



Investigation of Physics at the Interface of Manganite/Wurtzite Heterostructures

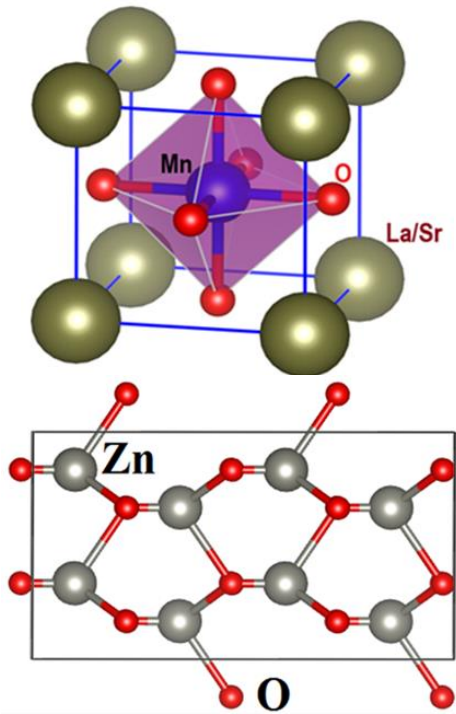
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Heterostructures and Heterointerfaces

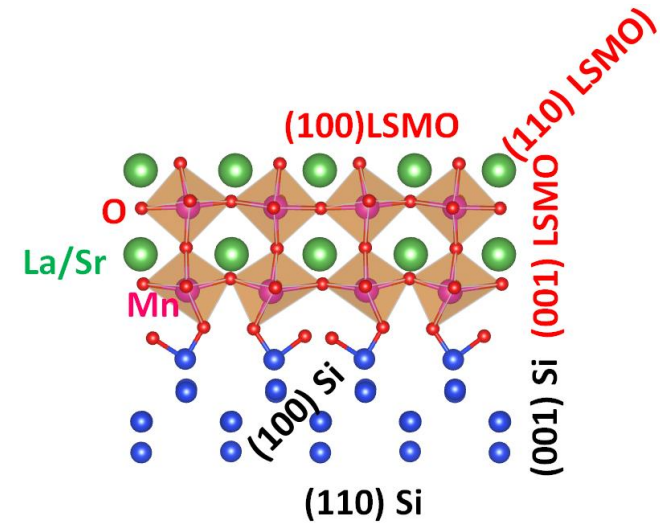


Lattice Mismatch

$$\frac{d_{100}^{\text{LSMO}} - d_{110}^{\text{Si}}}{d_{100}^{\text{LSMO}}} = -1.01\%$$

$$\frac{d_{1-10}^{\text{ZnO}} - d_{110}^{\text{LSMO}}}{d_{1-10}^{\text{ZnO}}} = 2.14\%$$

$$\frac{d_{1-10}^{\text{ZnO}} - d_{120}^{\text{Si}}}{d_{1-10}^{\text{ZnO}}} = 13.52\%$$



Application of $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3/\text{ZnO}$

- Photo-carrier injection
- UV photovoltaic application
- Better Rectifying behavior than Si/LSMO

Heterostructures:

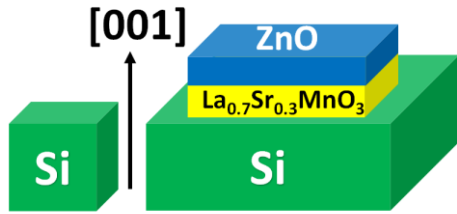
Si (Diamond)-LSMO(Pseudocubic)

Pseudocubic (LSMO)-ZnO(Wurtzite)

Heterointerfaces: Si-LSMO interface

LSMO-ZnO interface

Deposition and Characterization



Targets used: $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$, ZnO

Substrate : **Silicon**

Deposition Pressure :

$$9.0 \times 10^{-3} \text{ mBar}$$

Temperature: 700 °C

Ar:O₂ : 20:80% (LSMO)

60:40% (ZnO)

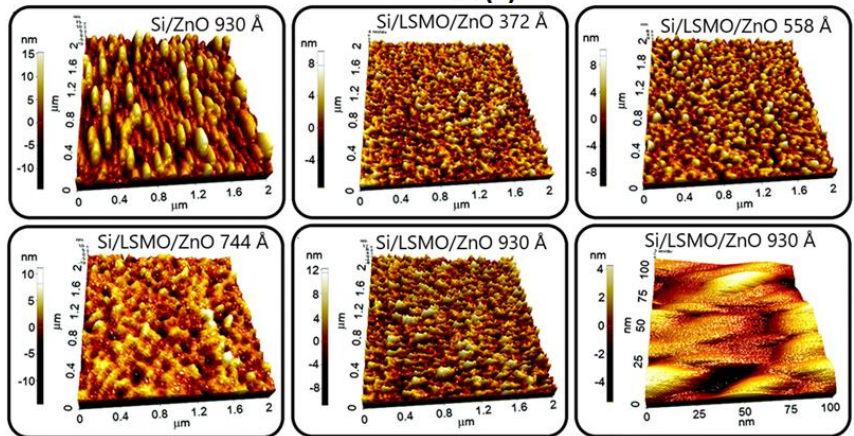
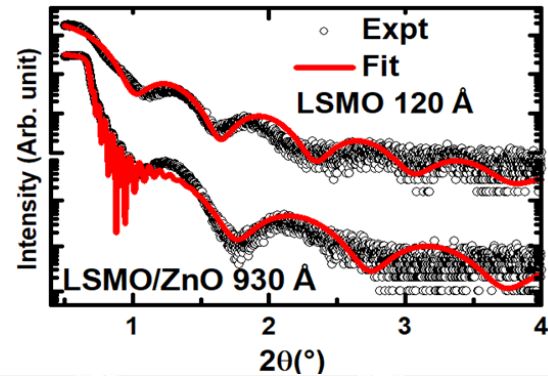
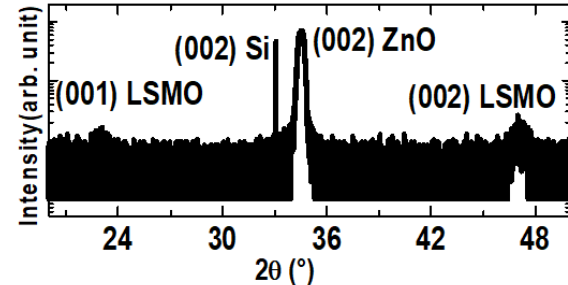
Post Annealing :

45 min in 300 mbar O₂



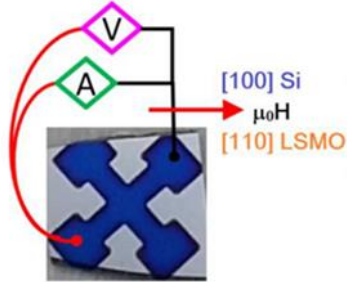
LSMO

ZnO thickness

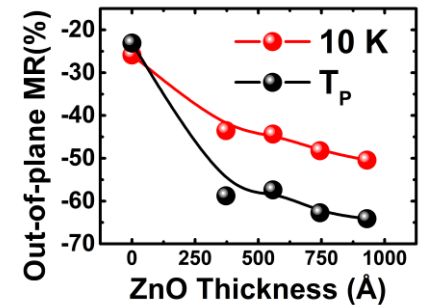
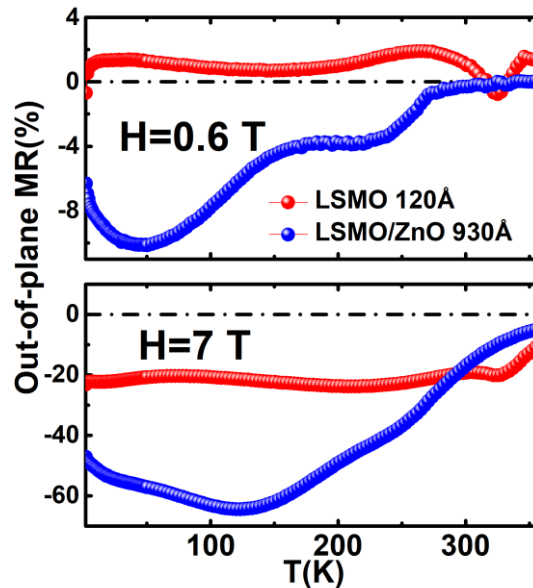
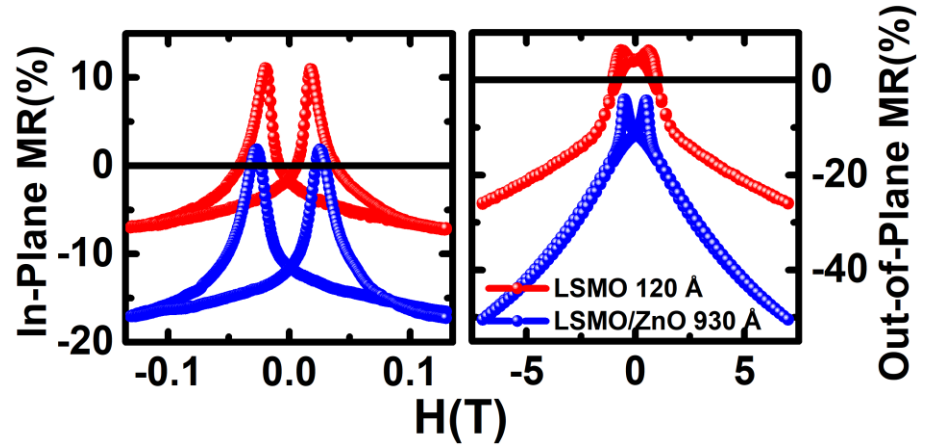
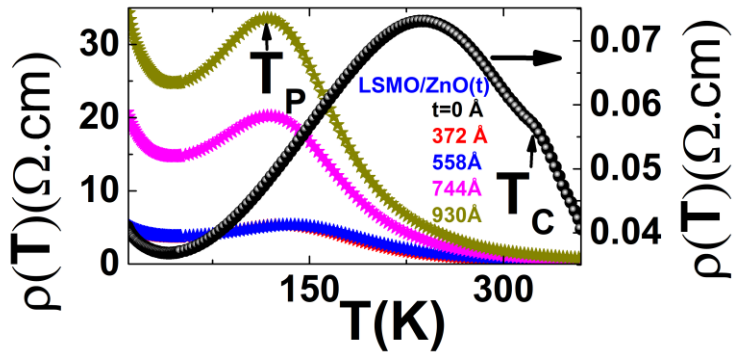


Spintronic Properties

In-plane geometry



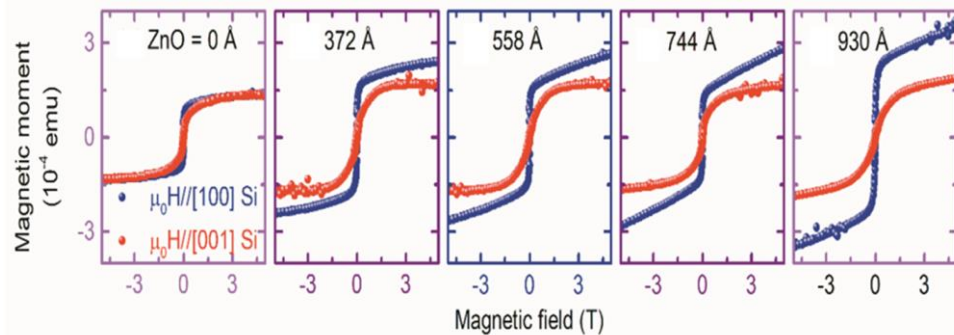
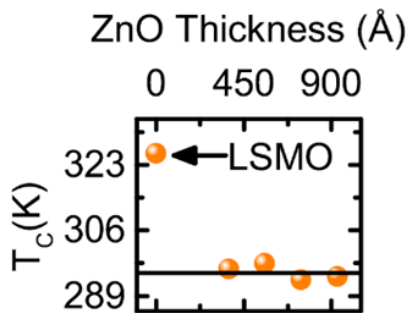
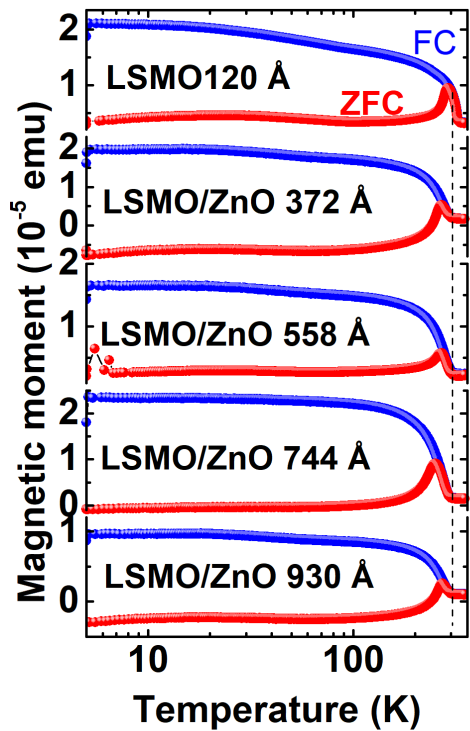
$$MR = \frac{R(H) - R(0)}{R(0)}$$



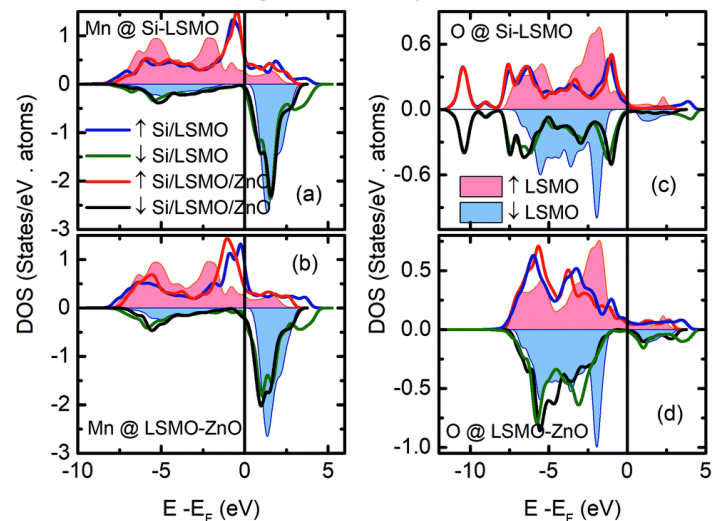
$$MR_{LSMO} = 26\%$$

$$MR_{LSMO/ZnO} = 64\%$$

Magnetization and DFT study



Projector density of states



DFT study: **Charge transfer** at Si-LSMO
 Very small charge transfer at LSMO-ZnO

Conclusions

- Oriented LSMO and ZnO layers
- Roughness increases with ZnO thickness
- T_C is reduced $\sim 30\text{K}$ due to distortion in MnO_6 octahedra
- LSMO and LSMO/ZnO show spin-glass transition behavior
- Positive MR is due to **charge transfer** induced interfacial anti-ferromagnetic coupling and **spin-orbit coupling induced weak anti-localization at Si-LSMO interface**
- Enhanced negative MR of LSMO/ZnO is due to **magnetic scattering at the LSMO-ZnO interface**

References

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- S. Valencia, et al., Phys. Rev. B 98, 115142 (2018)
- S. Hikami, et al., Prog. Theor. Phys. 63, 707 (1980)
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Thank You