Double-perovskite La_2NiMnO_6 thin films grown by RF sputtering

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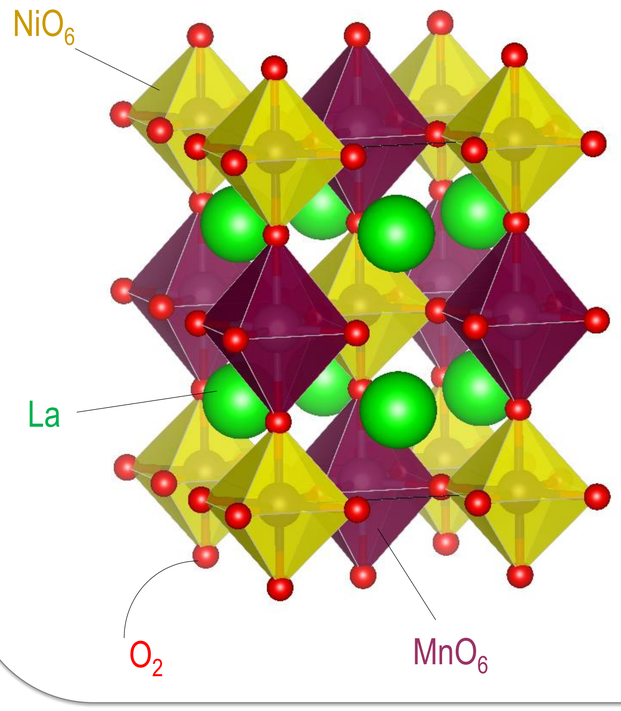
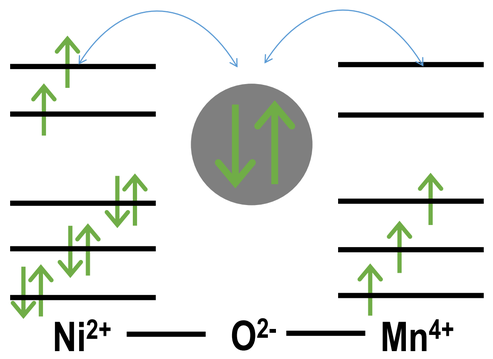
La_2NiMnO_6 double perovskite



- La_2NiMnO_6 (LNMO) is a ferromagnetic insulator with $T_c \sim 280$ K [1].
- Magnetoresistance and magnetocapacitance are observed near RT [2].
- Ferromagnetic coupling is predicted by Goodenough-Kanamori-Anderson rules

Super exchange interaction

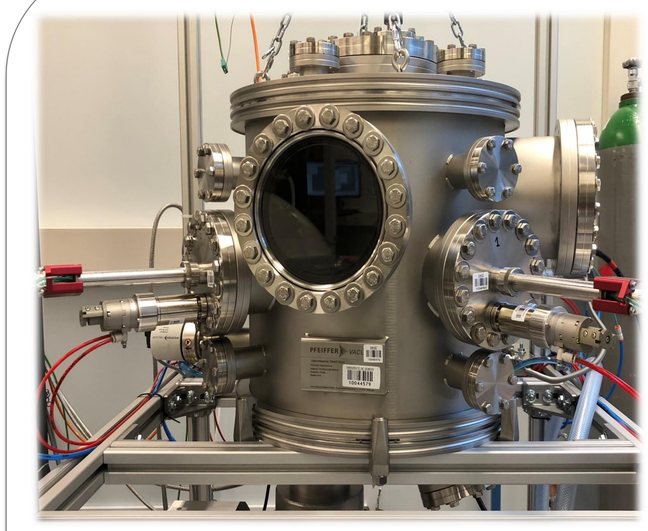


Ni^{2+} = d^8 (t_{2g}^6 e_g^2) , M_{Ni} = 2.0 μ_B

Mn^{4+} = d^3 (t_{2g}^3, e_g^0) , M_{Mn} = 3.0 μ_B

- For ordered LNMO films, M_s = 5 μ_B/f.u is expected

Film deposition



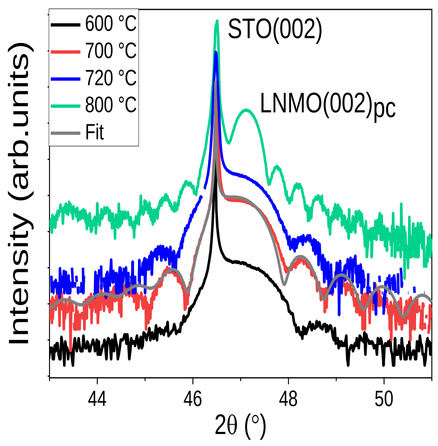
The films are grown by off-axis RF magnetron sputtering

Optimized growth conditions for La_2NiMnO_6 films on $SrTiO_3$ (001)

Tensile strain (ε)
LNMO/STO (001) = 0.61%

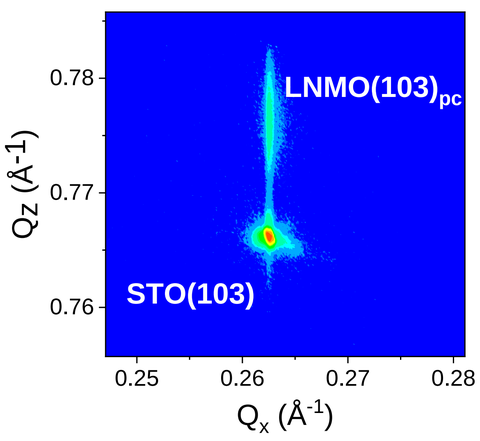
- Thickness = 12-15 nm
- Growth pressure = 0.18 mbar
- Ar:O_2 ratio = 1:1

XRD fittings indicate lattice parameter $c \approx 3.85$ Å

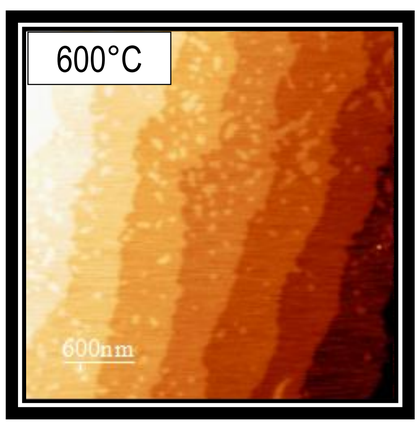


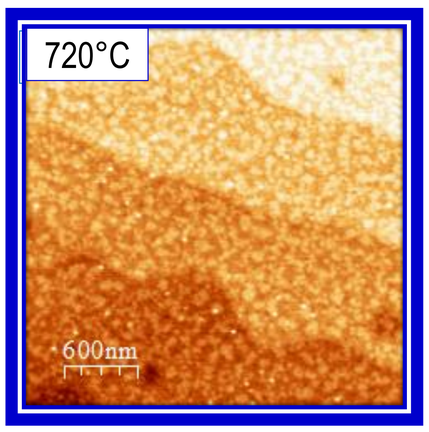
High crystalline quality nearly independent from growth temperature

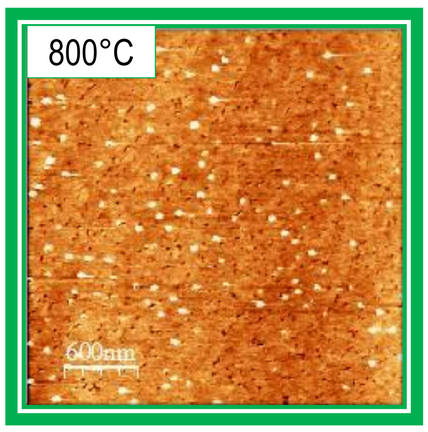
$LNMO(103)_{pc}$ peak compatible with $c \approx 3.85$ Å



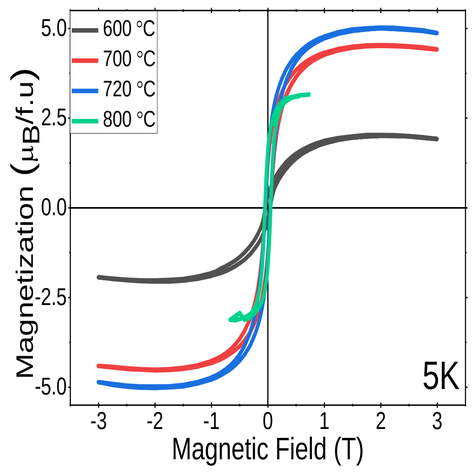
All films are in-plane lattice-matched to the substrate



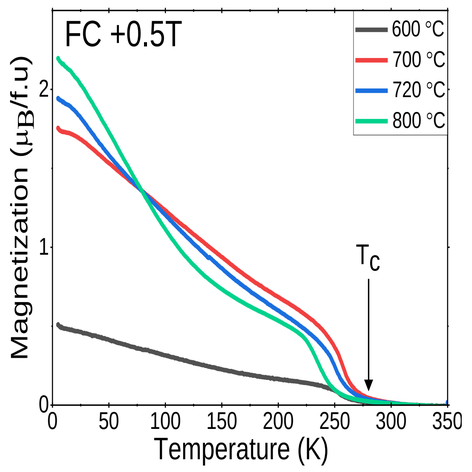




AFM images indicate that surface topography is highly affected by growth temperature



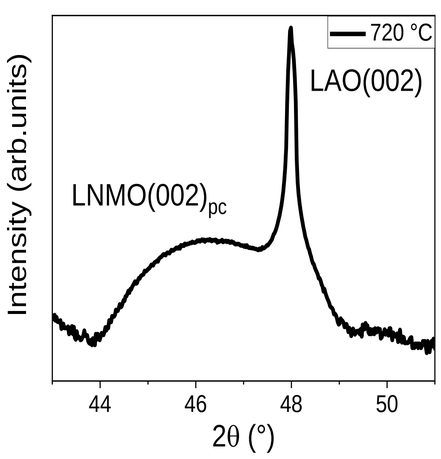
Growth temperature is an important parameter to control saturation magnetization



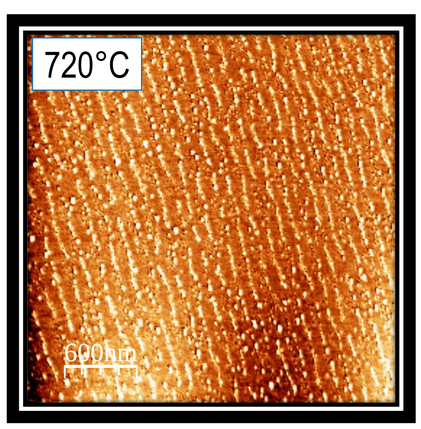
M(T) curves show a Curie temperature close to 280 K

Towards strain tuning…

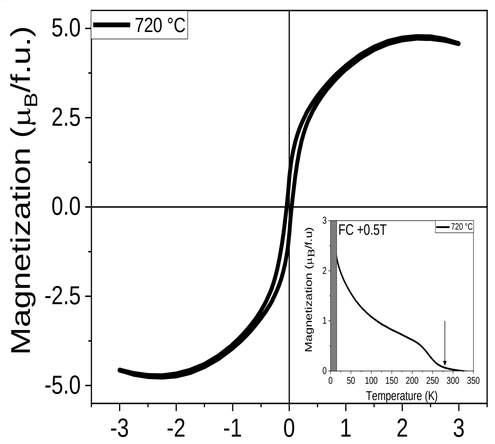
Compressive strain (ε) LNMO/LAO (001) = 2.37%



XRD fittings suggest a lattice parameter $c \approx 3.95$ Å



Surface topography is not completely optimized



Saturation magnetization (measured at 5K) ≈ 5 μ_B/f.u.

Outlook and references

- High quality La_2NiMnO_6 films were grown on STO(001) substrates by off-axis RF sputtering
- Growth temperature is a fundamental parameter to maximize the saturation magnetization
- Influence of epitaxial strain on the magnetic and structural properties of the LNMO films will be further investigated

[1] K. Asai et al. *J. Phys. Soc. Jpn.* **67**, 4218 (1998)

[2] N. Rogado et al. *Adv. Mater.* **17**, 2225 (2005)