Abstract

Oxygen separation from air by ionic conducting ceramic membranes is considered as a unique energy-saving alternative to conventional cryogenic distillation or pressure swing adsorption. Ceramic membrane technology offers higher energy efficiency as well as a smaller environmental footprint. However, large scale introduction of currenly developing ceramic oxygen separation membranes is stalled because of high operating temperatures, typically >800°C. This address this problem new, thin-film, dense, bicpercolative membranes are investigated to obtain fully selective O_2 transport at operating temperatures of 300…500°C.

In the work presented, supported thin films of dense bipercolative platinum/GDC (Gd_2O_3-doped CeO_2) are investigated for their potential as oxygen separation membrane. A <200 nm thick mesoporous GDC membrane is deposited on porous a-Al_2O_3 supports followed by electroless deposition of platinum. The electroless deposition ensures the formation of a dense percolative platinum/GDC dual-phase structure. O_2 is transported though the membrane as a combination of electrons and O^{2-} ions. The electrons migrate in the metallic, Pt, phase; O^{2-} in the GDC electrolyte phase.. It is demonstrated that such structures exhibit fully selective O_2 transport as temperatures as low as 200°C. The highest O_2 permeance observed thus far is 7.6×10^{-8} mol/(m^2·s·Pa) 500°C with an air feed and He sweep at balanced pressured of 1 Bar. The is similar to what is obtained for state-of-art inorganic dense O_2 membranes at >800°C. In the presentation aspects of support and membrane synthesis, membrane thickness characterization by spectroscopic ellipsometry and SEM cross-sections, and transport characterization will be discussed.