Enhanced reducibility and electronic conductivity of Nb or W doped Ce0.9Gd0.1O1.95 - δ -

The transport and thermomechanical properties of acceptor (Gd) and donor (Nb or W) co-doped ceria were investigated. The solubility limit of Nb in Ce0.9Gd0.1O2 - δ (CGO10) exceeds 4 at.%, whereas that of W is approximately 2 at.%. Both the thermal and stoichiometric expansion coefficients are decreased relative to that of CGO10. Charge compensation of the donor dopants takes place primarily by annihilation of oxide ion vacancies, and a sharp decrease in ionic mobility is observed upon Nb or W doping of CGO10. On the other hand, the n-type electronic conductivity, associated with the reduction of Ce4+, increases upon doping with Nb or W, due to enhanced reducibility of cerium. This is beneficial for applications where electronic conductivity is also required, like oxygen permeation membranes. Modeling shows that 4 at.% Nb or W doped CGO10 will deliver higher oxygen fluxes than CGO10, due to the enhanced electronic conductivity and despite the reduced ionic conductivity.