

Fabrication of new LSCF infiltrated BSCF material to increase electrochemical performance of fuel cells

Takin Ghavimi

School of Metallurgical and Materials Engineering, College of Engineering, University of Tehran, Tehran, Iran

INTRODUCTION

A solid oxide fuel cell (SOFC) is an electrochemical conversion device that produces electricity directly from fuels. These fuel cells are comprised of ceramic electrolytes that can provide high efficiency in performance, fuel flexibility and overall low cost of the system [1]. The main disadvantage of these systems is the high operation temperature, which can result in (1) formation of an insulating layer, caused by reaction between electrode and electrolyte materials, (2) the necessity of using high cost interconnecting materials such as LsCrO_3 and (3) possibility of crack formation caused by thermal coefficient mismatch between the electrode and electrolyte materials [2]. As is shown in literature, material characteristics in general can be modified using different thermal and environmental treatments and before and after fabrication and synthesis [3-10]. In our work, we investigate modification methods to reduce the operating temperature of SOFCs without sacrificing the system performance through fabrication of a new solution infiltrated $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ (BSCF) cathode, employing the two most effective cathode materials BSCF ($\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$) and LSCF ($\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{0.2}\text{Fe}_{0.8}\text{O}_{3-\delta}$).

METHODS

Ceramics were synthesized using co-precipitation method at precipitation pH of at least 8 and a calcination temperature of 1000°C . The structure of synthesized ceramics is studied using X-ray diffraction (Philips PW-1730).

RESULTS

BSCF has the advantage of high ionic conductivity due to its high concentration of oxygen vacancies, enabling it to easily permit the diffusion of oxygen ions while LSCF is known to possess significantly higher electronic conductivity as well as better performance at operating temperatures of below 750°C [11,12]. We aim to achieve both characteristics of the individual components. To produce the infiltrated BSCF, we first used our developed method of co-precipitation synthesis, which was followed by structure analysis using X-ray Diffraction (XRD).

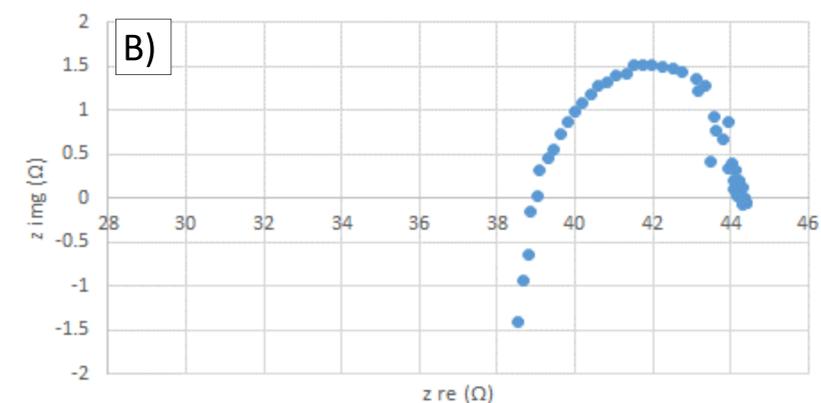
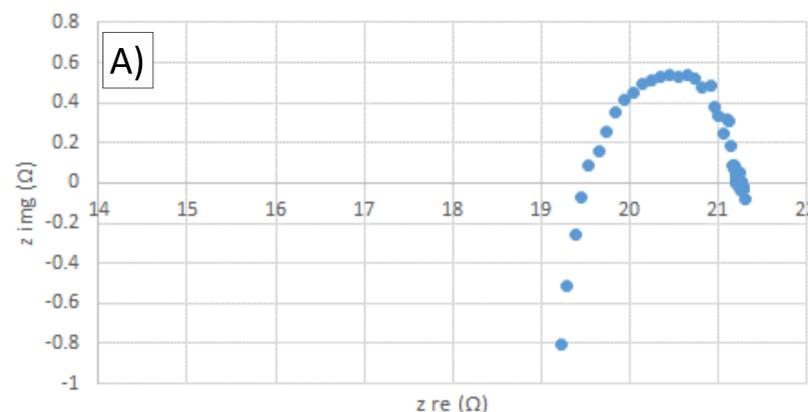


Fig.1. Impedance spectra of (A) BSCF infiltrated LSCF and (B) LSCF at 600°C shows lower resistance and therefore higher electronic conductivity in BSCF/LSCF

The synthesized powders were then used to fabricate electrochemical half cells. These cells were infiltrated with a nitrate solution of LSCF and calcined at 1000°C for 5 hours to permit the LSCF to crystallize. The electrochemical performance of the half cells was then evaluated. Our results show the cells with infiltrated BSCF electrode possess higher electronic conductivity than those with pure BSCF electrodes.

CONCLUSIONS

The results of this investigation can be used in fabrication of fuel cells capable of operating in lower temperatures, which can reduce the overall costs of obtaining electricity and increase the performance efficiency.