

Sign reversal of the Hall coefficient in $\text{La}_2\text{DyNi}_2\text{O}_7$ thin films by varying epitaxial strain

Zhengyang Zhong¹, Motoki Osada¹, Atsushi Tsukazaki^{1,2}

¹ Department of Applied Physics and Quantum-Phase Electronics Center (QPEC),
The University of Tokyo

² RIKEN Center for Emergent Matter Science (CEMS)

Superconducting signatures at 78 K were discovered in bulk $\text{La}_3\text{Ni}_2\text{O}_7$ under high pressure [1], and ambient-pressure superconductivity with $T_c = 40$ K has been achieved in compressively strained bilayer nickelate thin films [2]. This observation has been mainly confined to the films on SrLaAlO_4 (SLAO) substrates, which impose a large compressive strain of approximately -2.0% . The control of lattice size by applying various substrates is a topic worth researching to improve superconducting properties.

Our group has tuned the lattice size of $\text{La}_2\text{LnNi}_2\text{O}_7$ films prepared by pulsed-laser deposition through Ln substitution and hydrostatic pressure [3]. Ln substitution on SLAO yields superconductivity for $\text{Ln} = \text{Pr}, \text{Nd}, \text{Sm}, \text{Eu}$, and Dy , with T_c and the Hall coefficient R_H varying with the c -axis length. In this study, we investigated $\text{La}_2\text{DyNi}_2\text{O}_7$ films for varying the epitaxial strain using YAlO_3 , SLAO, LaAlO_3 (LAO) and LaSrGaO_4 (LSGO) substrates. The a -axis constant of the films on SLAO, LAO and LSGO are coherent to that of substrates. Superconductivity appeared only on SLAO with $T_c^{\text{onset}} = 22$ K. R_H at 60 K is negative on compressive SLAO and LAO, while it becomes positive on tensile LSGO (Fig. 1). Ln substitution and substrate strain may thus tune R_H through different Fermi-surface variation, acting mainly on the X-point hole pocket of $d_{3z^2-r^2}$ character and on the Γ -point electron pocket of $d_{x^2-y^2}$ character.

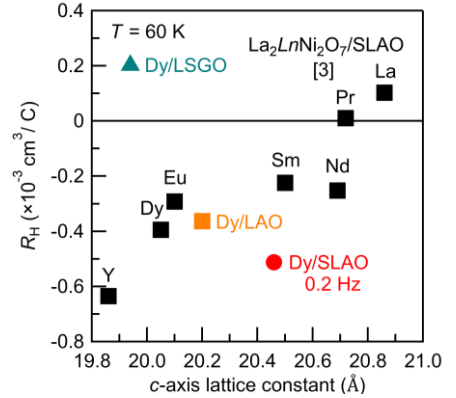


Fig. 1: R_H vs. c -axis at 60 K for previous study [3] and this study.

[1] H. Sun *et al.*, *Signatures of superconductivity near 80 K in a nickelate under high pressure*, Nature **621**, 493–498 (2023).

[2] E. Ko *et al.*, *Signatures of ambient pressure superconductivity in thin film $\text{La}_3\text{Ni}_2\text{O}_7$* , Nature **638**, 935–940 (2025).

[3] M. Osada *et al.*, *Bridging ambient- and high-pressure superconductivity in $\text{La}_2\text{LnNi}_2\text{O}_7$ films*, Nature Mater., online published: 18 August (2026).