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Substrate-dependent structural and CO sensing properties of LaCoO₃ epitaxial films

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Abstract: LaCoO₃ thin films were grown on different (001) oriented LaAlO₃, SrTiO₃ and (LaAlO₃)_{0.3}(Sr₂AlTaO₆)_{0.7} by the polymer assisted deposition method, respectively. All the LaCoO₃ thin films are in epitaxial growth on these substrates, with tetragonal distortion of CoO₆ octahedrons. Due to different in-plane lattice mismatch, the LaCoO₃ film on LaAlO₃ has the largest tetragonal distortion of CoO₆ octahedrons while the film grown on (LaAlO₃)_{0.3}(Sr₂AlTaO₆)_{0.7} has the smallest tetragonal distortion. The relative contents of the surface absorbed oxygen species are found to increase for the LaCoO₃ epitaxial films grown on (001) oriented (LaAlO₃)_{0.3}(Sr₂AlTaO₆)_{0.7}, SrTiO₃ and LaAlO₃ substrates, sequentially. The film sensors exhibit good CO sensing properties at 150 °C, and the LaCoO₃ film on LaAlO₃ shows the highest response but the film on (LaAlO₃)_{0.3}(Sr₂AlTaO₆)_{0.7} shows the lowest. It reveals that the larger degree of JT-like tetragonal distortion of CoO₆ octahedrons may greatly improve the surface absorbing and catalytic abilities, corresponding to more excellent CO sensing performance. The present study suggests that the formation of epitaxial films is an efficient methodology for controlling the octahedral distortion and thereby improving the gas sensing performance of perovskite transition metal oxides.

Keywords: LaCoO₃, Epitaxial films, Tetragonal distortion, CO, Sensors.

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