Available online at www.sciencedirect.com
SCIENCE DIRECT®
Journal of Power Sources 151 (2005) 103–107
JOURNAL OF POWER SOURCES
www.elsevier.com/locate/jpowsour

Short communication

Evaluation of ferritic steels for use as interconnects and porous metal supports in IT-SOFCs

I. Antepara*, I. Villarreal, L.M. Rodríguez-Martínez, N. Lecanda, U. Castro, A. Laresgoiti

Ikerlan-Energía, Parque Tecnológico de Álava, Juan de La Cierva 1, 01510 Miñano, Álava, Spain

Accepted 7 February 2005
Available online 24 May 2005

Abstract

As a way of reducing the production costs of stacks by replacing ceramic components with metal components with a similar thermal expansion coefficient (TEC), today, much of the research work has focused on SOFCs operating at temperatures of under 800 °C. Some semi-commercial ferritic stainless steels (FSS) satisfy this TEC. Ikerlan has evaluated samples of two of these. Also, AMETEK stainless steel powders were tested in sintered disks until they were completely densified in order to compare results from dense and porous materials. The first tests performed by Ikerlan were conducted with dense samples and included the oxidation test in air at 800 °C and measurements of contact surface electrical resistance (area specific resistance, ASR), to compare electrochemical techniques (electrochemical impedance spectroscopy, EIS) with the traditional four-wire method and indirect measuring of the resistance through current and voltage measurements. An alloy from the last melt manufactured by the company ThyssenKrupp VDM GmbH performed best. These results did not differ greatly from the previous laboratory results attained during alloy development. Only AMETEK powder metallurgy materials were tested as porous bodies, to compare these with these dense materials, and were found to provide much higher oxidation levels, as might be expected. While dense materials can operate under the working conditions of the SOFC, porous materials still need new alloys.

Keywords: SOFC; Ferritic stainless steel; Oxidation; ASR

1. Introduction

The approach of Ikerlan's SOFC project [1] is similar to those of other research units [2–4], although it has planned a tubular geometry instead of a planar one for the prototype and a different final application in domestic generators that produce HSW and electricity. The basis is an operating temperature of under 800 °C, so that ceramic components, such as the bracket for the electrochemical ceramics and the interconnect, can be replaced with metal components. In view of the fact that Ikerlan plans to use metallic components to develop solid oxide cells, one of the main aims is to search for the optimum alloys for our system.

There is a great deal of scientific literature dealing with this problem, including a number of reviews [5,6]. The main characteristic that determines the validity or not for using these high temperature metal alloys in IT-SOFCs is the thermal expansion coefficient (TEC), which in turn must be similar to the ceramic materials used ($11 \times 10^{-6}\,K^{-1}$ for YSZ electrolyte between 20 and 1000 °C [7]) in order to prevent the degradation of these cells in the heating and cooling processes. The afore-mentioned metal alloys must also have good corrosion resistance in oxidising (air on the cathode) and reducing atmospheres (methane reformed gas on the anode [8]) up to 800 °C, acceptable electrical conductivity, and thermochemical stability in contact with ceramics (to avoid problems relating to the diffusion of elements between steels and ceramics and the vaporisation of chromium in atmospheres

Abbreviations: ASR, area specific resistance; EIS, electrochemical impedance spectroscopy; FSS, ferritic stainless steel; IT-SOFCs, intermediate temperature solid oxide fuel cells; TEC, thermal expansion coefficient

* Corresponding author. Tel.: +34 945 297032; fax: +34 945 296926.
E-mail address: IAntepara@ikerlan.es (I. Antepara).

0378-7753/$ – see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.jpowsour.2005.02.084