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BOOK OF ABSTRACTS

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IONCODUCTING PROPERTIES OF PEROVSKITE SOLID SOLUTIONS $(La_{1/2}Li_{1/3+x})TiO_3$

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Recent years, considerable attention has been devoted to solid lithium ion conductors because of wide perspectives for their application as gas sensors and solid electrolytes. Of special interest are perovskite solid solutions $(La_{2/3-x}Li_{3x})TiO_3$ which reveal extremely high ionic conductivity ($\sigma \approx 10^{-3}$ Oh $m^{-1}\cdot cm^{-1}$ at room temperature) originated from the presence of vacancies in the A-sites of the perovskite lattice [1-3].

In this work perovskite solid solutions $(La_{1/2}Li_{1/3+x})TiO_3$ (x=0, 1/10, 1/6, 1/5, 1/4) have been prepared by the solid state reaction method. Ceramic samples have been studied by the X-ray diffraction, electron microscopy, IR- and dielectric spectroscopy methods.

Tetragonal distortion of the perovskite unit cell has been confirmed. The unit cell volume decreases with x increasing. The temperature dependence of conductivity follows Arrhenius' law at temperatures higher than 400K for all the samples studied. It has been shown, that addition of the over stoichiometric quantity of lithium oxide provides the decreasing of ionic conductivity in compositions $(La_{1/2}Li_{1/3+x})TiO_3$ due to the cationic ordering. The anomalies on temperature dependences of dielectric permettivity and dielectric losses have been revealed. We consider the low temperature anomalies at T<500K to be connected with the crystal structure transformation from tetragonal to cubic phase, while the high temperature anomalies at T≈850K connected with the effects of cation disordering.

[1]. Belous A. G. et al. // Bull. Acad. Sci. Inorg. Materials, 1987. V.23. N3. P.470.
[2]. Belous A. G. // J. European Ceramic Society. 2001. V.21. P.1797.
[3]. Inaguma Y.et al. // Solid State Communications. 1993. V.86 N10. P.689.

LANTHANUM GALLATE BASED MIXED CONDUCTING PEROVSKITE CERAMICS

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Anion deficient mixed conducting oxides with the perovskite structure $ABO_{3-\delta}$ attract much attention due to the prospects of their applications as oxygen separating membranes and catalysts for a variety of chemical reactions.

In this work, results of complex investigations of structure, microstructure, dielectric and transport properties of $LaGaO_3$-based perovskite ceramics have been presented. Solid solutions $(La,Sr)(Ga,Mg,M)O_y$, with M=Fe, Ni, have been prepared using the solid state reaction method. The samples have been studied by means of X-ray diffraction, electron microscopy, gravimetry, dilatometry, *dc*- and *ac*- dielectric spectroscopy methods in a wide temperature range.

Substitution of iron and nickel for gallium up to ~40 at.% leads to the perovskite lattice contraction due to the transition element valence changing. Accordingly, change from pure ionic to the mixed ionic-electronic conductivity is observed at increasing the Fe or Ni ions content for both the systems studied. The results obtained clearly demonstrate the tendency to augmentation of electronic conductivity in the $(La,Sr)(Ga,Mg,M)O_y$ ceramics along with x increasing.

Both the enhancement of total conductivity and increasing in the thermal expansion coefficient values have been proved to correlate with the increasing amount of weakly bounded oxygen species at high temperatures in the Fe or Ni-doped ceramics. Electronic conductivity seems to be surely sufficient to compensate possible ionic conductivity in any composition with $x \geq 0.15$ of the $(La,Sr)(Ga,Mg,Fe)O_y$ system.

The diffusion coefficient and oxygen ionic conductivity along the system have been estimated from the kinetic experiments using the dilatometry method under the condition of abrupt change of the atmosphere from reducing to oxidizing one. Finally, electro- and mass- transport properties are discussed in terms of structure related factors, microstructure and valence changes.

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