Effect of A-site sophisticated disorder on the Electromagnetic properties of 'A-site ordered $RBaMn_2O_6$ (R= rare earth)' perovskite

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Introduction

Correlated Electron System Doped Manganites

- Phase separation controls wide range of electronic & magnetic properties.
- Reduction of size to nanoscale leads to dramatic changes to properties through finite size, grain boundary, surface strain effects.
- Strain effects combined with compositional distribution may tune the magnetic properties.
- Magnetic frustration at low temperature and/or inhomogeneous glassy magnetic ground state.
- Localized strain.

Where to Probe……

A-site randomness:1.CMR & Electronic phase separation 2.Destruction of hidden phase

Answer is still pending…… To find the answer

- Look at $RBaMn_2O_6$:Change the ordering of R and Ba >>> Phase diagram modifies
- Look at $YBaMn_2O_6$:Charge ordering transition temperature at 500 K with a new stacking variation of 4-fold periodicity along the c axis
- Advantages: Near Room Temperature Probing is Possible

So we go for Double Perovskite System

Why $RBaMn_2O_6$ (R=Sm ~ Ho & Y)

- Charge-ordered-insulator (COI) transition above 300K
- Offer testing ground whether disorder at the A site plays a vital role in the occurrence of CMR and phase separation.
- New stacking variation of Charge exchange (CE)-type CO with 4-fold periodicity
- Structural transition above CO transition
- No lowering of Curie transition
- No lowering of FM-to-antiferromagnetic insulator transition
- CMR is related to the conversion of COI phase to FM phase under magnetic fields, MR effect above room temperature is expected in $RBaMn_2O_6$

Easy to probe properties near Room Temperature: We choose $RBaMn_2O_6$

How to prepare double perovskites ??

- **Solid State Route: Established Route, Associated with: Inherent in-homogeneity**
- Our approach: Chemical Sol-Gel and solid state route

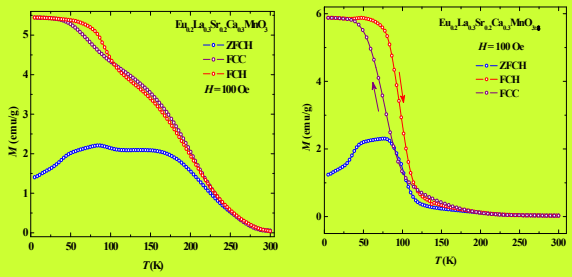
Target: Uniform & controllable particle size, Challenges: Control of Reaction & Post Heat Treatment & Phase Purity

Way through: Our Expertise in Sol-Gel and solid state route

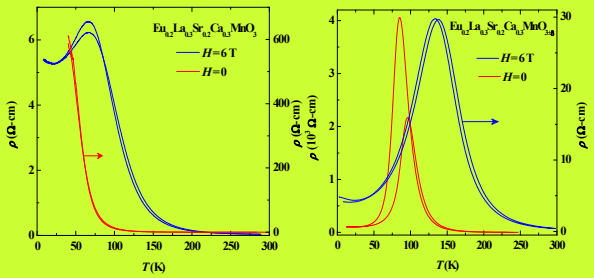
Some recent results

Pre-study on $Eu_{0.2}La_{0.3}Sr_{0.2}Ca_{0.3}MnO_3$ with different O_2- concentration

(a) M-T behavior:



(b) ρ-T behavior:



The above measurements were carried out at UGC-DAE CSR, Kolkata

N.B.: PI already published his work related to this topic [1].

[1] K. De, M. Patra, S. Giri, and S. Majumdar, Solid State Comm., 142, 457 (2007).

Work Plan

- Good quality sample [$RBaMn_2O_6$ (R= Sm ~ Ho & Y)] preparation through solid state route & chemical sol-gel route
- Detailed structural characterization
- Magnetic measurements with temperature and field variations
- Transport property measurements (with/without magnetic field)
- Structural transition (from neutron diffraction), Magnetic transition & their correlation
- Correlation of transport property with structure
- Finally, How A-site gives modification in above behavior

Outcome

- With introduction of A-site disorder in $RBaMn_2O_6$ the COI phase of A-site is expected to be destroyed by magnetic field generating CMR effect around room temperature for application in electronic devices.
- New comprehension of physics of perovskite manganites.
- Possibility of getting improved material for magnetic recording and permanent magnets.
- Precise understanding of novel electromagnetic property of $RBaMn_2O_6$, effect of A-site order/disorder on their characteristic features.

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