Multiple strain-induced phase transitions in $LaNiO_3$ thin films

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Supplementary Information

We have measured the temperature dependence of the resistivity in all films reported here. In **Figure S1** below we show some of the collected data. It can be appreciated that all films are metallic down to the lowest temperatures. To emphasize the low temperature region, we have normalized all R(T) values to the room temperature value (i.e. $R_N(T) = R(T)/R(300\ K)$). It turns out that the resistivity ratio rrr = R(300 K)/R(10 K) of all films (within the explored thickness range) is larger for the thickest films irrespectively on the substrate used. This observation is at odds with the common behavior observed in thin films, where due to either by the presence of interface defects or interface scattering or charge localization, the resistivity ratio commonly decreases when reducing film thickness.

Therefore the observed increase of rrr with increasing film thickness suggests that the thickest films have an additional, non-metallic, contribution to the resistance. This observation goes in line with the increasing presence of the $LNO_{2.5}$ intergrowth described in the manuscript. Consistently, the room temperature resistivity values increase when going from 35 nm to 130 nm: 52 μΩcm and 145 μΩcm for LNO/LAO and 89 μΩcm and 152 μΩcm for LNO/LSAT, respectively.

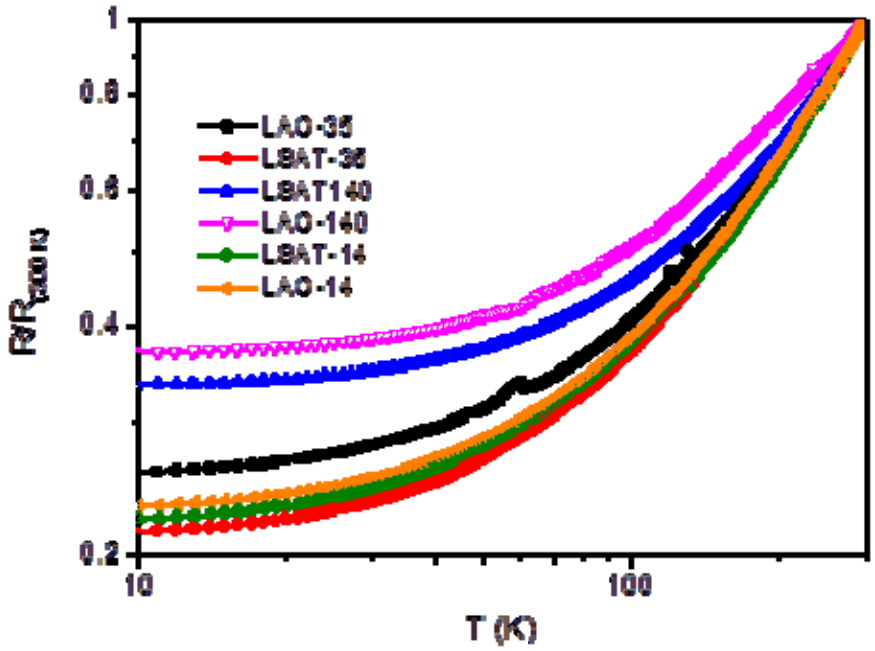

Figure S1. Temperature dependence of the normalized resistivity of the LNO films of different thickness (14, 35 and 140 nm) grown on different substrates (LSAT and LAO) as indicated in the labels.