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Controlling the dual mechanisms of oxide interface doping WEITAO DAI, CHENG CEN, West Virginia Univ — The formation of two dimensional electron gas (2DEG) at LaAlO3/SrTiO3 interfaces involves multiple electronic and structural causes. The interplay between them makes the investigation of individual mechanism very challenging. Here we demonstrate the nanoscale selective control of two interface doping pathways: charge transfers from surface adsorbed protons and oxygen vacancies created in LaAlO3 layers. The selective control is achieved by combining intensive electric field generated by conducting AFM probe which controls both the creation/migration of oxygen vacancies and the surface proton density, with plasma assisted surface hydroxylation and solvent based proton solvation that act mainly on surface adsorbates. Robust nanoscale reversible metal-insulator transition was achieved at the interfaces with the LaAlO3 layer thicker than the critic thickness. Different combinations of the experimental methods and doping mechanisms enable highly flexible tuning of the 2DEG's carrier density, mobility and sensitivity to ambient environments. The reversible and independent controls of surface states and vacancies add to the fundamental material research capabilities and can benefit future exploration of designed 2DEG nanoelectronics.

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