Two-Layered Anode-Electrolyte Sandwich Structure Manufactured From Zirconia-Based Powder Using CIP

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Development of three-layered ceramic sandwich with porous anode, porous cathode, and gas-tight intermediate solid electrolyte from fully stabilized zirconia (FSZ) is a key problem arising at manufacturing SOFC ceramic components, taking into account tight connection between all these layers.

Main difficulty in such sandwich is in matching of co-sintering shrinkages for first two layers - anode and electrolyte.

Cold isostatic pressing (CIP) allows to overcome this difficulty in quite simple manner by varying CIP pressures and thereby adjusting green densities of both materials within wide range of values.

Present paper outlines experimental results on the development of two-layered anode-electrolyte ceramic sandwich using CIP. Ceramic anode was prepared as follows. Equal weight amounts of zirconia + 8 mol.% yttria and NiO powders were mixed with porophore in the planetary mill. A pellet with 40 mm in dia. and 5 mm in thickness was isostatically pressed from this powder composition. One side of this pellet was green polished, and then the pellet was pre-sintered under the special schedule with highest temperature about 1400 deg. C. Open pre-sintered porosity was measured to be about 50 %.

Smooth side of pre-sintered pellet was further built-up by FSZ, again using isostatic pressing. CIP pressure was thereat selected such as to provide exact green density value needed to preclude any buckling, warping, peeling, or spalling at subsequent co-sintering. Green FSZ layer was polished down to ensure required sintered thickness. Then the sandwich was sintered at 1500 deg. C under another special time schedule providing attainment of theoretical poreless density of electrolyte. Anode porosity was naturally decreased at such co-sintering but remained open and equal to about 30 %.

Ceramic cathode was finally formed by covering another side of electrolyte layer with paste based on powder mixture of LSM, PSZ, and porephore; burning, and annealing at 1250 deg. C under third special time schedule. Above procedures had allowed to produce perfect three-layered sandwich for SOFC.