Highlights

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Persistent Photoconductivity in 2D Electron Gases at Different Oxide Interfaces

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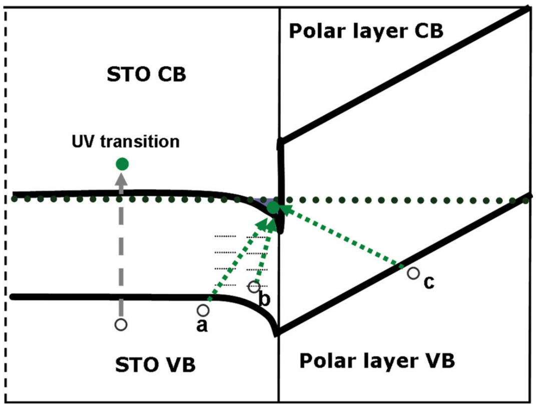
The transport characterization in the dark and under light irradiation of three different interfaces — $LaAlO_3/SrTiO_3$, $LaGaO_3/SrTiO_3$, and the novel $NdGaO_3/SrTiO_3$ heterostructure — is reported. All of them share a perovskite structure, an insulating nature of the single building blocks, a polar/non-polar character, and a critical thickness of four unit cells for the onset of conductivity.



Sketch of the band structure of a polar/non-polar interfaces where the band bending is depicted as expected within an ER scenario and localized states possibly due to oxygen vacancies or intermixing are also considered in the gap. The bending of the STO band is emphasized for clarity. The possible mechanisms (a), (b) and (c) described in the text for the promotion of carriers at the interface into the STO CB by sub-gap photons are sketched. A standard inter-band transition induced by above-gap UV light is also shown.

The interface structure and charge confi nement in $NdGaO_3/SrTiO_3$ are probed by atomic-scale-resolved electron energy loss spectroscopy showing that, similarly to $LaAlO_3$ /$SrTiO_3$, extra electronic charge confi ned in a sheet of about 1.5 nm in thickness is present at the $NdGaO_3/SrTiO_3$ interface. Electric transport measurements performed in the dark and under radiation show remarkable similarities and provide evidence that the persistent perturbation induced by light is an intrinsic peculiar property of the three investigated oxide-based polar/non-polar interfaces. This sets a framework for understanding the previous contrasting results found in the literature about photoconductivity in $LaAlO_3$ /$SrTiO_3$ and highlights the connection between the origin of persistent photoconductivity and the origin of conductivity itself. An improved understanding of the photoinduced metastable electron–hole pairs might allow light to be shed directly on the complex physics of this system and on the recently proposed perspectives of oxide interfaces for solar energy conversion.