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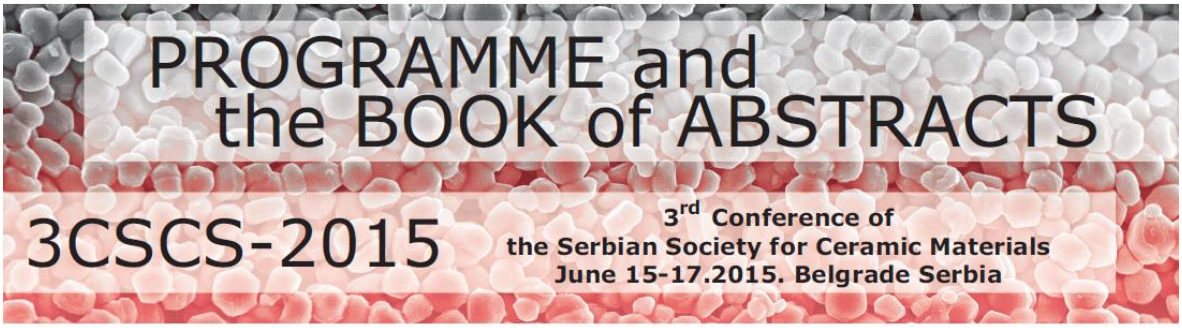

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O-11

HIGHLY CONDUCTIVE LANTHANOIDE STABILIZED δ-Bi_2O_3 PHASES

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Due to the increasing demands for new highly efficient and environmentally friendly energy conversion technologies, the oxide ion conductors applicable in solid oxide fuel cells (SOFCs) have widely been investigated. The aim is to find a suitable electrolyte with the ionic conductivity high enough at intermediate temperatures in order to reduce the operating temperature of SOFCs. The high temperature δ-Bi_2O_3 phase has been proposed as a good candidate for electrolyte in SOFCs because it is the fastest known ionic conductor.

In this study, the possibility to stabilize O^{2-} ion conductors related to the δ-Bi_2O_3 polymorph in Bi_2O_3–Tm_2O_3 and Bi_2O_3–Lu_2O_3 systems was investigated. Six starting mixtures with the following compositions $(Bi_{1-x}Tm_x)_2O_3$, x = 0.11, 0.14 and 0.20, and $(Bi_{1-y}Lu_y)_2O_3$, y = 0.15, 0.20 and 0.25, were dry homogenized in an agate mortar, heat treated at 750 °C for 3 h and then slowly furnace cooled. The samples were characterized by XRD, TEM/SAED, SEM, DTA and SEI techniques.

Based on XRD and TEM/SAED, the targeted cubic δ-Bi_2O_3 single-phase samples (space group $Fm\bar{3}m$) were successfully obtained within all six systems. The unit cell parameter of both Tm- and Lu-doped δ-Bi_2O_3 decreases as dopant content increases. By comparing Tm- and Lu-doped δ-Bi_2O_3 phases mutually, an expected increase of the unit cell parameters with larger ionic radii of dopant was found [$r_i(Tm^{3+})$ = 0.88 Å, and $r_i(Lu^{3+})$ = 0.86 Å in the octahedral environment[1]].

Electrochemical impedance of δ-Bi_2O_3 phases was measured between 300 and 800 °C. At temperatures 550 – 800 °C the conductivities are of the same order of magnitude (0.1 – 0.4 S cm^{-1}), but with lowering temperature they rapidly decrease resulting in two activation energies. This is due to the changes in conductivity mechanism which will be discussed.According to the cyclic DTA curves, no phase transitions were observed in the following samples: $(Bi_{0.8}Tm_{0.2})_2O_3$, $(Bi_{0.8}Lu_{0.2})_2O_3$ and $(Bi_{0.75}Lu_{0.25})_2O_3$, indicating that these δ-Bi_2O_3 phases are stable within the whole investigated interval, *i.e.*, from room temperature to 985 °C. This means that the application of these electrolyte materials could result not only in the significant enhancement of IT-SOFC electrochemical performance, but also in their good structural stability over long time service in a wide temperature range.

1. R. D. Shannon, *Acta Cryst. A*, **32** (1976) 751