CONTEMPORARY METALLIC MATERIALS

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Chapter 018

Recent Trend on Application of High Temperature Ferritic Fe-Cr Alloys in Solid Oxide Fuel Cells

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Keywords: Solid oxide fuel cells, Ferritic Fe-Cr alloys, High temperature steam oxidation.

Abstract. The application of high temperature ferritic Fe-Cr alloys in Solid Oxide Fuel Cells (SOFCs) has been reviewed. The associated problems in SOFCs have been highlighted. It is understood that the development of new high temperature alloys without the formation of insulators such as SiO_2 or Al_2O_3 is crucial to be used in SOFCs. Moreover, the presence of water vapor may decrease the cell's performance, hence need to be addressed adequately.

Introduction

The development of Solid Oxide Fuel Cells (SOFCs) attracts a lot of attention and has been a subject of intensive research due to its potential to convert chemical energy (fuel sources) to electrical energy directly without combustion. In conventional steam power plant, the chemical energy is first converted to mechanical energy to rotate the turbine, and later converted to electrical energy. This intermediate step of conversion into mechanical energy is one of the reason that conventional power plant having a lower efficiency in energy conversion.

The electric generation base on theoretical solid-state energy conversion is a promising technology to cope the crucial problem of global warming. Energy generation from SOFCs offers a lot of advantages such as zero emission, high efficiency, low environmental impact and zero noise pollution. It is a promising technology as a power sources to households, commercial buildings, vehicles and aircraft systems. These applications will give great impacts to the energy industry worldwide.

The main parts of SOFCs are ion conducting electrolyte, anode, cathode and interconnector. Schematic diagram of SOFCs is shows in the Figure 18.1. A single cell of SOFC generates only about 1 V. In a planar type SOFC, the cell parts are stacked together and later connected into siries to generate sufficient high power output. Interconnector material plays an important role as it enables the electric connection between anode of a unit cell to cathode of the other cell. It also separates fuel in anode from air in cathode. For that reason, interconnector material is exposed in severe oxidizing and reducing environments at each side. For example, Kurokawa [1] has summarized the oxygen, water vapor and hydrogen potential in anode and cathode. The results are shown in the Table 1. The oxygen potential for anode and cathode is around 4.1×10^{-17} Pa and 2.1×10^{4} Pa, respectively. Many challenges to commercialize SOFCs are due to materials related issues.