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Electrostatic doping limits and control of magnetism in electrolyte gated $LaAlO_3(001)/La_{0.5}Sr_{0.5}CoO_{3-\delta}$ thin films JEFF WALTER, HELIN WANG, CHRIS LEIGHTON, University of Minnesota — Recently developed ionic liquid/gel gating techniques have proven remarkably expedient in the study of charge density effects in a variety of conductors, ranging from organics to complex oxides. Here we present electrolyte gate control of magnetism in ultrathin (8 u.c.) $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ (LSCO) films, using ion gels in electric double layer transistors. The LSCO films are initially metallic and ferromagnetic ($T_c \approx 170$ K), with anomalous Hall conductivity up to 40 S/cm, and strong perpendicular magnetic anisotropy. Based on extensive temperature and gate voltage dependences we first determined the limits for electrostatic *vs.* electrochemical operation, concluding that negative bias enables reversible hole accumulation, whereas positive bias irreversibly induces oxygen vacancies. Following this we demonstrated clear voltage-control of resistivity, magnetoresistance, andT_c. Utilizing the anomalous Hall conductivity as an exceptional probe of the magnetic order parameter in the gated surface region, a 12 K shift in T_c is obtained. This compares favorably to the state-of-the-art and exhibits potential for much larger modulation in films of lower Sr content. Work supported by NSF MRSEC.

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