Polar surface stabilization mechanism of LaCrO3 (001) film

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We report an angle-dependent X-ray photoemission spectroscopy (XPS) study of bulk-like (~500 Å thick) $LaCrO_3/SrTiO_3$ (001) single-crystalline film deposited using reflection high energy electron diffraction (RHEED) equipped PLD technique. In situ, RHEED monitoring reveals two-dimensional layer-by-layer growth of (1 × 1) $LaCrO_3$ (LCO) (001) film. High-resolution x-ray diffraction and Rutherford backscattering spectrometry (RBS) spectra in channeling geometry confirm the high crystalline quality and epitaxial nature of LCO film. The simulated random direction RBS spectrum taken at O-resonance energy establishes the stoichiometric composition of LCO film in good agreement with the chemical composition calculated from x-ray photoelectron spectroscopy (XPS). Probing depth variation achieved through angle-dependent XPS measurements revealed a cationic ratio gradient, resulting in CrO_2 surface termination. Angle-dependent XPS core-level analysis shows that the polar surface of the CrO_2 terminated LCO film is stabilized through a purely electronic mechanism associated with the electronic reconstruction of Cr^{+3} ions to Cr^{+2} ions.