SOLID OXIDE FUEL CELL

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Solid Oxide Fuel Cells (SOFCs) offer an efficient and pollution-free technology to electrochemically convert gaseous fuels such as hydrogen and natural gas into electricity. These fuel cell systems operate at temperatures in the range 800-1000 °C and can be designed for applications ranging from centralized MW-scale generation through to localized domestic generation on the 10 kW scale. There is also an increasing interest in SOFC applications in the 10 W range for auxiliary power generation in vehicles. Essentially, SOFCs consist of two porous electrodes separated by a dense electrolyte. Such a ceramic fuel cell requires complex fabrication technologies and each component must fulfill several different criteria. Thermal and chemical compatibility, good electrochemical and mechanical properties, and thermal stability are key issues regarding this technology. The research activities at IPEN are primarily concerned with the development of the SOFC materials, aiming to the use of simple and low-cost methods for high-performance SOFC components. The activities of the SOFC research group at IPEN have been focused on the synthesis, processing, and microstructural characterization of the SOFC components. Along with the traditional solid oxide reaction, several different chemical techniques have been used for SOFC components preparation. The coprecipitation technique has been used for the fabrication of nanometric ZrO2:3-10 mol%Y2O3 (YSZ) powders, as shown in (FIG.1) High-density YSZ electrolytes have been produced by sintering at 1500 °C, resulting in specimens with high fracture toughness (~ 7 MPam1/2 for 3YSZ) and high electrical conductivity (~ 1.30.1 Scm-1 at 1000 °C for 9YSZ). This chemical route has been also applied to the preparation of dense and homogenous YSZ-NiO composites, which is the precursor of the anode material YSZ-Ni. Ceramic based on YSZ-TiO2 system has also been studied as anode material. The La0.6Sr0.4MnO3 (LSM) cathode materials have been prepared by the polymeric precursor technique resulting in sinteractive powders and single-phase materials. The combustion reaction was used to fabricate dense La1-xSrxCr1-yCoyO3 interconnect materials with good electrical properties. The slurry coating technique was used for fabrication tests of both single cells and electrode/electrolyte interfaces. The stability and homogeneity of the ceramic suspensions have been investigated for the deposition of thick films of the component materials. Some preliminary results of cathode and anode depositions onto YSZ pellets are shown in (FIG.2 and 3).

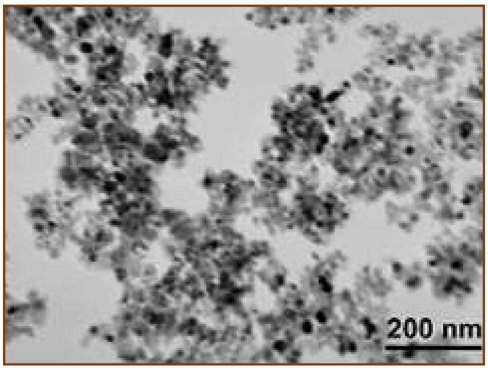

FIGURE 1 - Transmission electron micrograph of nanometric YSZ powder.

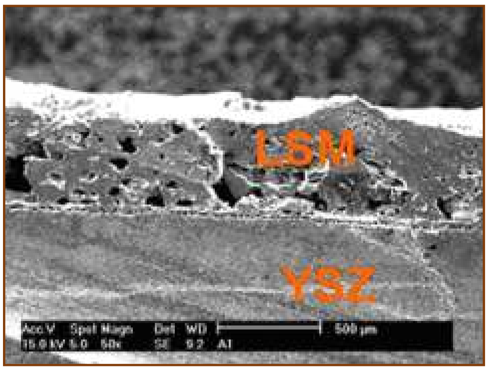

FIGURE 2 - Scanning electron micrograph of the cross section of YSZ electrolyte/LSM cathode interface.

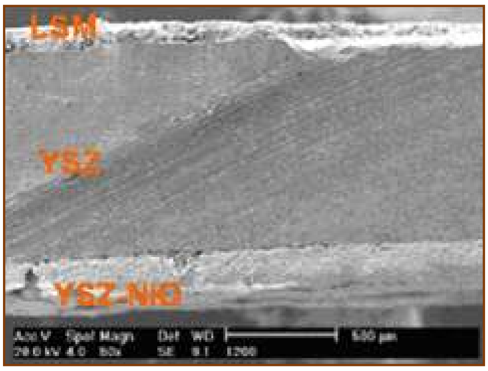

FIGURE 3 - Scanning electron micrograph of the cross section of LSM / YSZ / YSZ-NiO single cell produced by slurry-coating.