

Nanocomposites and nanomaterials

Performances of tape casted SOFC based on Ukrainian yttria stabilized zirconia powder

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Solid oxide fuel cell (SOFC) is an electrochemical device, which converts chemical energy into electrical energy with high efficiency and low emissions [1]. SOFC consists of dense yttria stabilized zirconia (8YSZ) electrolyte, which separates porous electrodes, namely lanthanum-strontium manganite (LSM) – YSZ cathode and Ni – YSZ anode. Addition of YSZ into both electrodes provide better coefficient of thermal expansion (CTE) with an electrolyte. SOFC would be fabricated to be based on electrolyte or one of electrodes. SOFC based on anode support is the most common configuration due to reducing thickness of electrolyte layer that decreases its ohmic resistance.

Despite of many advantages, SOFCs are have to be optimized structurally [2]. The problems could be solved via increasing of their performance, reducing the cost of materials, and/or reducing fabrication cost. Although various methods have been applied for planar SOFCs fabrication, tape casting is recognized as one of the most perspective in order to large-scale production of flat ceramic fuel cells could be viable economically.

The present work is devoted to elaboration of tape casting technique for production of thin SOFC to be compared with their commercially available alternatives. SOFC samples were made of Ukrainian zirconia powder 8YSZ (Zirconia Ukraine Ltd.). The 8YSZ electrolyte and 8YSZ – NiO anode slurries included complex combination of binders to achieve required homogeneity and planarity of the casted tapes. Anode and electrolyte tapes were laminated in a half cell and sintered at 1400 °C. Commercial cathode material (LSM – 8YSZ) was deposited on the half cells and sintered at 1100 °C. The manufactured SOFCs and commercial SOFC with similar composition (8YSZ electrolyte, NiO – 8YSZ anode and LSM – 8YSZ cathode) were tested at the same conditions (temperature, fuel and air flows). Manufactured SOFC showed much higher performances than commercial ones. Thus, tape casting technique elaborated for Ukrainian powders is very promising and could be used as a base for further elaboration of a technology meeting requirements of SOFC large-scale manufacturing.

1. *Shaikh S., Mughtar A., Somalu M.* A review on the selection of anode materials for Solid Oxide Fuel Cells // *Renewable and Sustainable Energy Reviews.*-2015.-**51**.-P. 1–8.
2. *Vasylyev O., Brychevskiy M., Brodnikovskiy Y.* The Structural Optimization of Ceramic Fuel Cells // *Universal Journal of Chemistry.*-2016.-**4 (2)**.-P. 31–54.