The influence of synthesis method on properties of Nb doped $BaCe_{0.9}Y_{0.1}O_{3-\delta}$ as a proton conducting electrolyte for IT-SOFC

A.Radojković, M. Žunić, Z. Branković, S.Savić, G. Branković

Institute for Multidisciplinary Research, University of Belgrade, Kneza Višeslava 1a, 11030 Belgrade, Serbia

Abstract

Materials with perovskite structure based on yttrium-doped barium cerate have been widely investigated as proton conducting electrolytes for intermediate-temperature solid oxide fuel cells (IT-SOFC). The main drawback of these materials is stability in CO_2 that can be further enhanced by doping with Nb.

By the method of auto-combustion (AC) it is possible to synthesize fine ceramic nano-powders compared to classic solid-state route (SS). The aim of this work is to investigate the influence of different synthesis methods on chemical stability and electrical properties of the sintered $BaCe_{0.9}Y_{0.1}O_{3-\delta}$ samples doped with various concentrations of Nb.

$BaCe_{0.9-x}Nb_xY_{0.1}O_{3-\delta}$ (where x = 0.01, 0.03 and 0.05) powders were synthesized by the AC and SS methods. Much higher specific surface areas were observed for the samples synthesized by the AC method. The dense electrolyte pellets were obtained after sintering of the powders at 1550 ºC for 5 h.The conductivities determined by impedance measurements in temperature range of 550-750 ºC in wet hydrogen medium showed a decreasing trend with increase of Nb content. The samples synthesized by the AC method had a slightly higher conductivities compared to the same compositions obtained by the SS method. The stability in CO_2 at 700 ºC for 5 h, determined by X-ray analysis, was enhanced with increase in Nb concentration and there was no significant difference in stability in respect to the synthesis method. It was found that $BaCe_{0.87}Nb_{0.3}Y_{0.1}O_{3-\delta}$ is the optimal composition that satisfies the opposite demands for electrical conductivity and chemical stabilty. Its conductivity in wet hydrogen at 650 ºC is $8.7 \cdot 10^{-3}$ Scm^{-1} which is a bit lower than for undoped $BaCe_{0.9}Y_{0.1}O_{3-\delta}$ ($1.0 \cdot 10^{-2}$ Scm^{-1}).

It was concluded that application of AC method enables synthesis of fine, low-agglomerated nanopowders and further processing that results in better microstructures of the sintered electrolyte samples and consequently higher electrical conductivities.