

Application of Plasma Spraying to Solid Oxide Fuel Cell Production

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Summary

New technology for electricity generation is required to be efficient environmentally benign and able to handle a variety of fuels. The solid oxide fuel cell (SOFC) is a direct conversion system of chemical energy to electrical one, and has become a promising technology which satisfies all these requirements. The basic element of SOFC consists of solid oxide electrolyte coating ($ZrO_2\text{-}Y_2O_3$) in contact with a porous anode ($LaCoO_3$) and a cathode ($Ni/ZrO_2\text{-}Y_2O_3$) on either side. The fuel and oxidant gases flow past the backside of the anode and cathode, respectively, and generate electrical energy by the electrochemical reactions at the high temperature of about 1170°C (Fig.1). A practical SOFC structure is the tubular type one which has the multiple elements connected with an interconnector coating of cermet (Ni alloy/ $ZrO_2\text{-}Y_2O_3$) on the calcia stabilized zirconia porous tube (Fig.2).

This article shows that the plasma spraying process has become one of the most promising processes to produce the SOFC component parts. The low pressure plasma spraying of fine $ZrO_2\text{-}Y_2O_3$ particles is applied to forming the electrolyte coating of high density in order to increase the efficiency. The plasma spraying of cermet is applied to forming the cathode and interconnector coatings, followed by controlling the linear thermal expansion coefficient and electrical conductivity. The porous anode coating of $LaCoO_3$ is formed by gas flame spraying. The SOFC produced by plasma spraying process has been proved to represent a high performance as the fuel utilization of 87.1% and the power generation efficiency of 38%, the values of which show the high usability. Based on these results, a 1kW module in which 48 SOFC tubes are built up has been successfully operated for 3000 hours. The module scaled up to 10kW is now under operating.

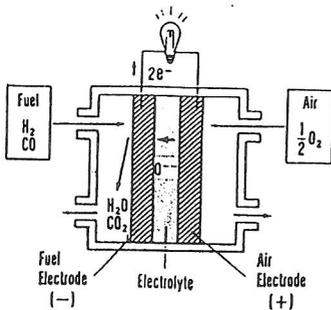


Fig.1 Principle of SOFC.

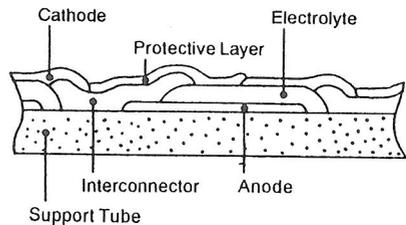


Fig.2 Schematic illustration of a tubular type SOFC.