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Mixed metal oxides La-Mn as a catalysts for Lean methane combustion

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Abstract

In PhD thesis was to evaluate the effect of the method of synthesis of mixed metal oxides $LaMnO_3$ and $La_{0,8}Sr_{0,2}MnO_3$ with perovskite like structure, on their physicochemical properties, in particular on the catalytic activity in lean methane combustion. It focuses mainly on the solvothermal method for determine the effects of selected parameters of this method on physicochemical properties of perovskite like $LaBO_3$ (B = Mn, Co, Fe), $La_{1-x}Sr_xMnO_3$ (x = 0, 0.1, 0.2, 0.3 0.5) and $La_{0.8}Me_{0.2}MnO_3$ (Me = Sr, Ba, Ca, Mg). The catalytic oxidation of methane is one of the most effective solutions aimed at reducing emissions of methane into the atmosphere, as well as reducing emissions of nitrogen oxides, which are produced during combustion. In addition, this process can be used to remove methane from the gas with low concentration of methane, e.g Ventilation Air Methane or biogas from landfill sites. The precondition to carry out this process is to develop stable and catalytically active in lean methane combustion materials. Mixed metal oxides with perovskite like structure are an important group of materials characterized by unique properties in processes with oxygen. Perovskite structure, described by the general formula ABO_3, allows at partial replacement of cations in the position A and/or B by other metals, leading to materials with different physical and chemical properties.

The first part of the PhD thesis constitutes widely described introduction to the catalytic combustion of methane. In consecutive points were presented basic information about methane, their emission sources and its impact on the environment. Then were described the method of reducing methane emissions into the atmosphere, as well as more broadly outlined the problem of methane emissions with the air of mine ventilation. It was described in detail the mechanism of methane oxidation. Further, in the literature part were described the catalysts of methane combustion, mainly focusing attention on mixed metal oxides with perovskite like structure. The literature part of PhD thesis was closed by presenting the purpose of the work and scope of the study.

The experimental part begins with presenting the purpose of the work and scope of the study. The next point deals with the research method, specifying the using raw materials, the methods of catalysts synthesis and techniques for characterizing the physicochemical properties, such as: analysis of X-ray diffraction, sorption of nitrogen, scanning and transmission electron

microscopy, the measurement of acid-base properties, temperature programmed reduction with hydrogen, temperature-programmed desorption of oxygen and carbon dioxide, surface analysis by X-ray photoelectron spectroscopy and tests of lean methane combustion.

The next part of the PhD thesis are the results of research and their discussion, which divided into two chapters. In the first chapter were presented and discussed the results about the influence of the method of synthesis of mixed metal oxides $LaMnO_3$ and $La_{0,8}Sr_{0,2}MnO_3$, synthesized by following techniques: sol-gel, chemical combustion, solvothermal and spray pyrolysis. In turn, the second chapter, consisting of four subsections, relates to mixed metal oxides with perovskite like structure produced by solvothermal method and includes the results about the effects of various synthesis parameters of this method on the physicochemical properties of these materials. Each of these chapters were closed by a summary of the results.

The last part of the work are the conclusions. The work ends with a list of cited literature, as well as the presentation of scientific achievements.