Dynamic strain engineering of the metal-insulator transition in nickelates for thermo-optical applications

laboratoire Albert Fert

Scientific Context

Rare-earth perovskite nickelates ($RNiO_3$, with R a rare-earth element) are correlated oxides that exhibit sharp, tuneable metal–insulator transitions (MITs). Their electronic properties are highly sensitive to lattice distortions and strain (Fig. 1), making them excellent model systems for studying structure–property coupling in quantum materials.

Our group has demonstrated that the MIT in nickelate thin films can be shifted toward room temperature by mixing Sm and Nd in controlled ratios, opening opportunities for device-oriented applications. Building on this progress, **the proposed project aims to achieve active and reversible control of the transition through strain engineering.**

Epitaxial films will be grown on **piezoelectric substrates** ($BaTiO_3$ or PMN-PT), where an applied gate voltage dynamically modulates the biaxial strain and, consequently, the MIT. The resulting strain-driven tuning will be explored through transport and infrared optical measurements to realize dynamically tuneable properties relevant for thermo-optical applications.

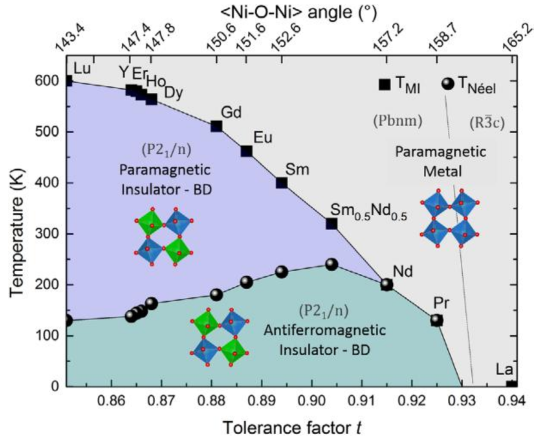

Figure 1. Phase diagram of the $RNiO_3$ family showing the changes in the metal-insulator transition, the Néel transition and the evolution of the structure as a function of the tolerance factor (t) (bottom x axis) and the Ni-O-Ni angle (top x axis).

Work program & skills acquired during internship

The student will grow and optimize nickelates thin films of selected compositions using **Pulsed Laser Deposition (PLD)** technique on piezo electric substrates. He/she will also perform a complete structural characterization of the thin films through **X-Ray reflectivity (XRR), X-Ray diffraction (XRD), Reciprocal Space Map technique (RSM) and Atomic Force Microscopy (AFM)**. Resistivity measurements as a function of the temperature and gate voltage will determine the influence of strain on the metal-insulator transition, while optical characterization, including thermal reflectance, emissivity measurements and ellipsometry, will assess the strain-dependent infrared behaviour. Experience with **electrical transport** and **optical characterization techniques** will be considered an asset, along with strong **experimental skills, data analysis capabilities, and the ability to work effectively in an** interdisciplinary environment bridging **academic research and industrial innovation**.

Work environment

You will be working under the supervision of: **Lucia Iglesias (CNRS) and Julian Peiro (Thales)** at **Laboratoire Albert Fert** located in Thales Research and Technology building on the Paris-Saclay campus.

https://laboratoire-albert-fert.cnrs-thales.fr/
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Requested background : **Master 2**
Duration : **6 months**
Start period : **Feb 2026**
Possibility of the PhD thesis: **YES**

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