CERAMIC FUEL CELL ELECTRONIC DEVICE: STRUCTURE & PROPERTIES

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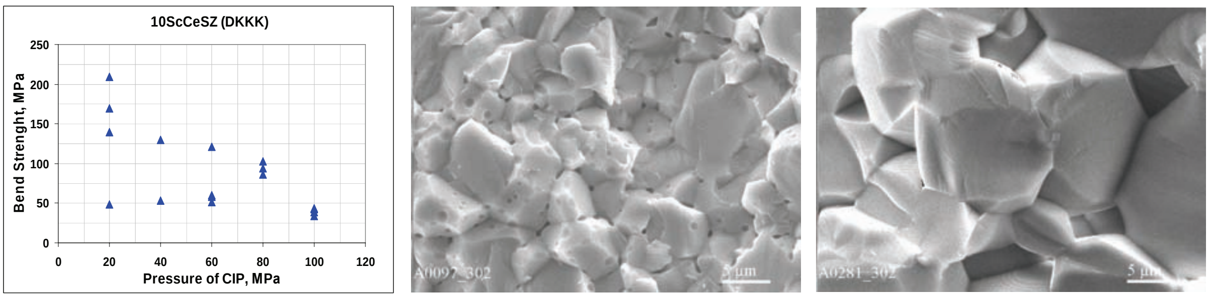
There is a growing interest in development of new materials and engineering designs for solid oxide fuel cells (SOFC) operating below 600^{o}C that are considered as a promising technology for reliable and environmentally safe energy generation. Decreased energy costs, chemical degradation, and mechanical stresses make these cells especially attractive from the point of their high thermodynamic efficiency and low emissions that contribute to a secure future of our nation. Nevertheless, the current state-of-the art state of fuel cells for a wonder, shows that their structure as a structure of complicated macrocomposite requires to be still optimized.

Quality of zirconia powders that is a main material for zirconia ceramic fuel cells plays the most important role in operation properties of SOFC. Electrolyte made of author's nanosized (20-30 nm) powders with co-deposition and hydrothermal synthesis have practically the highest total electrical conductivity and mechanical strength among the studied industrial powders in spite of comparatively high level of contaminants like silica, alumina, titania etc. Nanosized zirconia powders have different susceptibility to pressure at cold isostatic pressing: the higher pressure the weaker ceramics resulted from dramatic increase of grain and pore sizes. As an example of negative influence of grain size on strength or electric conductivity of zirconia electrolytes is shown in Fig. 1.



a b c

Fig. 1. Influence of pressure of cold isostatic pressing on strength (a) and grain size and fracture mechanisms (b, c) of 10Sc1CeSZ electrolyte.
Samples shown were pressed at 20 (b) and 100 MPa (c) and sintered both at 1550^{o}C.

The data obtained are discussed in terms of influence of properties of powders (size, agglomeration, impurities and their distribution along particles), temperature of their sintering, and fracture micromechanisms on electrochemical, catalytic and mechanical properties of all constituents of zirconia fuel cells and SOFC as a whole.