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Ionic conductivity of electric field-assisted sintered gadolinia-doped ceria/alkali salts membranes

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Ceramic-carbonate dual-phase membranes were prepared according to the usual procedure: by vacuum impregnation of molten sodium-lithium carbonates (NLC) into sintered porous ceria-20 mol% gadolinia (20GDC) solid electrolyte cylindrical pellets; and also by flash sintering samples with 75 wt.% (CeO_2: 20 mol% Gd_2O_3) and 25 wt.% NLC. Sintering was accomplished by applying 200 V cm^{-1} to the membrane positioned in a sample holder of a dilatometer for monitoring thickness shrinkage, limiting the electrical current to 1 A. Electrochemical impedance spectroscopy measurements were performed in the 5 Hz-13 MHz frequency range from 300°C to 600°C in composite ceramic membranes, covering the solid-to-molten NLC temperature range. Analysis of the impedance diagrams allowed for the evaluation of the oxide ion and carbon dioxide ion conductivities. The Arrhenius plots showed the transition from oxide ion conduction (due to the solid electrolyte) to carbonate ion conduction (due to the molten NLC). The ionic conductivity values of membranes flash sintered at 420°C in 2 min were higher than those of conventionally sintered membranes and similar to reported values of membranes sintered at 690°C for 2 h.