World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:10, No:05, 2016

Development of LSM/YSZ Composite Anode Materials for Solid Oxide Electrolysis Cells

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Abstract : Solid oxide electrolysis cell (SOEC) is a promising technology for hydrogen production that will contribute to the sustainable energy of the future. An important component of this SOEC is the anode material and one of the promising anode material for such application is the Sr-doped LaMnO3 (LSM) and Yttrium-stabilized ZrO2 (YSZ) composite material. In this study, LSM/YSZ with different weight percent compositions of LSM and YSZ were synthesized using solid-state reaction method. The obtained samples, 60LSM/40YSZ, 50LSM/50YSZ, and 40LSM/60YSZ, were fully characterized for its microstructure using X-ray diffraction, FTIR, and SEM/EDS. EDS analysis confirmed the elemental composition and distribution of the synthesized samples. Surface morphology of the sample using SEM exhibited a well sintered and densified samples and revealed a beveled cube-like LSM morphology while the YSZ phase appeared to have a sphere-like microstructure. Density measurements using Archimedes principle showed relative densities greater than 90%. In addition, AC impedance measurement of the synthesized samples have been investigated at intermediate temperature range (400-700 °C) in an inert and oxygen gas flow environment. At pure states, LSM exhibited a high electronic conductivity while YSZ demonstrated an ionic conductivity of 3.25 x 10-4 S/cm at 700 °C under Oxygen gas environment with calculated activation energy of 0.85eV. The composite samples were also studied and revealed that as the YSZ content of the composite electrode increases, the total conductivity decreases.

Keywords : ceramic composites, fuel cells, strontium lanthanum manganite, yttria partially-stabilized zirconia
Conference Title : ICCMME 2016 : International Conference on Composite Materials and Materials Engineering
Conference Location : Tokyo, Japan
Conference Dates : May 26-27, 2016