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Influence of the sputtering mode on thermochromic properties of LaCoO3 selective layers for thermal solar collectors

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Thermochromic rare-earth perovskite $LaCoO_3$ is a promising functional material for a new generation of selective layers for passive regulation in thermal solar collectors. An efficient absorber coating of a thermal solar collector should possess both high solar absorption within the visible and near infrared wavelength range (>90%) and low infrared emissivity (<10%) within the wavelength range of 6 to 10µm. However, when the solar panel is exposed to strong solar radiation while hot water demand is poor or if the system is off, the temperature inside the collector may reach 200°C (stagnation conditions) resulting in heat-transport fluid degradation. A possible solution is to use thermochromic materials capable to reversibly switch their emissivity. Nevertheless, due to structural and chemical complexity, the design of this material is challenging and requires a deep understanding of crystallization mechanisms. In this work, we investigate the influence of *in-situ* (i.e. during deposition) oxidation of LaCo metallic films on perovskite formation conditions and eventual optical properties of the material. All films were deposited on aluminium substrates by magnetron sputtering in elemental (ESM) and compound (CSM) modes using a semi-industrial reactor with back-and-forth scrolling of the substrate. The samples were annealed in air for 2, 5 and 10 minutes at temperatures in the range between 500 and 600°C and characterized using XRD, FTIR, TEM and IR camera. TEM cross-sectional evaluations reveal that the structure of as-deposited films issued from the semi-industrial reactor corresponds to La/Co multilayers. It was found that preoxidizing fosters perovskite formation allowing to significantly decrease the annealing temperature. Obtained emissivity change (Δε) results confirm the great prospect of $LaCoO_3$ for the considered application.

Keywords
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thin film