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A comparative study of various Pr(La)SrBaCeCo(Ni)Ox compounds for total oxidation of ethanol

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This work presents a comparative study of several Co-based perovskite catalysts with varying compositions and structures for the oxidation of ethanol, representing VOCs. Perovskite oxides of the ABO_3 type are highly efficient catalysts for the oxidation of volatile organic compounds (VOCs) because they offer high thermal stability and the possibility to tune their composition. Two types of Pr(La), Ba, Ce, Sr, Co(Ni) mixed oxides with various molar ratios were prepared by the Pechiney method (sintering of a mixture of nitrates, citric acid, and ethylene glycol at 950 °C) and coprecipitation (metal nitrates were precipitated with an alkali solution of Na_2CO_3 and NaOH, and the product calcined at 700 °C).

Powder XRD revealed the formation of various kinds of perovskites ($SrCoO_{2.8}$, $Pr_{1.5}Sr_{0.5}NiO_4$, $BaNiO_3$, $BaCeO_3$, $La_{1.16}Sr_{0.77}NiO_{3.94}$), along with oxides and carbonates, in the sintered catalyst. In contrast, $Pr_{0.33}Sr_{0.67}(CoO_{2.7})$ perovskite, along with various oxides and carbonates, was found in the precipitated catalysts. The surface area of the sintered catalysts was about 2 m^2g^{-1}, while that of the precipitated catalysts was about 14 m^2g^{-1}. XPS measurements showed that the surface cobalt concentrations in both types of catalysts were roughly half of that of the bulk composition. The most active catalysts achieved complete ethanol oxidation below 200 °C and showed high selectivity toward CO_2. Catalytic activity was higher for precipitated catalysts. Their T_{50} values were almost half that observed for sintered catalysts. The low activity is most likely due to the small surface area. Typical for the investigated perovskite catalysts is a very low concentration of CO as a reaction by-product. These findings highlight the potential of tailored perovskite catalysts for efficient VOC abatement.