LSCF CATHODE MATERIALS FOR INTERMEDIATE TEMPERATURE SOLID OXIDE FUEL CELLS

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Fuel cells directly and efficiently convert chemical energy into electrical one [1]. Solid oxide fuel cells (SOFC) possess certain advantages over the other types of fuel cells due to their high performance and low requirements for fuel purity and variety of fuels applicable. Reducing the costs for SOFC systems is one of the main current issues of this technology. On the other hand, lowering the operating temperature to 600 °C and below leads to decreasing power densities due to overpotentials at the cathode [2]. This makes it necessary to develop new cathode materials with a higher electrocatalytic activity than those of the state-of-the-art LSM perovskites. In recent years, it has been shown that LSCF perovskites due to their high electronic and ionic conductivities and catalytic activities at 600-700°C are considered as good candidates for intermediate temperature SOFC cathode applications [3].

Iron- and cobalt-containing perovskites $La_xSr_{1-x}Co_yFe_{1-y}O_{3-\delta}$, (x = 0.8; 0.6 and y = 0.8; 0.2) were synthesized via the solid state reaction method. Study of synthesized powder by SEM revealed that it consists of fine particles (~ 300 nm) with narrow size distribution. The temperature for the formation of LSCF perovskite structure was optimized. In this study the influence of iron oxide valence on the formation of perovskite structure and electric properties were carried out. Composite cathode materials (with addition of gadolinia doped ceria (GDC)) were also developed. Influence of temperature on total conductivity of cathode materials with different composition was studied. Analysis of XRD patterns showed that formation of LSCF perovskite structure appears at 950-1000°C. Nature of iron oxide has no significant influence on the perovskite formation temperature. Cathode samples with Fe^{+4} in composition showed 10 times higher conductivity than those having Fe^{+3} nearly within the whole temperature range measured. The highest conductivity at the target temperature of 600°C was observed on composite $La_{0,6}Sr_{0,4}Co_{0,8}Fe_{0,2}O_{3-\delta}$ -GDC cathode samples. Performance of complete fuel cells with cathodes under study was measured. Study of the fracture surface by SEM showed that addition of GDC not only influence on conductivity but enhanced sinterability of powders changing the fracture mechanism of cathode material from intergranular to the cleavage one.

References

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