Surface Stabilization and in-situ Analysis of Epitaxial $SrRuO_3$ Films

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Strontium ruthenium oxide, $SrRuO_3$, plays an important role in oxide electronic devices because of its metallic nature and lattice constant compatible with many transition metal perovskites. Use in device fabrication requires excellent surface and interface stability without reduction or loss of volatile oxides. Our previous studies have shown that exposure to atmosphere leads to decomposition of the surface at ~300°C, despite good crystalline order in electron diffraction before annealing. This decomposition was associated with hydrocarbons observed on the surface. We now provide additional evidence that hydrocarbons lead to instability, report success in stabilizing the surface after contamination by annealing in high pressures of oxygen, and explore the stability of epitaxial $SrRuO_3$ films that have not been exposed to atmosphere. Distinct differences in reflection high-energy electron diffraction patterns are observed if films exposed to air are preannealed to 600ºC in oxygen (10^{-2} Torr) before annealing in vacuum. Preannealed films show no evidence of decomposition below 600°C. Epitaxial $SrRuO_3$ thin films were also grown by pulsed-laser deposition using a stoichiometric target on (001) $SrTiO_3$ substrates and transferred in-situ to a surface characterization chamber. We report in-situ studies of intrinsic surface structure, chemistry and transport properties of $SrRuO_3$ using low energy electron diffraction, x–ray photoelectron spectroscopy, scanning tunneling microscopy and thermal desorption spectroscopy and compare results to ex-situ observations.

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