

ABSTRACT

Improving the ionic conductivity of Samarium doped cerium oxide electrolyte at low temperature is essential to enhance the performance of solid oxide fuel cell (SOFC). Lower grain boundary resistance and higher densification of the electrolyte at low temperature is of paramount importance for achieving good performance. This thesis reports different strategies to engineer the grain boundary for enhanced oxygen ionic conductivity. Enhancing the oxygen vacancy concentration and lowering the space charge potential at the grain boundary enables faster ionic migration. The addition of both sintering aid and scavenger together influences the grain and grain boundary conductivity to a great extent. Reactive sintering of the co-dopants during sintering can provide liquid phase to densify and enhance ionic conduction. Modification of ionic conduction by doping alkaline earth metals (Mg^{2+} , Ca^{2+} , Sr^{2+} and Ba^{2+}) of different ionic radii results in high grain boundary conductivity by enhancing the oxygen vacancy concentration and lowered space charge potential. Increasing oxygen vacancy beyond optimum level is deleterious ionic conduction due to the association of oxygen vacancy defects. Increase in configurational entropy in the lattice by doping different dopants suppress the oxygen vacancy ordering. Synergistic effect of sintering aid and scavenger enhances the low temperature densification and configurational entropy which in turn increase the oxide ion conduction. An overall optimization of dopants concentration, ionic radii and sintering temperature significantly improved the efficiency of grain boundary scavenging for the realization of potential solid oxide fuel cell.