WPI MANUFACTURING ENGINEERING

PhD Proposal

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HL 102

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Thermodynamics Investigation into Chemical Stability of (La,Sr)CrxFe1-xO3-δ and Dual-Phase (La,Sr)CrxFe1-xO3-δ/ stabilized Zirconia for Oxygen Transport Membranes

Abstract:

Ceramics oxides with mixed ionic and electronic conductivity have received a lot of attention due to their wide range of applications in solid oxide fuel cell, interconnects, gas sensors, and ion transport membranes. However, owing to harsh operating conditions, the choice of proper materials and engineering their properties are still challenging. Perovskite and fluorite structures are two promising structures for ceramic membrane applications. The objective of this research is to explore stability of lanthanum chromite-based perovskite (LaSrCrFeO3-δ) and stabilized) as single phases and dual-phase composites with fluorite phase under fabrication and operating conditions of Oxygen Transport Membranes (OTM).

The current research has been categorized into two sections: structural and chemical stability of perovskite phase and dual-phase perovskite/fluorite composite. Also, investigation on the both categories have been conducted with two separate approaches: experimental examinations and computational thermodynamics. In the computational part, independent approaches have been considered for the single-phase perovskite and dual-phase perovskite/fluorite composites. In the experimental section, the bulk chemical stability of the dual-phase samples has been examined under controlling oxygen partial pressure p(O2) atmospheres at 1400°C for 10 hours with slow and fast cooling rates. In addition, the phase stability of the perovskite structures as a single phase has been also examined under OTM fabrication conditions.

Defect chemistry and chemical stability of single-phase perovskites and dual-phase composites have been studied and modelled through using computational methods and thermal analysis data.