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Suppression of two-dimensional electron gases at oxide surfaces across the ferroelectric transition

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The discovery of a two-dimensional electron gas (2DEG) at the LaAlO3/SrTiO3 interface has set a new platform for all-oxide electronics which could potentially exhibit the interplay among charge, spin, orbital, superconductivity, ferromagnetism and ferroelectricity. In this work, by using angle-resolved photoemission spectroscopy and conductivity measurement, we have studied the behavior of photon-induced 2DEGs at the bare surfaces of ferroelectric oxides. We found that the onset of ferroelectric polarization induces a delocalization transition for the quantum well states at the surface. We propose that this suppression could be due to that the ferroelectric polarization makes the quantum well states become spatially delocalized along the direction perpendicular to the surface and hence changes the conductivity nature. This finding suggests an opportunity for controlling the 2DEG at a bare oxide surface (instead of interfacial system) by using both light and ferroelectricity.

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