

Yttrium stabilized zirconia (YSZ) electrolytes for solid oxide fuel cells prepared via filter coating

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It is well known that fossil fuels are the main contributors to global warming; therefore it is top priority the development of cleaner and renewable energy sources. One of the most promising clean energy technologies is fuel cell. Fuel cell is a device where the anode and cathode are separated by a dense electrolyte. On the anode side the fuel, usually hydrogen, is oxidized and on the cathode side the oxygen is reduced. The electrolyte must be a good ionic conductor. There are several types of fuel cells, which are usually classified by the kind of the electrolyte. The most important ones are the Proton Exchange Membrane (PEM) and the Solid Oxide Fuel Cell (SOFC). SOFC's show some advantages such as higher catalytic activity, higher efficiency (up to 60% and up to 90% with co-generation), no use of noble metals, possibility of using hydrocarbon as fuels without external catalytic reforming. Despite the great advantages there are still some issues to be solved, specially the high working temperatures, which leads to high degradation rates and to the need of using high cost materials for cell assembling. Aiming to reduce the SOFC work temperature, in the last ten years efforts have been made to develop SOFC anode supported technology where thin electrolytes are used. Other option is to use as electrolyte materials with higher ionic conductivity than stabilized zirconia, which is considered the standard SOFC electrolyte due to its special characteristics. The main objective of this work is to obtain anode supported cells with a thick ($\sim 20 \mu\text{m}$) electrolyte using the filter coating technique. Anode substrates were cold isostatic pressed (200 MPa) from a homogeneous mixture of 56 % mass of NiO (VTEC, Lot Number 047820), 44 % mass of YSZ (Tosoh TZ-8Y, Lot Number Z804508P) and 40 % volume of corn starch (particle size $\sim 10 \mu\text{m}$) as pore former. The substrates were pre-sintered at 1250 °C- 6 min in order to match the sintering shrinkage between the anode substrate and electrolyte film. After pre-sintering, a functional layer, mixture containing 60% mass of NiO and 40% mass of YSZ (FCM), was deposited by spray coating. The substrates with functional layer were sintered at 1250°C-2h. A film of YSZ was cast over the functional layer using an iso-propanol suspension containing 6 g/L YSZ (Tosoh TZ-8Y, Lot Number Z804508P). The additives Butvar B-98 and S-2075, both from Solutia, were used in the suspension as ligand and plasticizer, respectively. The thickness of YSZ film was controlled through casting time. Samples were characterized by scanning electron microscopy and electrical impedance spectroscopy before and after reduction of NiO to Ni. The film surface was free of defects and the thickness range was 20-60 μm .

Keywords: SOFC, anode supported, filter coating

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