Abstract #2375, 224th ECS Meeting, © 2013 The Electrochemical Society

Electroless and electrolytic deposition of silver and nickel for Solid Oxide Fuel Cells anodes.

E Ruiz Trejo, P Boldrin, F. Tariq, N Brandon
Department of Earth Science and Engineering, Imperial College London, SW7 2AZ, UK
M Millan-Agorio
Department of Chemical Engineering, Imperial College London, SW7 2AZ, UK
A Atkinson
Department of Materials, Imperial College London, SW7 2AZ, UK
C Tighe, J Darr
Department of Chemistry, University College London, WC1H 0AJ, UK

We present a novel approach for the manufacture of nickel anodes for SOFC. Three scalable process were used: continuous hydrothermal flow synthesis (CHFS), screen printing and electro-less and electrolytic deposition of metals.

We have synthesised a range of phase pure $Ce_{0.9}Gd_{0.1}O_2$ electrolytes by continuous hydrothermal flow synthesis. Inks containing this material and pore formers have been produced and screen printed onto YSZ electrolytes (300 μm), producing a range of porous scaffolds (ca 10μm). The scaffolds have then been coated with silver followed by electrodeposition of Nickel. The samples were characterized by XRD, BET, FEG-SEM and FIB-SEM. The electrochemical properties of these anodes have been assessed in symmetrical cells and in operational Ni/YSZ/LSCF fuel cells using impedance spectroscopy. Fig 1 show a 3-D re-construction of one of the prepared anodes whle Fig 2 shows the microstructure obtained by FEG-SEM.

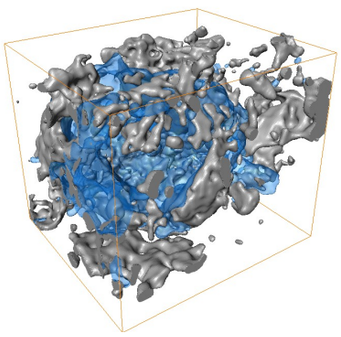

Fig. 1.Anode composite: Ni (gray), open pore (blue) and CGO (transparent).

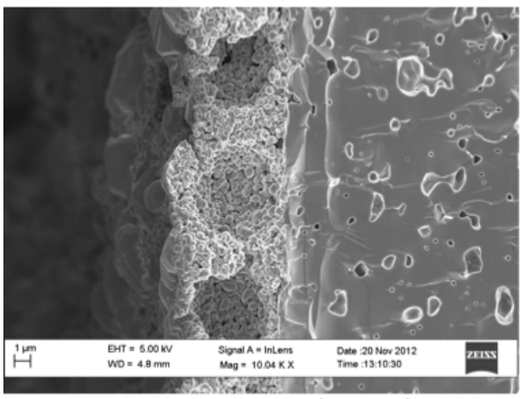

Fig 2. FEG-SEM cross-section showing the CGO scaffold with a deposit of silver and nickel.

Fig 3 shows the impedance plot of a symmetrical cell in different P_{H2} conditions at 600°C. The ohmic resistance corresponds to the YSZ, while the visible semicircle is the electrode response. Values of ASR around 1 Ω/cm^2 at 600°C were easily obtained with electrodeposited nickel

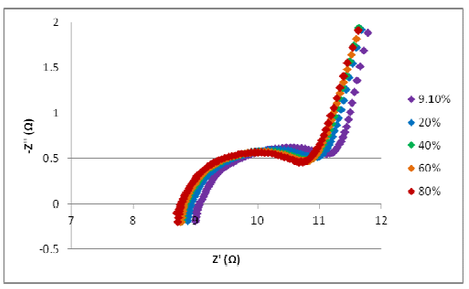

Fig. 3. Anode: Ni (gray), pore (blue) and CGO (transparent). The H_2 concentration is indicated as %.

Conclusions

We have successful undertaken a novel fabrication of anodes using three scalable techniques. The oxide nanoparticles are highly sinterable, we can control the size and percentage of the pores and we can determine precisely the Nickel loading. The electrodeposition presents considerable advantages compared to a simple impregnation technique. The anode composites manufactured showed a good performance at T < 600°C with an ASR of 1 Ω/cm^2