EFFECT OF INDIUM SUBSTITUTION ON THE STRUCTURE OF $SrFeO_{3-\delta}$ AND ITS TRANSPORT PROPERTIES

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Materials based on $SrFeO_{3-\delta}$ are promising candidates for cathodes in solid oxide fuel cells and oxygen-permeable membranes. However, undoped $SrFeO_{3-\delta}$ exhibits a high thermal expansion coefficient and is prone to phase transformations in a reducing atmosphere, which limits its practical application. The introduction of dopants into the B-sublattice enables control over structural stability, oxygen nonstoichiometry, and transport properties. This approach is realized in the present work by substituting $Fe^{3+/4+}$ with In^{3+} and studying its effect on these characteristics.

Samples with the formula $SrFe_{1-x}In_xO_{3-\delta}$ (x = 0.00–0.35) were synthesized using a sol-gel method with citric acid, followed by annealing at 1100 °C and sintering at 1190 °C. The phase composition of the samples was studied by X-ray diffraction with Rietveld refinement. The homogeneity range is within $0.0 \leq x \leq 0.30$. The samples with an indium content of x = 0.05–0.30 crystallize in a cubic perovskite cell (space group *Pm*-3*m*), whereas the base $SrFeO_{3-\delta}$ composition possesses an orthorhombic structure (space group *Cmmm*). Cubic symmetry can exist for the undoped composition, however, this modification is unstable under standard conditions. Thus, the introduction of indium stabilized the cubic structure of $SrFeO_{3-\delta}$ system. The unit cell parameter increases monotonically with increasing indium content in the samples, which is attributed both to the size effect from substituting $Fe^{3+/4+}$ ions with larger In^{3+} ions and to the accompanying decrease in the average oxidation state of iron.

Oxygen nonstoichiometry was determined using iodometric titration. Doping with In^{3+} leads to an increase in the concentration of oxygen vacancies at room temperature. Thermogravimetric measurements revealed that the release of oxygen from the crystal lattice begins at 300 °C, with samples containing high indium content exhibiting a lower oxygen loss upon heating. Thermal expansion was measured using high-temperature dilatometry. The temperature dependences of relative elongation are nonlinear.

Electrical conductivity measurements were carried out using the four-probe DC method in a controlled atmosphere (pO_2 = 0.5–10^{-20} atm) in the temperature range 750–950 °C. The samples are characterized by mixed ionic-electronic conductivity throughout the entire temperature range studied. The maximum ionic conductivity value is observed for the composition x = 0.05. Upon further increase in indium content, the ionic conductivity decreases, which may be attributed to ordering of the crystal structure and partial blocking of the migration pathways for O^{2-} ions.

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