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Improvement of oxygen permeability in cerium and yttrium doped perovskite-type ABO3-δ membranes

Numerous technical applications of perovskite-type (ABO3-δ) oxides exist, such as oxygen sensors, solid oxide fuel cells, oxidative coupling of methane, oxygen pumps, solar cells, hydrogen storage, and gas separation [1-6]. By appropriately partly replacing cations A and B, their characteristics can be controlled accurately. Cerium and zirconium-doped (BaSr)(Fe1-x-yCexZry)O3-δ (x = y= 0 –1.0) oxygen-permeable membranes were synthesized using an oxalate-based sol-gel route. In the case of cerium doping, Rietveld refinement shows the structural transformation from cubic (for x = 0) to orthorhombic (for x = 0.80 –1.0) via a mixture of these phases (for x = 0.10 –0.60). The amount of cubic phase decreases from 100% to 24% with cerium content (x) = 0 –0.60 and complete transformation to the orthorhombic phase occurred at x = 0.80. Perovskite-type (BaSr)(Fe1-xAx)O3-δ (A = Ce, Y) oxides exhibit a cubic phase and mixture of cubic and orthorhombic phases (space group Pm3m, Pmmm) for x = 0 - 0.10 and x > 0.10, respectively. Raman and photoluminescence spectra display excellent features. The oxygen permeability (Jo2) of the disc membrane lies in the range of ~ 1.474 –2.204 ml/cm2.min at 950 °C (Input feed air ~ 400 ml/ml, carrier argon gas ~ 40 ml/min) for cerium (x) = 0 - 1.0. Molecular simulation dynamics studies will be performed soon to find out its molecular interaction with oxygen. These findings suggest applications in the oxygen separation industry.

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