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Tailoring a two-dimensional electron gas at the $LaAlO_3/SrTiO_3$ (001) interface by epitaxial strain DAVID FELKER, C.W. BARK, University of Wisconsin, Y. WANG, University of Nebraska, Y. ZHANG, University of Michigan, H.W. JANG, C.M. FOLKMAN, J.W. PARK, S.H. BAEK, University of Wisconsin, X.Q. PAN, University of Michigan, E.Y. TSYMBAL, University of Nebraska, M.S. RZCHOWSKI, C.B. EOM, University of Wisconsin — Recently a two-dimensional electron gas (2DEG) was discovered at the interface between insulating oxides $LaAlO_3$ and $SrTiO_3$. Properties of this 2DEG have attracted interest due to its potential applications in nanoelectronics. Control over the carrier density and mobility is essential for applications of these novel systems, and may be achieved by epitaxial strain. The relationship between the strain and electrical properties of this 2DEG remains largely unexplored. We use different lattice constant single crystal substrates to produce $LaAlO_3/SrTiO_3$ interfaces with controlled levels of biaxial epitaxial strain. We have found that tensile strained $SrTiO_3$ destroys the conducting 2DEG, while compressively strained $SrTiO_3$ retains the 2DEG, but with a carrier concentration reduced in comparison to the unstrained $LaAlO_3/SrTiO_3$ interface. We have also found that the critical $LaAlO_3$ overlayer thickness for 2DEG formation increases with $SrTiO_3$ compressive strain. Our first-principles calculations suggest that a strain-induced electric polarization in the $SrTiO_3$ layer is responsible for this behavior.

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