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Low Temperature Processing of Composite Anode for Solid Oxide Fuel Cells

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Solid oxide fuel cells (SOFCs), considered as next generation energy source, have been paid great attention for many years [1]. There are several problems need to be solved in SOFC technology and one of these problems is interfacial reaction between anode/cathode and electrolyte due to high temperature processing. This causes large cell overpotential and limits cell performance. A simple solution for this problem can be offered by low temperature cell processing method. A low temperature thin film processing method (under 1000^{o}C) for electrolyte materials using this composite technology has been reported and showed that they were dense and had normal electrical conductivity [2]. Because of these facts, low temperature cell processing has become important for the development of SOFC. In this study, composite technology was applied for the preparation of anode electrode.

NiO-YSZ composite anodes were prepared by depositing YSZ colloidal suspensions (initial YSZ particle size ~ 100 nm) and Ni polymer precursors onto dense sapphire and YSZ substrates. The scheme of this process (colloidal-polymer method) is shown in Fig. 1. First, a porous layer is prepared on the substrate by coating the YSZ colloidal suspension, then the polymer precursor is applied to the porous film to fill pores. After several polymer precursor applications, NiO-YSZ anode is obtained by annealing at 950^{o}C. For the preparation of polymer precursor, the details were discussed elsewhere [3]. Figure 2 shows the results of redox cycle test for NiO-YSZ anode on sapphire substrate after 10 and 20 depositions of Ni polymer precursor. As can be seen, conductivity at 700 ^{o}C showed 0.1 S cm^{-1} in air and above 100 S cm^{-1} in reducing atmosphere and stability in the cycling test. This indicates that the composite anode can be a potential candidate for anode in SOFCs. Symmetrical cell test was also conducted in the fuel cell region and the results will be presented.

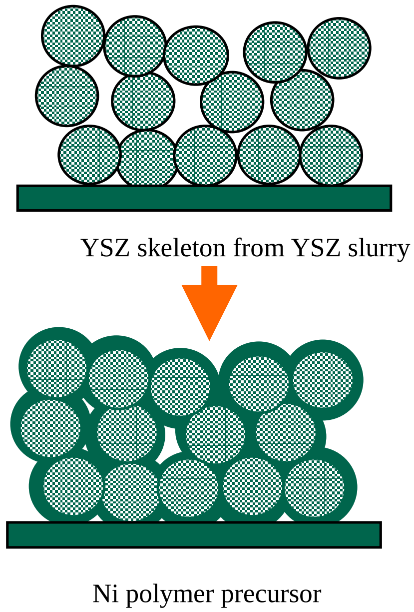

Figure 1: The schematic diagram of composite technique.

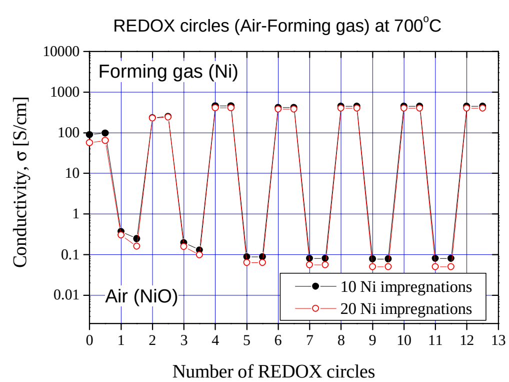

Figure 2: Redox cycle test of composite anode

Reference

1. N.Q. Minh and T. Takahashi. *Science and technology of ceramic fuel cell*. Elsevier, The Netherlands (1995)
2. V. Petrovsky, T. Suzuki, P. Jasinski, T. Petrovsky and H. U. Anderson. *Electrochem. Solid-State Letters*, 7 (6) p. 138, 2004
3. H. U. Anderson, M. M. Nasrallah, and C. C. Chen. *U.S. Patent* , 5494700 (1996).