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Negative electronic compressibility at the $LaAlO_3/SrTiO_3$ interface LU LI, Massachusetts Institute of Technology, STEFAN THIEL, CHRISTOPH RICHTER, JOCHEN MANNHART, University of Augsburg, RAY ASHOORI, Massachusetts Institute of Technology — The interface $LaAlO_3/SrTiO_3$ is a potential candidate for a high mobility two-dimensional electron system with novel electronic properties. An essential step for device applications is establishing the electric field effect. Metallic gates were fabricated on the top of the conductive interface to tune the carrier density at the oxide interface with electric gating fields. Varying the top gate voltage and monitoring the capacitance, we are able to change the charge carrier density and establish that we can completely deplete the metallic interface using the top gates. Moreover, the capacitance between the interface and the top gate is enhanced greatly at low carrier densities, rather than being simply determined by the geometry. For some devices, the enhancement of capacitance is as high as 40% of the geometric capacitance. For the same electron densities, field penetration measurements show that the oxide interface significantly overscreens applied electric fields. The observations are attributed to a negative thermodynamic density of states, or "negative electronic compressibility", a characteristic property of free two- dimensional electronic systems so far only observed in Si-based or GaAs-based high-mobility devices.

Lu Li
Massachusetts Institute of Technology

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