Advanced Ceramic Reactor Research Project

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Introduction

Objective of this research is to develop innovative manufacturing process of solid oxide fuel cell (SOFC) modules composed of micro-tubular cell with high volumetric power density. Recently SOFC has received much attention because it is environmentally harmless and has good energy efficiency. Various types of cell designs have been proposed; among them micro-tubular SOFC has shown to be suitable for compact SOFC modules because it has many advantages, such as substantial increase in the surface area of electrodes and high thermal shock resistance, which lead to quick start-up time and high thermo-cycling resistance.

Methods and Results

In this study, a honeycomb-type SOFC accumulated with multi micro-cells has been prepared using the fabrication process of extrusion of a honeycomb monolith (cathode:$LaSrMnO_3$ (LSM)) and subsequent inner wall coating (electrolyte) of multi channels. LSM powder was mixed with organic binder and water, and left to age overnight. LSM honeycomb monolith with channel density of 700cpsi (channels per square inch) and wall thickness of 200μm were extruded. After drying, the inner walls of multi channels in the LSM honeycomb were coated with electrolyte slurry and co-fired at 1300°C for several hours. The sintered LSM honeycomb coated with dense electrolyte layer was further coated with NiO-GDC anode slurry, followed by heating process at elevated temperature for several hours. Finally, the honeycomb-type SOFC was obtained with the cell density of about 1000cpsi, LSM wall thickness of 160μm, the dense electrolyte layer about 10μm and anode layer about 20μm. Volumetric power density of the honeycomb-type SOFC is estimated to be 2W/cc at 600°C using the performance data of a LSM supported single cell, prepared using the same technique.

Biographical Sketch

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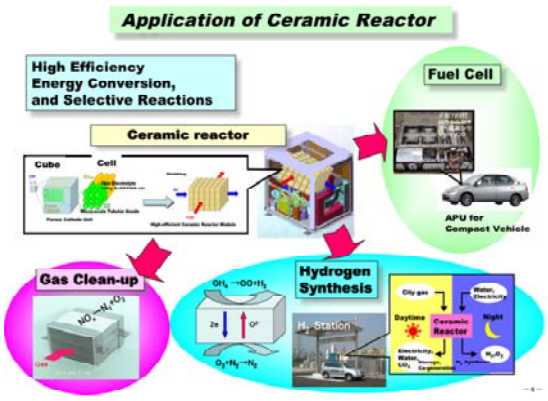
Dr. Toshiaki Yamaguchi received an Eng. Dr degree in applied chemistry at Nagoya University. He had studied and worked in Nagoya University for 12 years. He is currently a research scientist of the Functional Assembly Technology Group, Advanced Manufacturing Research Institute, National Institute of Advanced Industrial Science and Technology (AIST).

He has worked on 5-year project “Advanced Ceramic Reactor Project” supported by NEDO (from 2005 to 2010). Ceramic reactor is an electrochemical device, which enables highly effective conversion of energy and materials by electrochemical reaction, such as fuel cell power generation, hydrogen synthesis, and exhaust purifier. This research project aims at fabrication of accumulating module of ceramic micro reactors that can be operated below 600°C. Our development will make contribution to establish new ceramic fabrication technology.



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