Key Engineering Materials Vol. 301 (2006) pp 155-158
Online available since 2006/Jan/15 at www.scientific.net

doi:10.4028/www.scientific.net/KEM.301.155

Evaluation of Electrode Performances of Single-Chamber Solid Oxide Fuel Cells

Mikihiro Hori[1], Keisuke Nagasaka[1], Masaru Miyayama[1],
Giuseppe Trunfio[2] and Enrico Traversa[2]

[1]Research Center for Advanced Science and Technology, The University of Tokyo,
4-6-1 Komaba, Meguro-ku, Tokyo 153-8904, Japan
[2]The University of Rome "Tor Vergata", via della Ricerca Scientifica, 00133 Rome, Italy

Keywords: Single-Chamber SOFC, Electrode, Interfacial Resistance, Thermal Expansion Coefficient, Catalytic Activity

ABSTRACT

The interfacial resistances of $La_{1-x}Sr_xCo_{1-y}Fe_yO_{3-\delta}$ (denoted LSCF(10(1-x)/10x/10(1-y)/10y)) cathodes, and the catalytic activities of a Ni-$Ce_{0.85}Y_{0.15}O_{1.925}$ (Ni-YDC) anode and an LSCF(2/8/8/2) cathode of a single-chamber solid oxide fuel cells (SOFCs) were investigated. LSCF cathodes with high oxide ion conductivities gave low interfacial resistances. LSCF cathodes with suitable thermal expansion coefficients formed favorable interfacial structures with a ceria-based electrolyte. Ni-YDC showed a higher conversion efficiency for CH_4 and a lower selectivity for CO_2 than LSCF(2/8/8/2). The single-chamber SOFC based on the Sm-doped ceria electrolyte with the Ni-YDC anode and LSCF(2/8/8/2) cathode showed a maximum power density of 186 mW/cm^2 at 800ºC.

INTRODUCTION

Solid oxide fuel cells (SOFCs) are expected as promising power generators for directly converting chemical energy to electrical energy instead of internal combustion. Conventional SOFCs consist of two gas chambers for fuel and air, partitioned by electrolytes and interconnects [1-3]. In contrast, single-chamber SOFCs consist of only one gas chamber and two electrodes to which a mixed gas of fuel and air is supplied [4-6]. The difference in catalytic activity between the anode and the cathode of these SOFCs produces a difference in oxygen chemical potential between the surfaces of these electrodes, leading to the generation of electricity. A single-chamber SOFC has advantages in terms of its feasibilities for miniaturization and integration, because it does not require a component for gas separation [6].

Ni-doped ceria cermet anodes and $(La,Sr)MnO_{3-\delta}$ (LSM) cathodes are generally used for conventional SOFCs [1-3]. Recently, mixed ionic-electronic conductors, $La_{1-x}Sr_xCo_{1-y}Fe_yO_{3-\delta}$ (denoted LSCF(10(1-x)/10x/10(1-y)/10y)), have attracted considerable attention as a cathode for reducing operation temperature [1,2]. Fig. 1 shows the correlation between the oxide ion conductivity σ_o^{2-} (at 800ºC) and thermal expansion coefficient TEC (at 30-1000ºC) of LSCF, as determined using published data [7,8]. A positive correlation can be observed between σ_o^{2-} and TEC. A

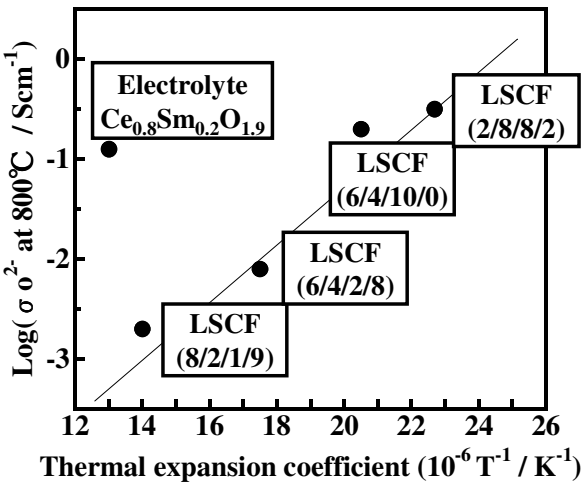

Fig. 1 The correlation between the thermal expansion coefficient TEC (at 30-1000ºC) and oxide ion conductivity σ_o^{2-} (at 800ºC) for LSCF [7,8].