Abstract Submitted
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In operando measurement of structural effects accompanying electrostatic and electrochemical doping in ion-gel-gated $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ thin films[1] BIQIONG YU, GUICHUAN YU, MARTIN GREVEN, School of Physics and Astronomy, University of Minnesota, JEFF WALTER, CHRIS LEIGHTON, Department of Chemical Engineering and Materials Science, University of Minnesota, ZHAN ZHANG, HUA ZHOU, JOHN FREELAND, Advanced Photon Source, Argonne National Laboratory — Electrolyte gating techniques employing ionic liquid/gels in electric double-layer transistors provide an effective way to continuously vary the charge carrier densities in various materials. However, it is unclear whether the doping mechanism in such devices is electrostatic or electrochemical, particularly in oxides. Our recent investigation of ion-gel-gated $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ (LSCO) thin films indicated the presence of both processes: Negative gate biases were found to cause simple electrostatic accumulation of holes, whereas positive gate bias led to irreversible electrochemical changes due to formation of oxygen vacancies [1]. Here we report a hard X-ray diffraction study of ion-gel-gated LSCO films. We find that, in electrostatic charging (negative bias), the c lattice constant of the films decreases slightly and is restored to its initial value upon subsequent removal of the gate bias. On the other hand, in electrochemical charging (positive bias) a large irreversible increase of the c lattice constant occurs. From a separate measurement of the lattice volume dependence on oxygen deficiency in bulk LSCO, we confirm that the observed large irreversible changes are due to oxygen vacancies created under positive bias. [1] Walter et al., ACS Nano (2016)

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