Elaboration of thick films of nanosized YSZ particle suspensions by a dip-coating process in a polymeric matrix. Application as electrolyte solid oxide fuel cells

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Abstract

Electrolyte yttria stabilized zirconia (YSZ, 8% Y2O3) thick films were coated on porous Ni-YSZ cermets substrates by dip-coating process using a new-formulation suspension. First, the suspension is obtained from the addition of a polymeric matrix to a stable suspension of a commercial YSZ (Tosoh) powders dispersed in an azeotropic MEK-EtOH solution [1]. After heat treatment, the obtained layers are adherent, homogeous and continuous with thicknesses ranging from 10 to 20 micrometers. Nevertheless, the film density was not gas tight enough. In order to increase the films microstructure after thermal treatment, the green density of the thick films is increased by using a bimodal distribution of YSZ particles in the previous suspensions. This bimodal distribution is obtained by mixing YSZ nanoparticles (5 nm) and YSZ commercial agregated powders . The well dispersed nanoparticles are obtained by the calcination of aerogel, arising from the supercritical drying of the gel elaborated in the zirconium n-propoxide, n-propanol, yttrium nitrate, acetylacetone and water system. The YSZ aerogel structure is made up of connected fractal clusters with small primary crystallites about 3 to 5 nanometers [2]. Furthermore, the colloidal nature of the sol is clearly established [3] and can also be added to the previous polymeric one. The in-situ growth of these colloids during an appropriated heat treatment increases significantly the layers density. Different microstructures are obtained depending on the synthesis parameters.

[1] M. Gaudon, PhD Thesis, Toulouse, 2002. [2] A. Lecomte, F. Blanchard, A. Dauger, M.C. Sylva, R. Guinebretiere, J. Non-Cryst. Sol., 1998, 225, 120. [3] A. Lecomte, A. Dauger, P. Lenormand, J. Appl. Cryst., 2000, 33, 3-1, 496.