High pO_2 flux growth and characterization of perovskite $NdNiO_3$ crystals

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Perovskite nickelates ($RNiO_3$, R=La-Lu) have attracted extensive attention in the past few decades in three areas: (1) as a model system for studying metal-insulator transition (MIT, R ≠ La) and the lattice-charge-spin-orbital interaction [1]; (2) potential applications such as new morphological computing, bioelectronic interfaces, and electrocatalysis [2]; and (3) as parent compounds to prepare superconducting infinite-layer nickelates via topotactical reduction [3]. Here, single crystals of the perovskite nickelate $NdNiO_3$ with dimensions of up to 50 μm on edge have been successfully grown using the flux method at a temperature of 400 °C and oxygen pressure of 200 bar. The crystals were investigated by a combination of techniques, including high-resolution synchrotron X-ray single-crystal and powder diffraction and physical property measurements such as magnetic susceptibility and resistivity. Resistivity measurements revealed an MIT at T_{MIT}~180 K with apparent thermal hysteresis; however, no superlattice peaks or peak splitting below T_{MIT}, which corresponds to a structural transition from *Pbnm* to $P2_1/n$, was observed. The successful growth of $NdNiO_3$ crystals at relatively low temperatures and oxygen pressure provides an alternative approach for preparing single crystals of interesting perovskites such as $RNiO_3$ (R = Sm-Lu) and parent phases of superconducting square planar nickelates.

References

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