

# Surface properties and catalytic performance of $\text{La}_{1-x}\text{Sr}_x\text{CrO}_3$ perovskite-type oxides for CO and $\text{C}_3\text{H}_6$ combustion

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## Abstract

Catalytic CO oxidation and  $\text{C}_3\text{H}_6$  combustion have been studied over  $\text{La}_{1-x}\text{Sr}_x\text{CrO}_3$  ( $x = 0.0\text{--}0.3$ ) oxides prepared by solid-state reaction and characterised by X-ray diffraction (XRD), nitrogen adsorption (BET analysis) and X-ray photoelectron spectroscopy (XPS). The expected orthorhombic perovskite structure of the chromite is observed for all levels of substitution. However, surface segregation of strontium along with a chromium oxidation process, leading to formation of  $\text{Cr}^{6+}$ -containing phases, is produced upon increasing  $x$  and shown to be detrimental to the catalytic activity. Maximum activity is achieved for the catalyst with  $x = 0.1$  in which mixed oxide formation upon substitution of lanthanum by strontium in the chromite becomes maximised.

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## 1. Introduction

Perovskite-type oxides  $\text{ABO}_3$  (where A is usually a rare earth cation and B a transition metal cation) are interesting as combustion catalysts due to their high thermal and chemical stability [1–6]. Such properties make them also most interesting as components of solid oxide fuel cells (SOFC) [7], and most particularly as electrode [8–10] or interconnect material [11]. Among this type of systems, those based on lanthanum chromite have been proposed as most interesting due to their comparatively higher thermal stability as well as the good match observed between them and materials typically employed as electrolytes (as YSZ) in their thermal expansion properties [7–12].

The catalytic properties of perovskite-type oxides, of general formula  $\text{ABO}_3$ , basically depend on the nature of

A and B ions and on their valence state [1,6,13–17]. The A site ions, in contrast to B site ones, are generally proposed to be catalytically inactive although their nature influence the stability of the perovskite. Nevertheless, replacement of part of A or B ions with other heterovalent ones can induce structural modifications related to generation of oxygen vacancies and/or changes in the valence state of the original cations. In particular, partial substitution of La with divalent ions, e.g.  $\text{Sr}^{2+}$ , can increase the average oxidation state of the cation in position B. These effects are proposed to enhance the oxidation catalytic activity of this type of systems either by facilitating oxygen mobility or by enhancing the redox activity of the  $\text{B}^{n+}$  cation [1,6,13,16,18,19].

Within this context, the aim of this work is to examine the catalytic properties of  $\text{La}_{1-x}\text{Sr}_x\text{CrO}_3$  for the combustion of CO and  $\text{C}_3\text{H}_6$ . An attempt to establish structure/activity relationships in the systems is done on the basis of parallel analysis of the catalysts by X-ray diffraction (XRD), determination of specific surface area ( $S_{\text{BET}}$ ) and X-ray photoelectron spectroscopy (XPS).

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