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Dense Membranes for Anode Supported all Perovskite IT-SOFCs

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The intent of the project is to develop inexpensive oxygen permeable, dense and high surface area membranes in the form of bulk and highly oriented thin films using soft solution chemical routes and pulsed laser deposition (PLD) technique for fabricating natural gas fuelled anode supported all perovskite based intermediate temperature (IT)-**SOFCs** with planar architecture.

This project at Southern University is three months old and to begin with we are optimizing various synthesis routes to obtain both regular perovskites (like $LaCrO_3$ and $La_{1-x}Sr_xCoO_3$ which find application as an interconnector and electrode respectively) and layered perovskites (like $La_2NiO_{4+\delta}$) with reduced dimensionality. Conventional methods of preparation of perovskite type oxides include ceramic solid state, hydrothermal, co-precipitation, alkoxide sol-gel and aqueous organic gel routes. $LaCrO_3$ prepared from such routes is often nonstoichiometric and (or) multiphasic. It has not been possible to obtain highly sintered $LaCrO_3$ derived from these routes. The maximum density obtained is generally between 92-94% of theoretical density. Prolonged heating at high temperatures to enable sintering results in grain coarsening and loss of CrO_3 under oxidizing conditions. Thus, the presently available general methods for the synthesis of $LaCrO_3$ and $La_{1-x}Sr_xCoO_3$ have severe limitations.

We have successfully prepared these materials in a very short time (10-15 minutes) by subjecting sol-gel generated amorphous precursors to microwaves of 2.45 GHz in a multimode microwave oven coupled with suitable microwave susceptors. No apparent loss of CrO_3 has been observed for $LaCrO_3$. $La_{1-x}Sr_xCoO_3$ have also been prepared by chelated complex-based precursor technique and their properties have been compared with those obtained from the microwave route. Simultaneously, we are also synthesizing nano scale electrolytes with high ionic conductivity (higher than 10^{-2}S cm^{-1}) over a wide range of temperature and oxygen pressure and low electronic conductivity using regenerative sol-gel synthesis.

The combined approach of sol-gel and microwave processing is unique because it is simple, rapid, energy efficient and yields materials of excellent phase purity with good densification. In this poster, we will discuss the relative merits of various synthetic methods in comparison with the proposed microwave synthesis route and report the XRD, SEM, HRTEM, and Conductivity measurements of $LaCrO_3$ and $La_{1-x}Sr_xCoO_3$.