OPTIMIZATION OF FUEL ELECTRODE MICROSTRUCTURE FOR APPLICATION IN REVERSIBLE SOLID OXIDE CELL

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The performance of mixed ionic electronic conductor (MIEC) based electrodes can be increased using careful design of the electrode microstructure. It has been demonstrated that for infiltrated electrodes impedance has a clear dependency on the structural parameters and on porosity of support structure. Structural change results in significant change in resistance of active centers but also in low frequency i.e. concentration related resistance, especially at higher current densities [1], [2]. In this study, porous $(Sc_2O_3)_{0.10}(CeO_2)_{0.01}(ZrO_2)_{0.89}$ (ScCeSZ) electrolyte scaffolds with different porosities were prepared using various amounts of pre-calcined electrolyte powder and different pore formers (Fig.1). Furthermore, various amounts of $Sr_2Fe_{1.5}Mo_{0.5}O_{6-\delta}$ (SFM) and $La_{0.76}Sr_{0.19}Cr_{0.49}Mn_{0.49}Ni_{0.02}O_{3-\delta}$ (LSCMN) MIEC materials were infiltrated into scaffolds to obtain solid oxide single cells with different MIEC loading. Pre-calcination of ScCeSZ electrolyte powder increased the average pore sizes and increased the overall porosity of scaffolds by about 10%. However, due to the use of pre-calcined electrolyte powder with increased particle sizes, specific area of electrolyte scaffolds, thus activity decreased at lower MIEC loadings. Results indicated that optimal loading depended on the conductivity of MIEC material and was found to be 30 or 50 wt. % for SFM and LSCMN based cells, respectively. Highest current density values of 1.11 and 0.78 A cm^{-2} for SFM and LSCMN electrodes, respectively, were measured for electrolysis mode at 850 °C, potential of 1.5 V and 30% of absolute humidity. Corresponding values for fuel cell mode were 0.44 and 0.28 A cm^{-2} at 0.85 V and 3% absolute humidity.

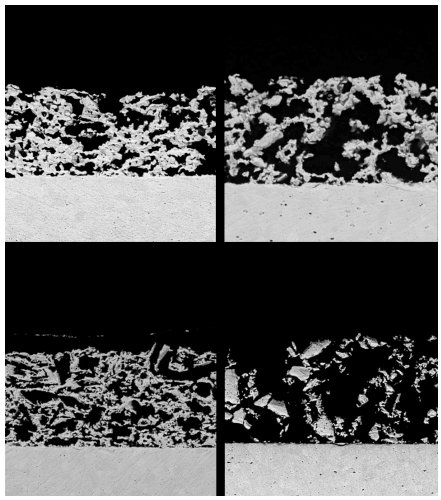

Fig.1 Selected porous electrolyte scaffolds with different pore size distributions and open porosities.

References

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