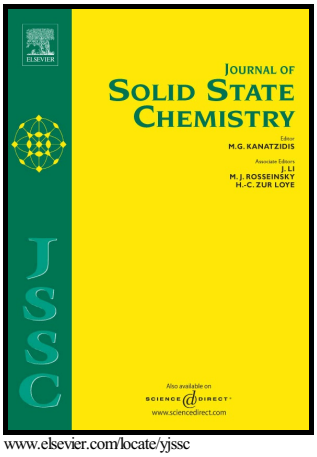

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PII: S0022-4596(17)30403-6
DOI: https://doi.org/10.1016/j.jssc.2017.10.005
Reference: YJSSC19967

To appear in: *Journal of Solid State Chemistry*

Received date: 20 July 2017
Revised date: 23 September 2017
Accepted date: 3 October 2017

Cite this article as: S.Ya. Istomin, A.V. Morozov, M.M. Abdullayev, M. Batuk, J. Hadermann, S.M. Kazakov, A.V. Sobolev, I.A. Presniakov and E.V. Antipov, High-temperature properties of (La,Ca)(Fe,Mg,Mo)$O_{3-\delta}$ perovskites as prospective electrode materials for symmetrical SOFC, *Journal of Solid State Chemistry,* https://doi.org/10.1016/j.jssc.2017.10.005

High-temperature properties of (La,Ca)(Fe,Mg,Mo)$O_{3-\delta}$ perovskites as prospective electrode materials for symmetrical SOFC

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Abstract

$La_{1-y}Ca_yFe_{0.5+x}(Mg,Mo)_{0.5-x}O_{3-\delta}$ oxides with the orthorhombic $GdFeO_3$-type perovskite structure have been synthesized at 1573K. Transmission electron microscopy study for selected samples shows the coexistence of domains of perovskite phases with ordered and disordered B-cations. Mössbauer spectroscopy studies performed at 300K and 573K show that while compositions with low Ca-content ($La_{0.55}Ca_{0.45}Fe_{0.5}Mg_{0.2625}Mo_{0.2375}O_{3-\delta}$ and $La_{0.5}Ca_{0.5}Fe_{0.6}Mg_{0.175}Mo_{0.225}O_{3-\delta}$) are nearly oxygen stoichiometric, $La_{0.2}Ca_{0.8}Fe_{0.5}Mg_{0.2625}Mo_{0.2375}O_{3-\delta}$ is oxygen deficient with $\delta \approx 0.15$. Oxides are stable in reducing atmosphere (Ar/H_2, 8%) at 1173K for 12h. No additional phases have been observed at XRPD patterns of all studied perovskites and $Ce_{1-x}Gd_xO_{2-x/2}$ electrolyte mixtures treated at 1173K-1373K, while Fe-rich compositions ($x \geq 0.1$) react with $Zr_{1-x}Y_xO_{2-x/2}$ electrolyte above 1273K. Dilatometry studies reveal that all samples show rather low thermal expansion coefficients (TECs) in air of 11.4-12.7 ppm K^{-1}. In reducing atmosphere their TECs were found to increase up to 12.1-15.4 ppm K^{-1} due to chemical expansion effect. High-temperature electrical conductivity measurements in air and Ar/H_2 atmosphere show that the highest conductivity is observed for Fe- and Ca-rich compositions. Moderate values of electrical conductivity and TEC together with stability towards chemical interaction with typical SOFC electrolytes make novel Fe-containing perovskites promising electrode materials for symmetrical solid oxide fuel cell.

Graphical abstract