Simplified (and superior!) Synthesis of Nickelate Superconductors

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Nickelates have been the subject of considerable interest because they are close cousins of the well-known "cuprates," a family of copper oxide-based superconductors that can have high transition temperatures, upwards of 100 Kelvin, at which point electrical resistance vanishes. Superconducting nickelate analogs of the cuprates have long been pursued and finally achieved in thin films using a rather involved processes.

Here, members of **PARADIM's In-House Research Team described a novel, flexible synthesis route** for infinite layer nickelate films—one that requires only gas phase reactants and is easily integrable with thin film growth techniques and surface sensitive probes. The gentle reduction of $NdNiO_3$ to $NdNiO_2$ in a way that preserves its crystal structure makes use of atomic hydrogen and can be accomplished in short periods (<20 minutes). Structural and electrical transport measurements of the resulting films show high crystallinity, fewer defects, low resistivity, and flat surfaces. Utilizing the addition of an ultrathin protection layer of $SrTiO_3$ just 1-3 atomic layers thick (0.4-1.2 nm), drastically improves the reduction process and inhibits the formation of a polycrystalline scale layer on the sample surface.

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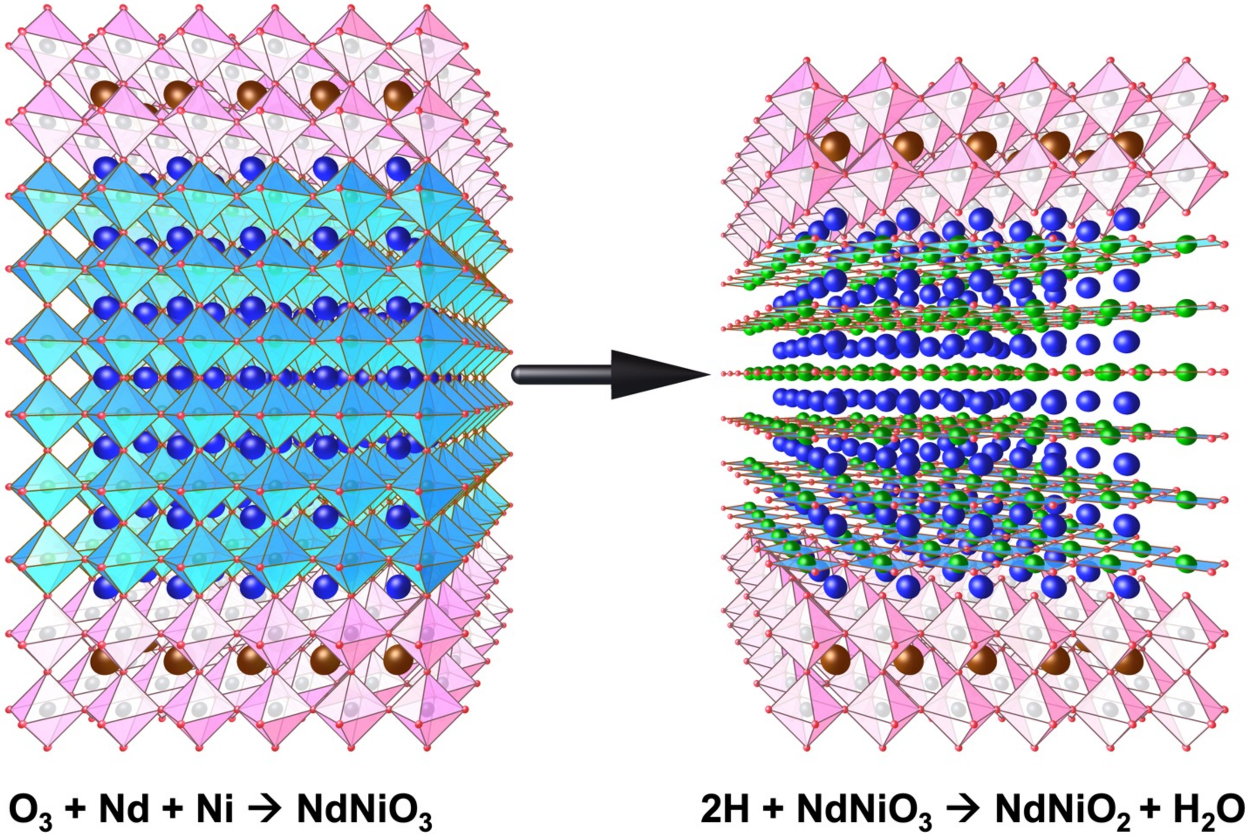

Figure: Schematic of the two-step *in situ* synthesis of $NdNiO_2$. (left) First the $NdNiO_3$ film (shown in blue) is grown by MBE. (right) Second, the temperature is lowered, and atomic hydrogen is used to scavenge oxygen from the film and reduce it to $NdNiO_2$. A capping layer of $SrTiO_3$ (shown in pink) helps to avoid damage to the surface of the $NdNiO_2$ layer and promotes uniform oxygen removal.