Perovskite mixed-conducting $La_{0.6}Sr_{0.4}M_{0.3}Fe_{0.7}O_{3-\delta}$(M=Co,Ti) oxides for air separation

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Oxygen-deficiency perovskite oxides are of interest for practical applications as oxygen-permeable membranes for oxygen separation due to their high mobility of oxygen vacancies at high temperatures (> 700 ℃), and as membrane reactors for the partial oxidation of light hydrocarbons. In this work, the perovskite $La_{0.6}Sr_{0.4}M_{0.3}Fe_{0.7}O_{3-\delta}$ (M = Co, Ti) powders have been synthesized by the citrate method. The structural and chemical stability of $La_{0.6}Sr_{0.4}M_{0.3}Fe_{0.7}O_{3-\delta}$ (M = Co, Ti) oxides were studied by x-ray diffraction, differential scanning calorimetry and thermogravimetric analysis techniques. The results demonstrate the chemical stability of $La_{0.6}Sr_{0.4}Ti_{0.3}Fe_{0.7}O_{3-\delta}$ oxide in H^2/He atmosphere is significantly improved compared to that of $La_{0.6}Sr_{0.4}Co_{0.3}Fe_{0.7}O_{3-\delta}$ oxide. The incorporation of $Ti^{3+/4+}$ ions in the perovskite can significantly stabilize the neighboring oxygen octahedral due to the stronger bonding strength, leading to the improved structural/chemical stability of $La_{0.6}Sr_{0.4}Ti_{0.3}Fe_{0.7}O_{3-\delta}$. In addition, the perovskite $La_{0.6}Sr_{0.4}M_{0.3}Fe_{0.7}O_{3-\delta}$ (M = Co, Ti) oxides possess much higher chemical stability in CO_2/He atmosphere than that of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ oxide, in which the perovskite structure is destroyed completely in a flowing CO_2-containing atmosphere.