TRANSPORT PROPERTIES AND THERMAL EXPANSION OF PEROVSKITE-LIKE $La_{0.3}Sr_{0.7}Fe(Al,Cr)O_{3-\delta}$ CERAMICS

A.A. Yaremchenko[a], V.V. Kharton[a], M.V. Patrakeev[b], F.M.B. Marques[a]

[a] Department of Ceramics and Glass Engineering, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

[b] Institute of Solid State Chemistry, Ural Division of RAS, 91 Pervomayskaya Str., Ekaterinburg 620219, Russia

Substitution of iron with aluminum and chromium in perovskite-type $La_{0.3}Sr_{0.7}Fe_{1-x-y}Al_xCr_yO_{3-\delta}$ (x = 0 - 0.4; y= 0 – 0.2) decreases thermal expansion and partial oxygen ionic and electronic conductivities. At oxygen partial pressures from 10^{-10}-10^{-8} to 0.5 atm, the total conductivity is predominantly *p*-type electronic. Temperature-activated character and relatively low values of hole mobility, estimated from the total conductivity and Seebeck coefficient data, suggest a small polaron mechanism. The oxygen ion transference numbers of $La_{0.3}Sr_{0.7}Fe(Al,Cr)O_{3-\delta}$ in air, determined from the data on faradaic efficiency, oxygen permeation and total conductivity, vary in the range 10^{-4} to 10^{-2} at 1023-1223 K, increasing with temperature and dopant content. As for other $(La,Sr)FeO_3$-based phases, reducing oxygen pressure below 10^{-14}-10^{-10} atm results in dominating ionic and *n*-type electronic contributions to the total conductivity. The low-$p(O_2)$ stability boundaries of $La_{0.3}Sr_{0.7}Fe(Al,Cr)O_{3-\delta}$ are similar to that of $LaFeO_3$. The activation energies for ionic transport, 90-130 $kJ\times mol^{-1}$, are essentially independent on the cation composition and oxygen chemical potential. While the oxygen ionic conductivity of $La_{0.3}Sr_{0.7}Fe(Al)O_{3-\delta}$ slightly increase on reducing $p(O_2)$, doping with Cr suppresses this dependence. The average thermal expansion coefficients of $La_{0.3}Sr_{0.7}Fe_{1-x-y}Al_xCr_yO_{3-\delta}$ ceramics, calculated from dilatometric data in air, are the in range $(12.1\text{-}13.1) \times 10^{-6}$ K^{-1} at 350-800 K and increase up to $(20.9\text{-}27.4) \times 10^{-6}$ K^{-1} at 800-1300 K.