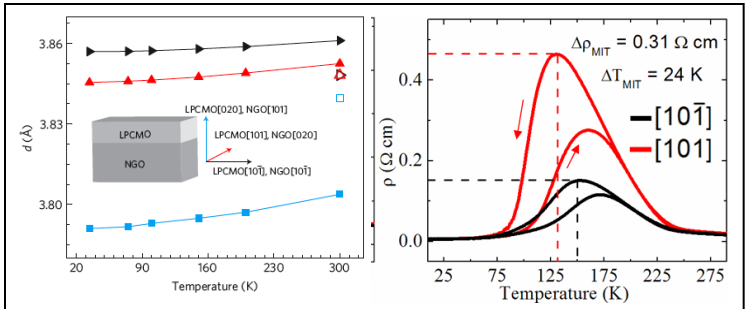
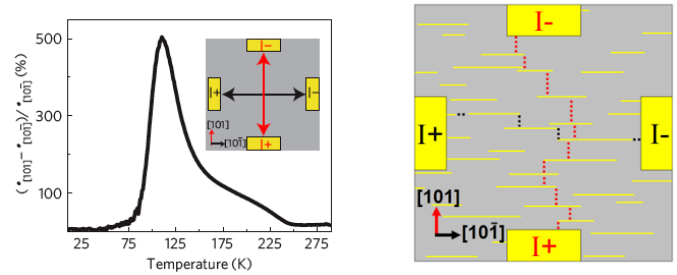
# Using Strain to Convert Insulators into Metals: Asymmetric Electronic Transport in Symmetric Crystals

In a normal cubic material, the physical properties are identical when measured along the perpendicular cubic axes. However, by applying a small uniaxial strain (<0.3%) to a cubic manganite material, we found that the material behaves as a metal in one direction and an insulator in the orthogonal direction! This intriguing discovery of such anisotropic transport not only helps answer fundamental questions on the role of electronic phase separation in manganites and provides better insights into the delicate energetics balance in complex materials, but also opens the door to new applications, including mechanical sensors and electronic devices tunable by external pressure.




***$La_{5/8-x}Pr_xCa_{3/8}MnO_3$ thin films are uniaxially strained along the [101] direction when grown on $NdGaO_3$ substrate. In-plane transport properties reveal large difference in metal-insulator transition temperature $\Delta T_{MIT}$ along the two orthogonal directions.***




***Anisotropic resistance as a function of temperature (left) and the diagram of a percolative model (right). Yellow blocks indicate metallic regions in insulating background. Dotted lines indicate possible channels through which current must travel. In an anisotropic strain field, metallic domain formation is aligned with field. This drives the difference in $T_{MIT}$ as the percolative network opens more quickly along the direction of the strain field.***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