Fabrication and Characterization of $Ce_{0.9}Gd_{0.1}O_2$ Ceramics based Micro tube-type Reactor for Low Temperature SOFC

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Low temperature (<650°C) solid state oxide fuel cell (SOFC) have been much attention for compact generator such as APU system because the cost of materials and fabrication will be dramatically reduced. Gd doped cerium oxide ($Ce_{0.9}Gd_{0.1}O_2$, GDC) electrolyte is known as high ionic conductivity between 500-700°C, and it is possible to reduce working temperature in SOFC. For the purpose of developing stable and high efficiency low temperature driven cell, micro tube type GDC cell was fabricated by sol-gel method at room temperature. $Ce_{0.9}Gd_{0.1}O_x$ (GDC) was fabricated using acetate precursor. $CeCl_3$ $7H_2O$ and $GdCl_3$ $6H_2O$ and acetic acid were dissolved in distilled water at molar ratio of [Gd]/[Ce] =0.1 and $[CH_3COOH]/[Ce+Gd]=3$. White gel formed by heating the mixed solution at 80°C for 30 min. Gel precursor was injected from syringe in open diameter of 1.7mm into 25% ammonia solution at room temperature, then the extruded gel was washed by distilled water. After drying at 120°C, the extruded products were calcined at 1200-1400°C for 2 h (Fig.1). Furthermore, similar extruded product was prepared using $CeCl_3$, $GdCl_3$, $NiCl_3$ and acetate mixed gel at NiO/ 40vol% $Gd_{0.1}Ce_{0.9}O_x$ composition as anode tube. The size of anode tube was ca. 800 μm in diameter, and length was 20mm after sintering at 1400°C. Grain size in dense GDC ceramics micro-tube was ca.500nm. Furthermore, fuel cell performance of 45vol%NiO-GDC/GDC/LSCF cell are investigated at 500-800°C (Fig.2). Power density of both GDC electrolyte and LSCF cathode coated NiO/GDC anode tube was characterized at 500-800°C under 30ml/min H_2 gas flowing.

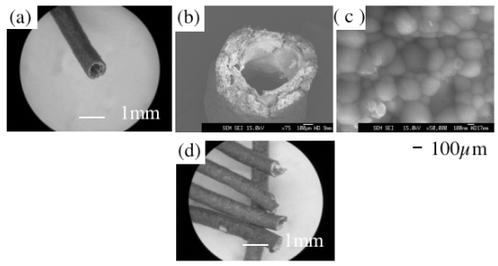

Fig.1 Optical microscope image of (a) GDC μ-tube ceramics and (b)NiO/GDC tube ceramics, and (d)SEM image of GDC μ-tube ceramics after calcined at 1400°C.

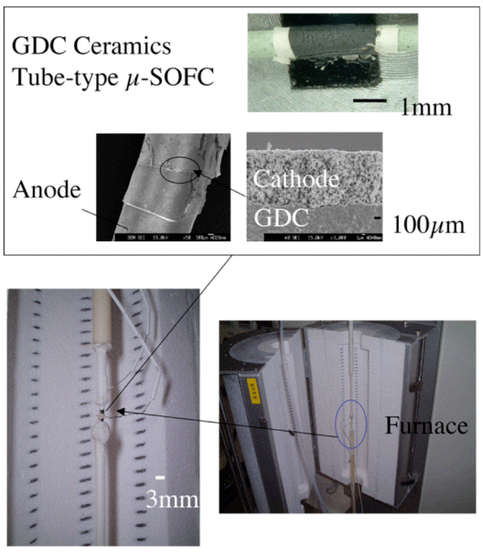

Fig.2 Photographs of GDC μ-tube ceramics SOFC, and fuel cell characterization of μ-tube GDC cell.