Preparation, structure and electrical conductivity of pyrochlore-type samarium–lanthanum zirconate ceramics

Zhan-Guo Liu, Jia-Hu Ouyang *, Yu Zhou, Jun Xiang, Xiao-Ming Liu

School of Materials Science and Engineering, Harbin Institute of Technology, 92 West Da-Zhi Street, Harbin 150001, China

A R T I C L E   I N F O

Article history:
Received 18 March 2011
Accepted 19 April 2011
Available online 27 April 2011

Keywords:
A. Ceramics
C. Sintering
E. Electrical

A B S T R A C T

A series of zirconate compounds with the general formula Sm$_{2-x}$La$_x$Zr$_2$O$_7$ (0 ≤ x ≤ 1.0) were prepared by pressureless-sintering method at 1973 K for 10 h in air. The relative density, structure and electrical conductivity of Sm$_{2-x}$La$_x$Zr$_2$O$_7$ ceramics were investigated by the Archimedes method, X-ray diffraction and impedance spectroscopy measurements. Sm$_{2-x}$La$_x$Zr$_2$O$_7$ (0 ≤ x ≤ 1.0) ceramics exhibit a pyrochlore-type structure. The measured electrical conductivity of Sm$_{2-x}$La$_x$Zr$_2$O$_7$ ceramics obeys the Arrhenius relation and gradually increases with increasing temperature from 673 to 1173 K. Sm$_{2-x}$La$_x$Zr$_2$O$_7$ ceramics are oxide-ion conductors in the oxygen partial pressure range of 1.0 × 10$^{-4}$ to 1.0 atm at all test temperature levels. The electrical conductivity of Sm$_{2-x}$La$_x$Zr$_2$O$_7$ ceramics decreases with increasing lanthanum content at identical temperature levels.

1. Introduction

Solid oxide fuel cells (SOFCs) are highly efficient devices that can convert chemical energy of a fuel to electrical energy. SOFCs have drawn much attention due to environmental friendliness, and fuel flexibility including hydrogen, natural gas, petroleum gas, coal gas, biogas, etc. [12]. Conventional SOFCs use typical 8 mol.% Y$_2$O$_3$–ZrO$_2$ (YSZ) electrolytes at operating temperatures of 1173–1273 K, and anode and cathode materials are Ni–YSZ cermets and gradually increases with increasing temperature from 673 to 1173 K. Sm$_{2-x}$La$_x$Zr$_2$O$_7$ ceramics are oxide-ion conductors in the oxygen partial pressure range of 1.0 × 10$^{-4}$ to 1.0 atm at all test temperature levels. The electrical conductivity of Sm$_{2-x}$La$_x$Zr$_2$O$_7$ ceramics decreases with increasing lanthanum content at identical temperature levels.

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