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Surface potential modification of molecular beam epitaxially grown $SrTiO_{3-\delta}$/Si(001) measured by Kelvin Force Probe Microscopy[1]

RYAN COTTIER, ALEXANDER CURRIE, NIKOLETA THEODOROPOULOU, Texas State University, TEXAS STATE UNIVERSITY TEAM — $SrTiO_3$ (STO) films have been grown by molecular beam epitaxy on p-Si(001), n-Si(001), and STO(001) substrates. The STO/Si films were of high crystalline quality as determined by x-ray diffraction (XRD) and TEM and ranged in thickness from 3.6 to 60 nm as measured by x-ray reflectivity (XRR). The partial pressure of oxygen (O_2) was varied during growth to induce oxygen vacancies within the STO structure. Through additional XRD and magnetotransport studies, we estimate that for the lowest O_2 pressure the oxygen deficiency is δ =0.02. The surface potential of the films was modified through the use of a conducting atomic force microscopy (AFM) tip by scanning regions of the STO surface in contact mode with a DC bias on the tip (referred to as 'writing'). Regions were written with either positive or negative voltage and then analyzed by Kelvin Force Probe Microscopy (KFPM). Following this writing mode, KFPM revealed a retained surface potential of the same polarity used in writing. The ability of the films to be written and read through this method depended on the growth O_2 partial pressure with higher O_2 pressures demonstrating weaker surface potential modification. The results agree with other studies regarding the drift and diffusion of charged O_2 vacancies in STO.

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