Oxygen permeation in thin, dense Ce0.9Gd0.1O 1.95- membranes I. Model study

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A model of a supported planar Ce0.9Gd0.1O 1.95-δ oxygen membrane in a plug-flow setup was constructed and a sensitivity analysis of its performance under varying operating conditions and membrane parameters was performed. The model takes into account the driving force losses at the catalysts at the feed and permeate side of the membrane, related to the gaseous oxygen reduction and fuel oxidation, respectively, as well as the gas conversion and gas diffusion resistances in the porous support structure at the permeate side. The temperature and oxygen activity dependence of the oxide ionic and electronic conductivity and the oxygen nonstoichiometry of Ce0.9Gd0.1O1.95-δ were described based on literature data. The performance of the membrane was characterised by the delivered oxygen flux and the membrane voltage. The dependence of the performance on the various membrane and operating parameters was analyzed by a separation of the various losses. The chemical expansion of Ce 0.9Gd0.1O1.95-δ under operation was estimated from the calculated oxygen activity and nonstoichiometry profiles inside the membrane. © 2011 The Electrochemical Society.

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