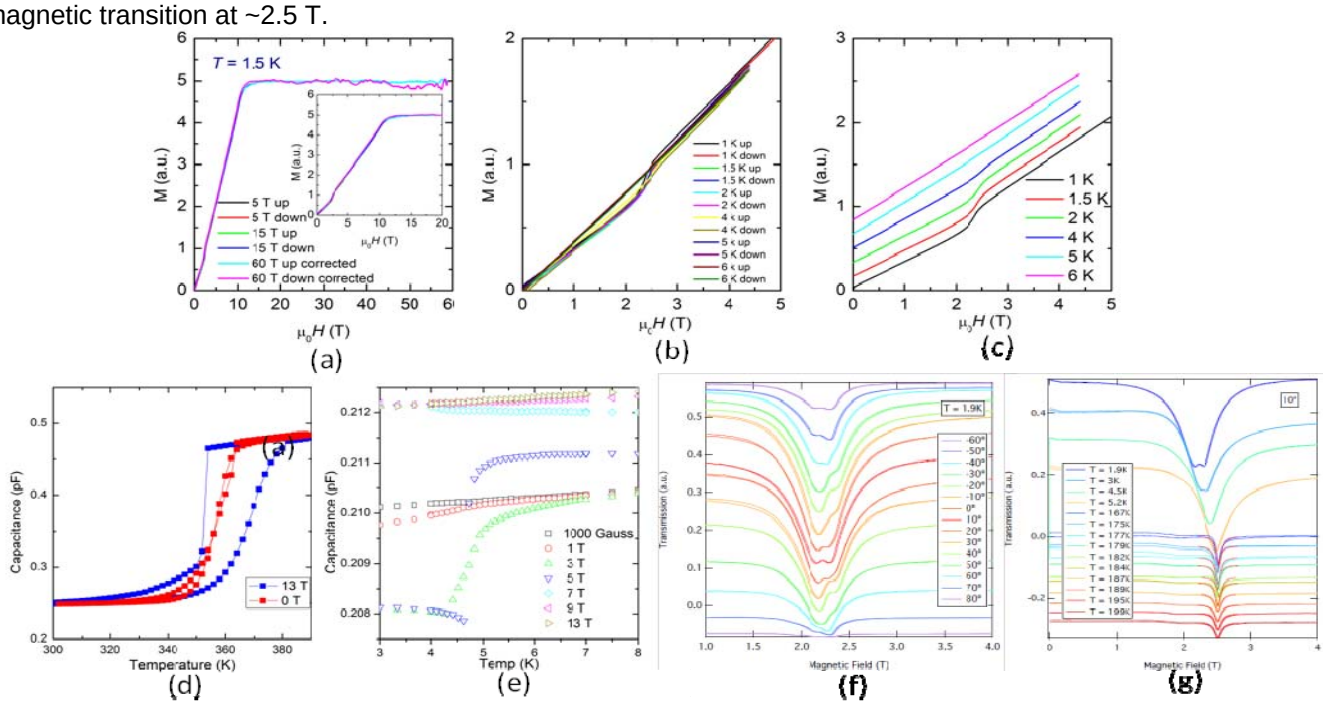

Figure 1. (a-c): Pulsed field *M(H)* isotherms; (d-e): capacitance vs Temperature; (f-g): ESR data of TIB

As expected TIB shows magnetodielectric coupling above 340K[4] (Fig 1d). Furthermore, it also shows a new transition at around 5K which appears only between 1 and 9 Tesla. To shed light on this phenomenon we performed ESR measurements (Fig 1f & 1g). From the splitting of the peaks it appears that this might be a mixture of structural and magnetic phase transitions.

Acknowledgements

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References(1) Li, W.; Zhang, Z.; Bithell, E. G.; Batsanov, A. S.; Barton, P. T.; Saines, P. J.; Jain, P.; Howard, C. J.; Carpenter, M. A.; Cheetham, A. K. *Acta Materialia* **2013**, *61*, 4928. 2) Stroppa, A.; Barone, P.; Jain, P.; Perez-Mato, J. M.; Picozzi, S. *Advanced Materials* **2013**, *25*, 2284.