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Crystallographic orientation dependence of electronic properties at $LaAlO_3/SrTiO_3$ interfaces NEIL CAMPBELL, MARK RZCHOWSKI, Department of Physics, University of Wisconsin, Madison, Wisconsin 53706, USA, SANGWOO RYU, HYUNGWOO LEE, CHANG-BEOM EOM, Department of Materials Science and Engineering, University of Wisconsin, Madison, Wisconsin 53706, USA — The two-dimensional electron liquid (2DEL) formed at the interface between perovskite oxides $LaAlO_3$ and $SrTiO_3$ has been found to show many interesting properties, including ones that depend on the electronic and structural properties of the interface. Most research has investigated the (001) orientation, where the crystal structure is square in the plane. Changing the crystallographic orientation can change the polarization mismatch and shift energies and occupations of the orbitals near the Fermi surface. This affects the 2DEL in many ways, particularly by changing the spatial extent and profile of the charge density. The interplay between interlayer hopping integrals and orbital energy shifts make the 2DELs in different orientations behave differently in response to gating. The interface plane defines a symmetry-breaking direction for the d orbitals and electrostatic potential, causing splitting of Ti d bands, affecting band occupation and mass near the interface. Heterostructures grown on (111) $SrTiO_3$, have similar Ti d orbital energies since they all have lobes crossing the interface, while in (001), the d_{xy}, and d_{x2-y2} orbitals do not have such lobes lobes. We present temperature-dependent Hall and magnetotransport data probing these orientational differences.

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