



Application of $\text{La}_{0.6}\text{AE}_{0.4}\text{MnO}_3$ (AE=Ca and Sr) to electric current collectors in high-temperature solid oxide fuel cells

Masashi Mori^{a,*}, Nigel M. Sammes^b, Eisaku Suda^c, Yasuo Takeda^c

^aCentral Research Institute of Electric Power Industry, 2-6-1 Nagasaka, Yokosuka, Kanagawa 240-0196, Japan

^bConnecticut Global Fuel Cell Center, University of Connecticut, 44 Weaver Road, Storrs, CT 06269-5233, USA

^cMie University, 1515 Kamihama, Tsu 514-0008, Japan

Received 19 January 2003; received in revised form 12 June 2003; accepted 19 July 2003

Abstract

The crystallographic, mechanical, thermal and electrical properties of $\text{La}_{0.6}\text{AE}_{0.4}\text{MnO}_3$ perovskites (AE = Ca and Sr) have been investigated. $\text{La}_{0.6}\text{Ca}_{0.4}\text{MnO}_3$ showed an orthorhombic symmetry at room temperature, and its symmetry changed into tetragonal at approximately 500 °C and into cubic at approximately 900 °C. $\text{La}_{0.6}\text{Sr}_{0.4}\text{MnO}_3$ showed tetragonal symmetry at room temperature and its symmetry changed into cubic at temperatures ≥ 90 °C. Transgranular fracture of dense $\text{La}_{0.6}\text{AE}_{0.4}\text{MnO}_3$ specimens, after mechanical strength measurements at temperatures ≤ 400 °C, was indicated, whereas the specimens mechanically tested after the measurement at temperatures ≥ 600 °C showed intergranular fracture. Thermal expansion coefficients (TECs) of the sintered specimens in the temperature range from 50 to 1000 °C were $11.7 \times 10^{-6}/^\circ\text{C}$ for $\text{La}_{0.6}\text{Ca}_{0.4}\text{MnO}_3$ and $12.2 \times 10^{-6}/^\circ\text{C}$ for $\text{La}_{0.6}\text{Sr}_{0.4}\text{MnO}_3$. Electrical conductivities of the dense specimens at 1000 °C were 227 S/cm for $\text{La}_{0.6}\text{Ca}_{0.4}\text{MnO}_3$ and 213 S/cm for $\text{La}_{0.6}\text{Sr}_{0.4}\text{MnO}_3$. To synthesize these materials as electric current collectors in high-temperature solid oxide fuel cells (SOFC), $\text{La}_{0.6}\text{AE}_{0.4}\text{MnO}_3$ perovskites were compounded with manganese oxide. The TECs of the composites at around 50 vol.% Mn_3O_4 were almost the same as that of the Y_2O_3 stabilized ZrO_2 (YSZ) electrolyte. Electrical conductivities of these dense specimens at 1000 °C were observed to be between 50 and 90 S/cm. Thus, dense $\text{La}_{0.6}\text{AE}_{0.4}\text{MnO}_3$ – Mn_3O_4 composites are appropriate for the electric current collectors in the SOFC.

© 2003 Elsevier B.V. All rights reserved.

Keywords: Lanthanum manganite; SOFC; Electric current collector; Composite; Perovskite