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Origin of the charge carriers at $LaAlO_3$-on-$SrTiO_3$ hetero-interfaces; possibility of intrinsic doping GERTJAN KOSTER, WOLTER SIEMONS, Stanford University, HIDEKI YAMAMOTO, NTT Basic Research Laboratories, WALTER HARRISON, Stanford University, GERALD LUCOVSKY, North Carolina State University, THEODORE GEBALLE, Stanford University, DAVE BLANK, University of Twente, MALCOLM BEASLEY, Stanford University — We have made very thin films of $LaAlO_3$ on TiO_2 terminated $SrTiO_3$. *In situ* UPS, XAS, vis-VUV-SE, transport measurements and annealing experiments results indicate that oxygen vacancies play an important role in the creation of the charge carriers and that these vacancies are introduced by the pulsed laser deposition process. Our results explain for the first time the origin of the large sheet carrier densities and high mobility observed previously. Simple model calculations confirm the plausibility of having defects at the origin of charge carriers while still maintaining a high mobility. By means of annealing experiments in atomic oxygen we examine the question whether an intrinsically doped interface does indeed exist at lower carrier concentrations. Work supported by the DoE BES and EPRI.

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