

Phase Diagram of Superconducting Infinite-layer Nickelates

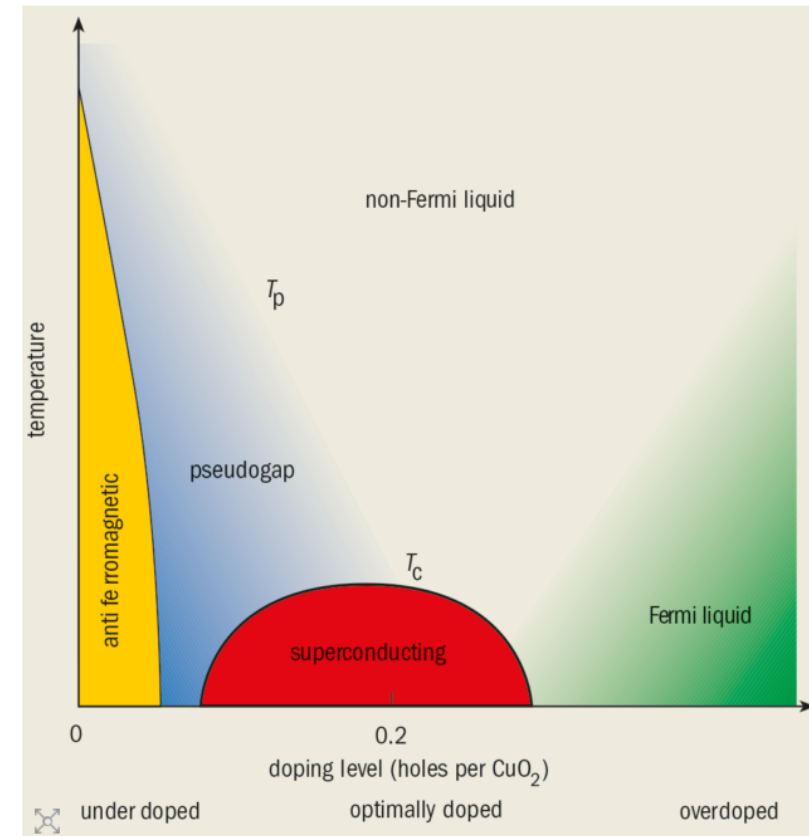
Ying-Ting Chan

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Why are layered nickelates interesting?

- A new type of superconductivity
- Layered structure
- Doping dependent behavior

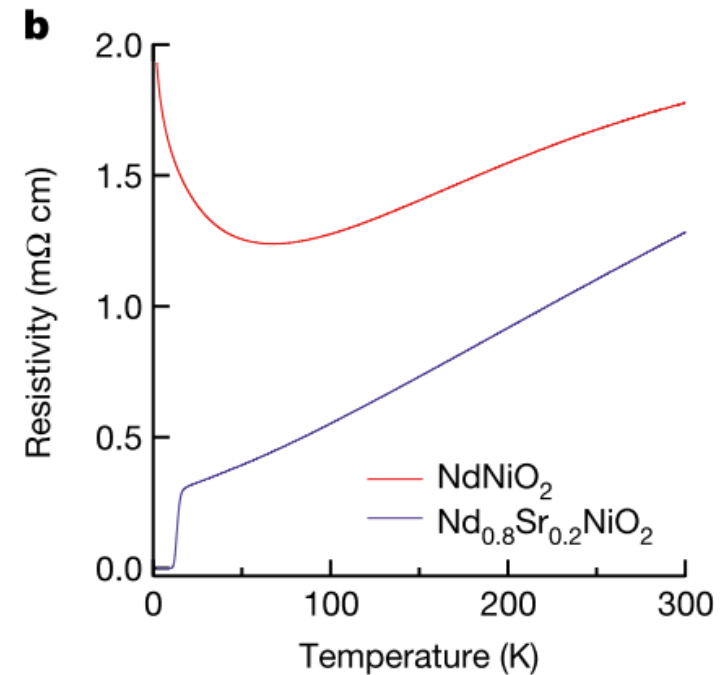
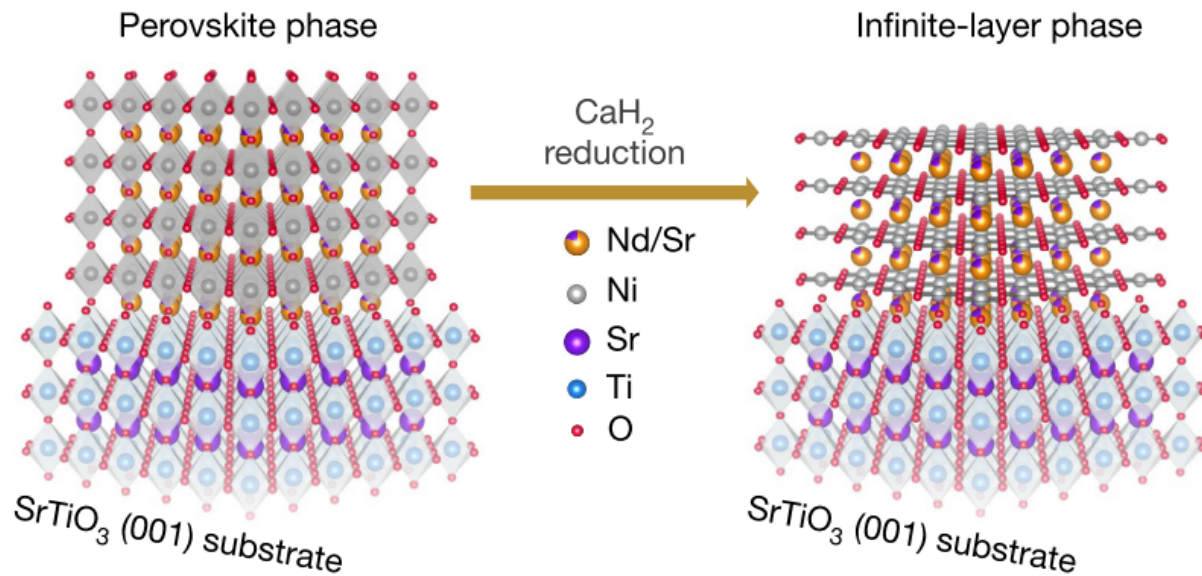
Phase diagram of cuprates










Similar to cuprates?

Superconductivity in an infinite-layer nickelate

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Superconducting Dome in $\text{Nd}_{1-x}\text{Sr}_x\text{NiO}_2$ Infinite Layer Films

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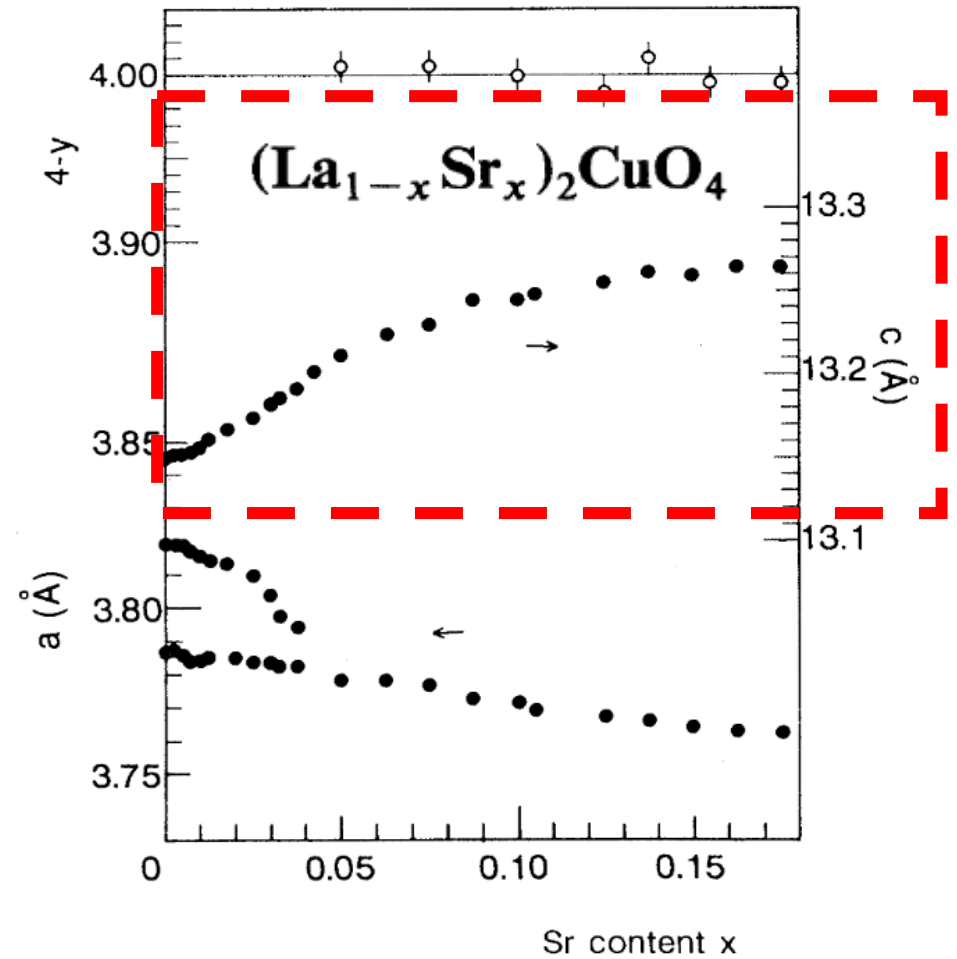
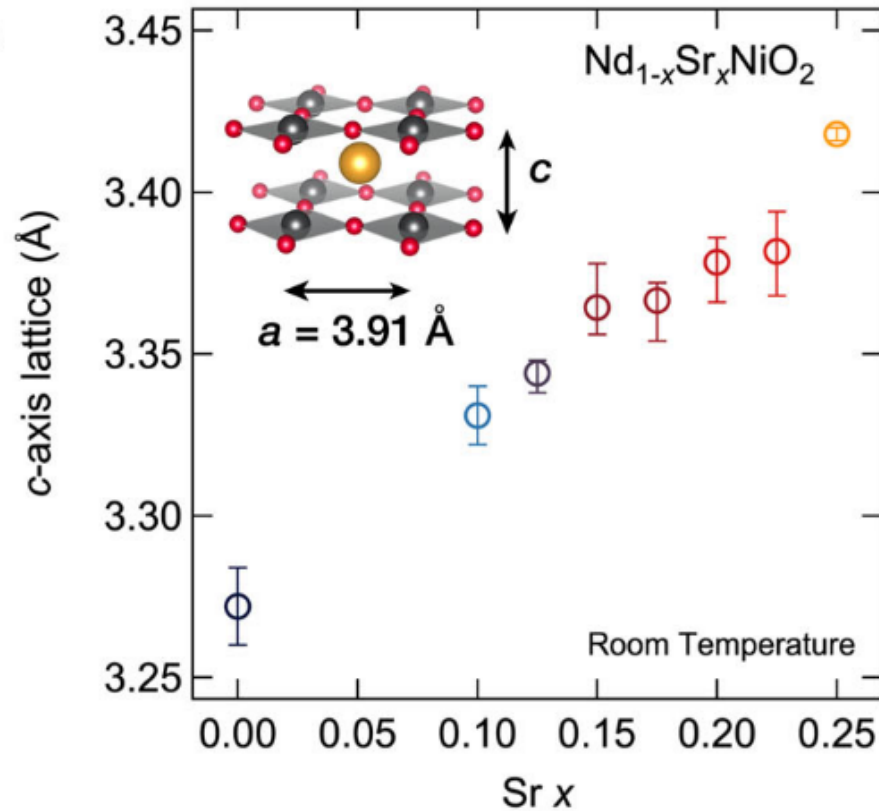
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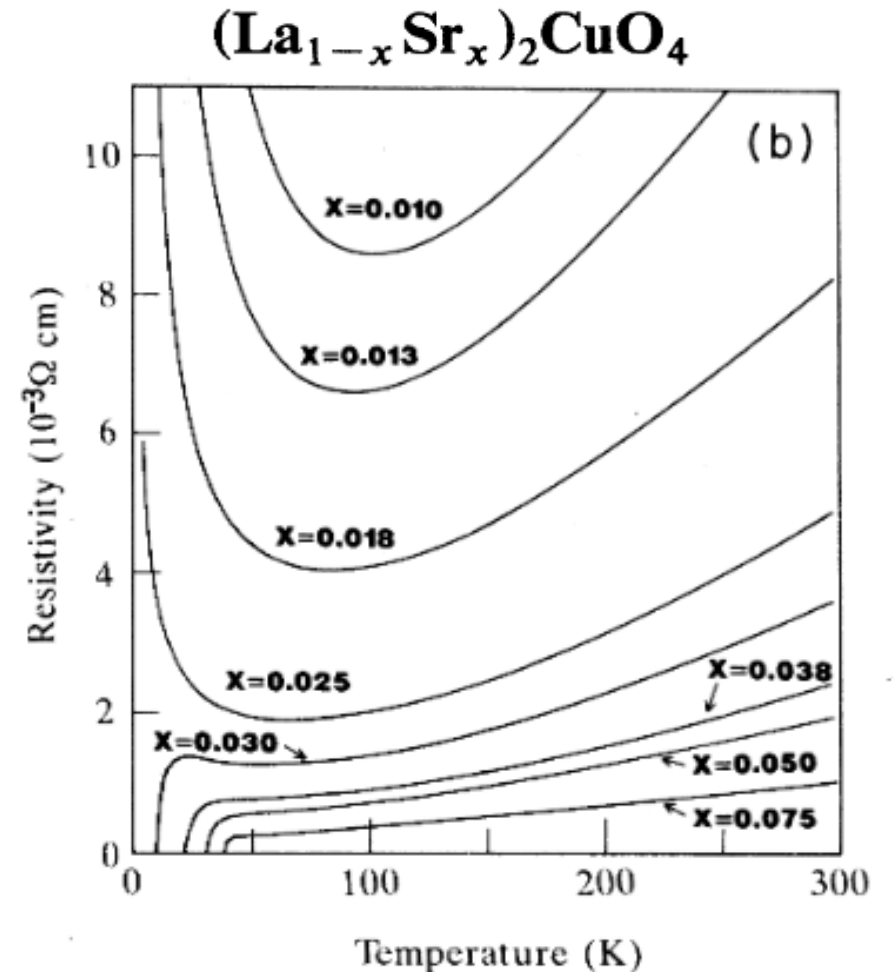
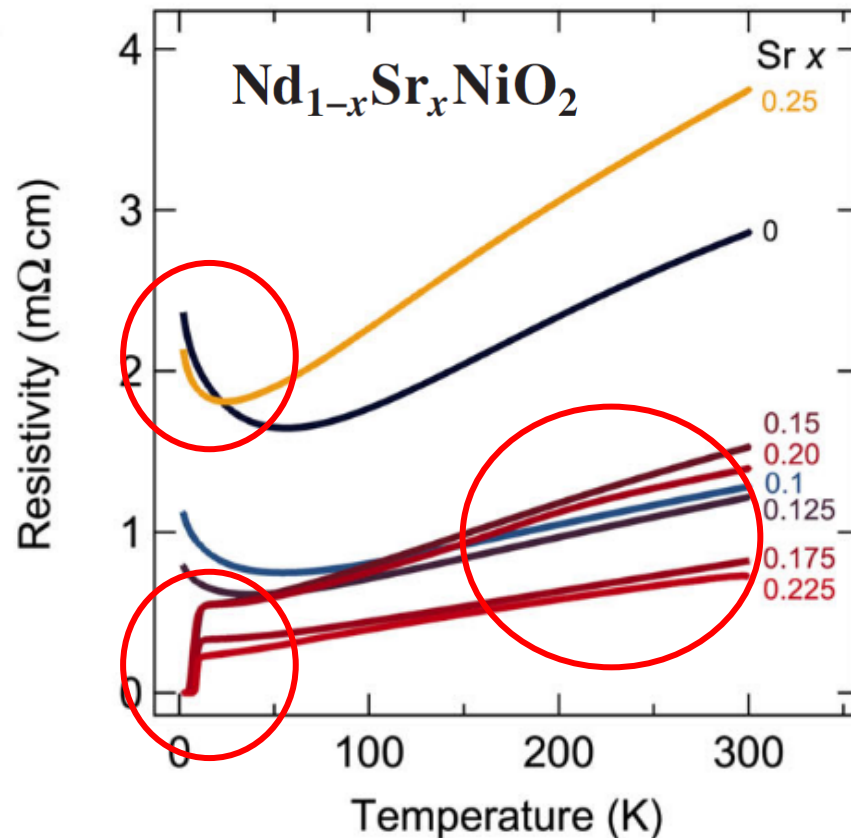
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C-axis lattice constant



Substitution of the larger Sr cation for Nd

Transport results

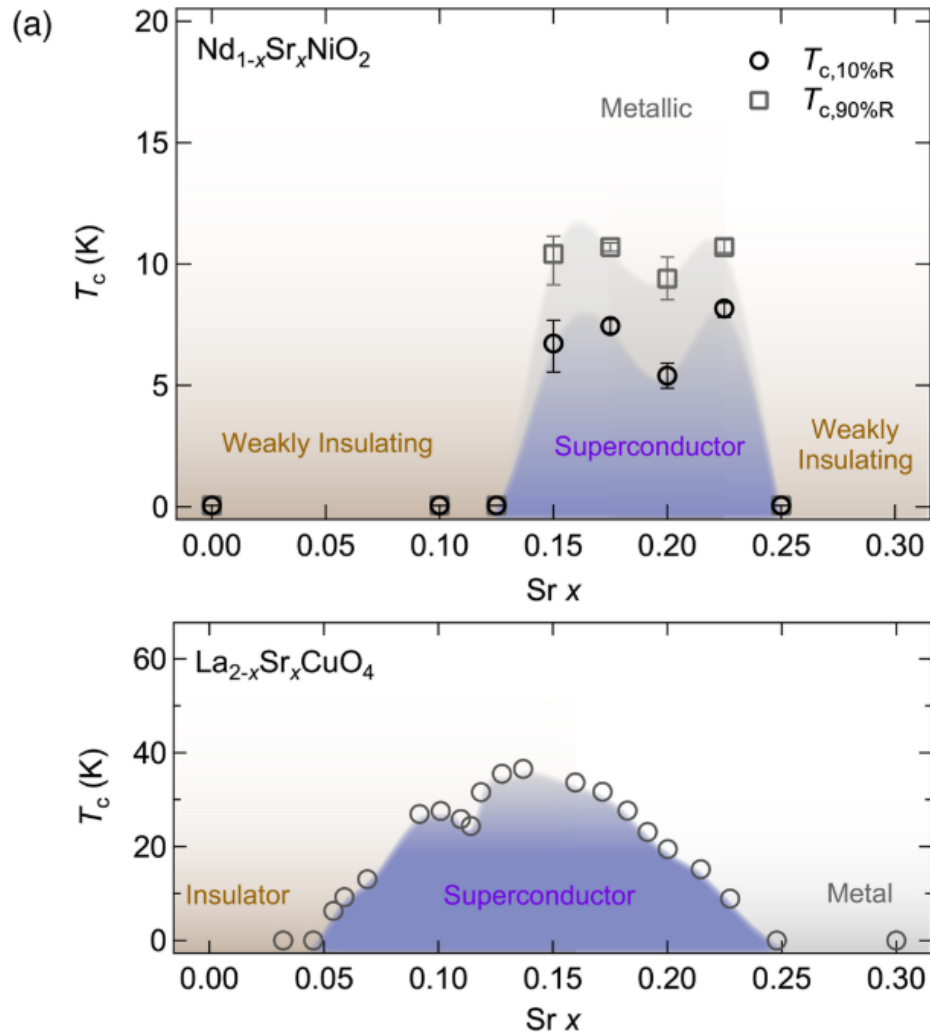


- $x = 0.15, 0.175, 0.2, \text{ and } 0.225$ show varying T_c
- Insulating behavior
- Nontrivial sample-to-sample variations in normal state

Phys. Rev. B 40, 2254 (1989).

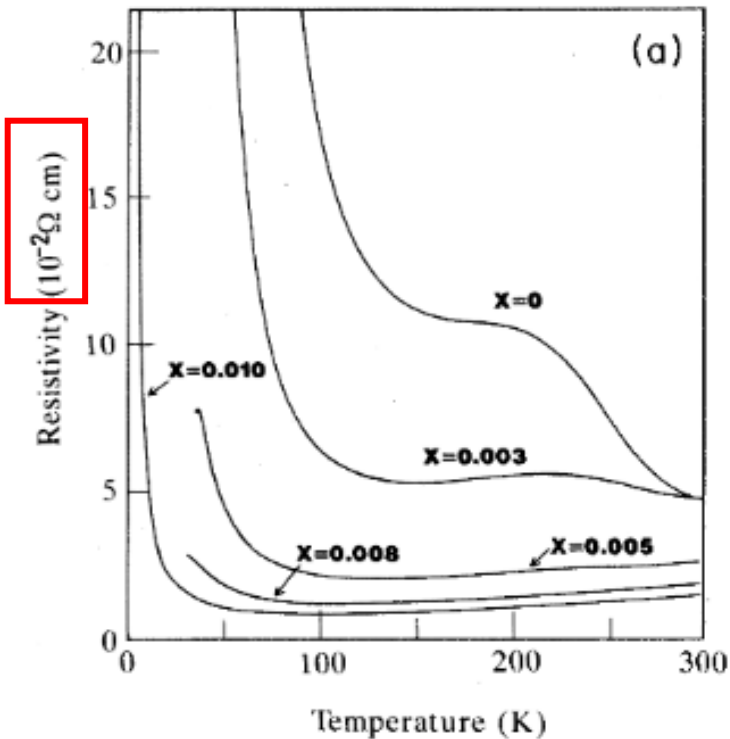
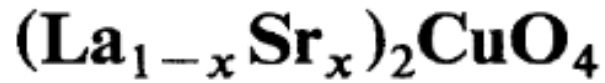
Phys. Rev. Lett. 125, 027001 (2020).

Phase diagram

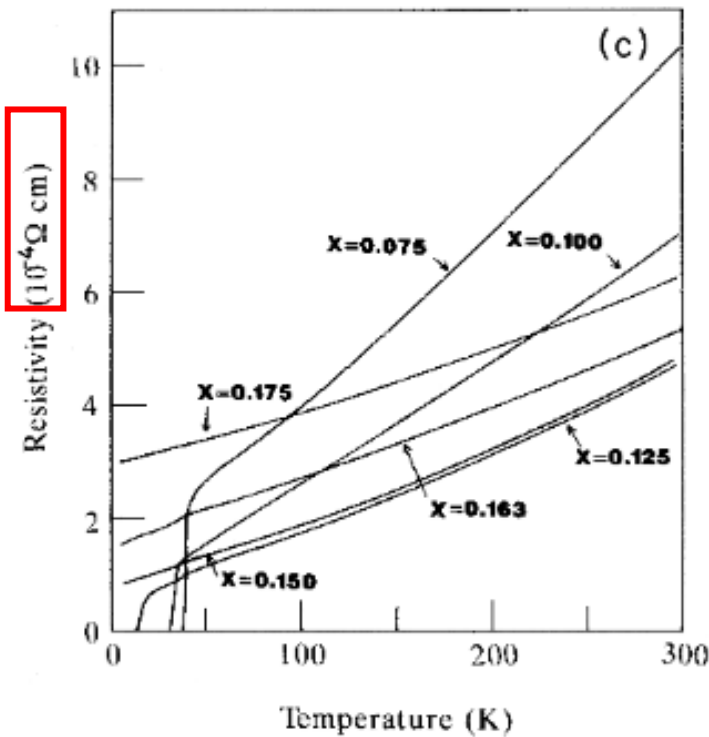


- Superconducting dome is qualitatively similar to the hole-doped cuprates but half as wide.
- A small dip in T_c for $x = 0.2$ (1/8 anomaly in cuprates)
- For $x = 0, 0.1, 0.125,$ and $0.25,$ no sign of superconductivity is observed down to <50 mK.
- The parent compound NdNiO_2 shows no sign of magnetic order at 1.7 K ([Solid State Sci. 5, 839 \(2003\).](#))

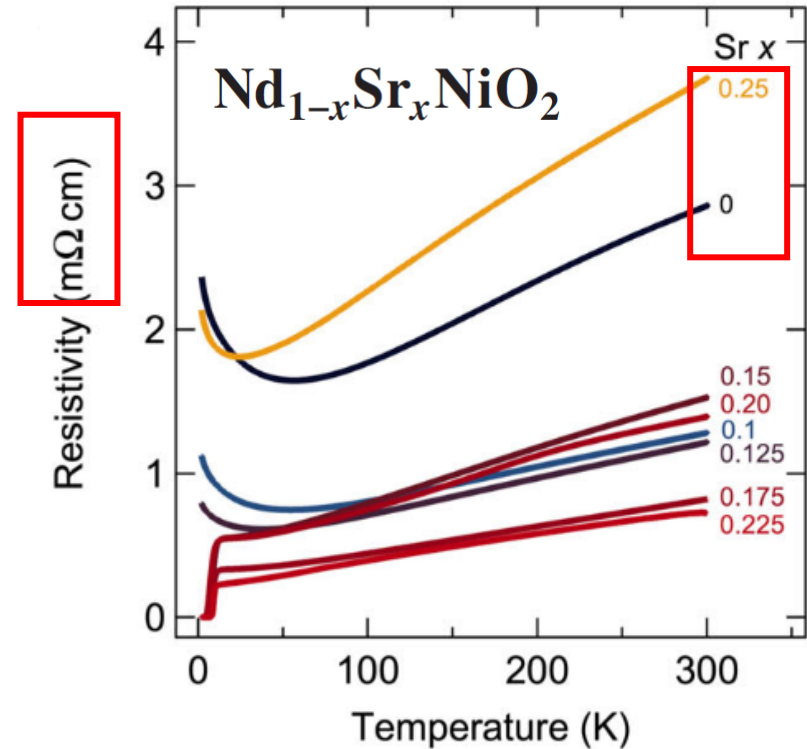
Normal state behavior



$2X < 0.02$



$2X > 0.15$

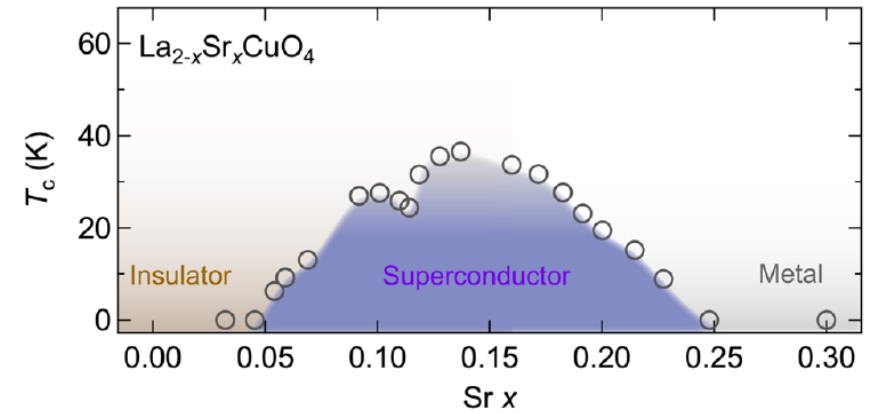
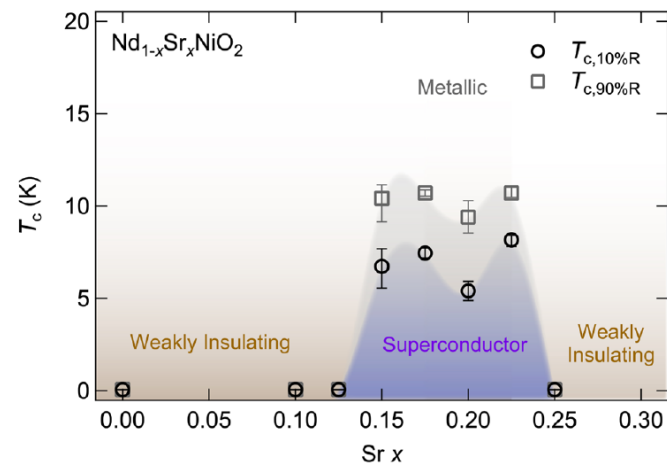


- Resistivity in LSCO drops by many orders of magnitude
- Qualitatively different from the cuprates

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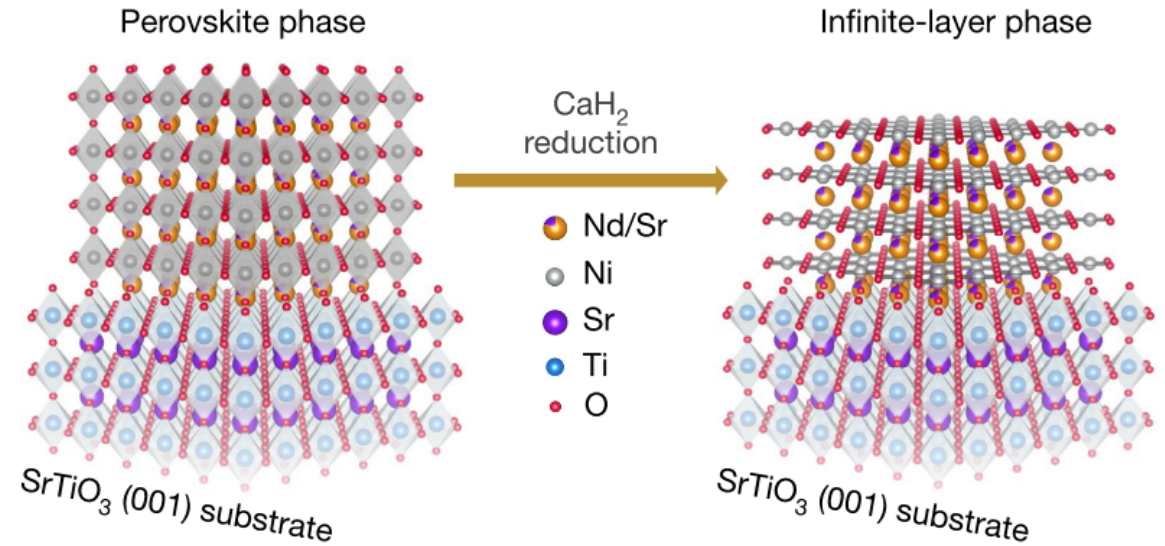
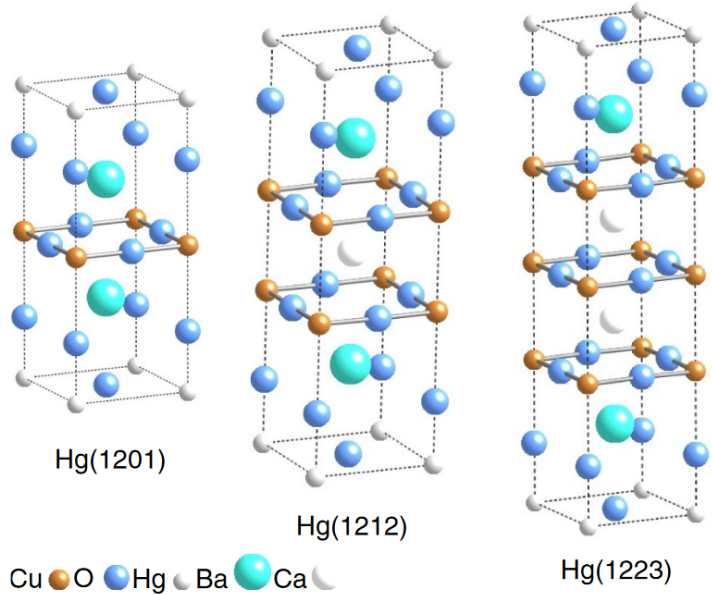
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Summary

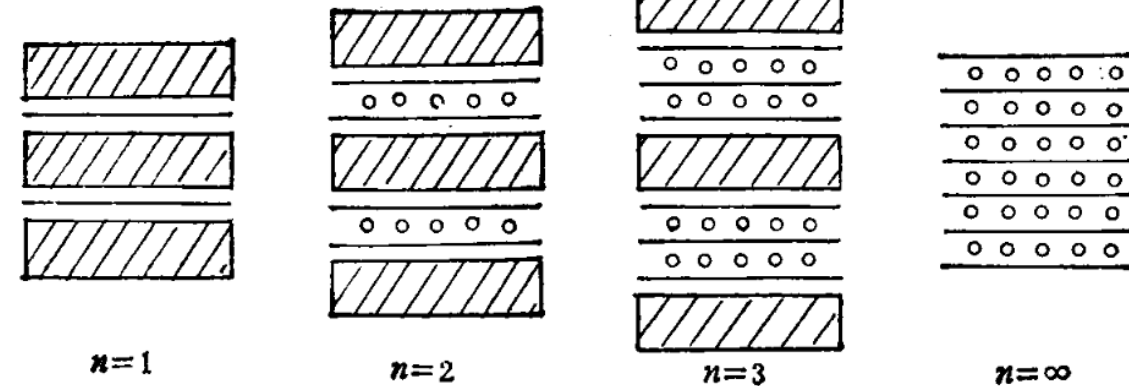


- Like cuprates, the superconducting dome is observed
- Weakly insulating behavior on either side of the dome, and no magnetic order was observed in parent compound.
- The normal state of the nickelates is qualitatively different from the cuprates

What does Infinite-layer mean?



Isolation layer



When n goes to infinite

Normal state Hall coefficient R_H

- $R_H = 1/ne$
- Two band model

