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Ionic Liquid/Solid Double Gate Modulation of the $LaAlO_3/SrTiO_3$ Interfacial Electron Gas ZHUOYU CHEN, GLAM, Stanford Univ., HONGTAO YUAN, YANWU XIE, GLAM, Stanford Univ. and SIMES, SLAC Nat. Acc. Lab., DI LU, GLAM, Stanford Univ., YASUYUKI HIKITA, CHRISTOPHER BELL, SIMES, SLAC Nat. Acc. Lab., HAROLD HWANG, GLAM, Stanford Univ. and SIMES, SLAC Nat. Acc. Lab., H. Y. HWANG TEAM — An intriguing combination of properties including high electron mobility, superconductivity, ferromagnetism, and strong spin-orbit coupling has been observed at the $LaAlO_3/SrTiO_3$ (LAO/STO) interfacial quasi-two-dimensional electron gas (q2DEG). To experimentally clarify the electronic band structure of the q2DEG and how these properties evolve with external tuning by the electric field effect is a key challenge. Here we study the transport properties of the q2DEG in a double-gate field-effect transistor geometry utilizing an ionic liquid as the top gate dielectric, and the STO substrate as the back gate. A systematic carrier density and mobility modulation over a previously unobtained parameter range is achieved, providing a clear picture of electrostatic gating in this system. Changes in the carrier density, mobility, and conductivity strongly suggest the filling of heavy- and light-mass subbands in the quantum well as the top gate voltage is increased with respect to the q2DEG. When the heavier-mass electron subbands dominate the conductivity, signatures of negative electronic compressibility were observed, implying the presence of a tunable strong Rashba spin-orbit splitting in the anisotropic heavier-mass bands at this heterointerface.

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