XRD and EDS Analysis of Composite Cathode Powders LSCF-SDCC-Ag for Low Temperature Solid Oxide Fuel Cells (LTSOFC)

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Abstract

X-ray diffraction (XRD) and energy dispersion spectroscopy (EDS) analysis has been conducted on composite cathode powder LSCF-SDCC-Ag. Composite cathode powder LSCF-SDCC has been produced via wet milling method, calcined at 750°C then press become pellets and sintered at 500, 550 and 600°C. There are no other secondary constituent exist detected by XRD sensitivity. EDS analysis shows that LSCF-SDCC-Ag has uniform distribution of elements. From EDS analysis, wet milling method able to produce composite cathode LSCF-SDCC-Ag with uniform distribution of elements and there are no secondary constituent detected via XRD sensitivity.

Introduction

Lowering the SOFC's operational temperature has lead to performance decline of SOFC systems. Research has been embarked to enhance the performance of low temperature SOFC (LTSOFC) during the low operational temperature.

Development of cathode elements was one of the key in enhancing the LTSOFC performance. In this paper, perovskite-type $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF6428) also a type of mixed ionic-electronic conductor material (MIEC) are combined with samarium doped cerium carbonated SDCC forming composite cathode powder LSCF-SDCC then acted as the cathode materials of LTSOFC [2]. Ag was added acting as conducting material in increasing the electrical conductivity of cathode elements [3]. The influence of wet milling method to the powder characteristics of composite cathode LSCF-SDCC-Ag was the investigate in this paper. The homogeneity of powder distribution of each element was analyzed using EDS mapping while the phase purity was confirmed via XRD analysis.

Method

A mixture of SDC nanopowder and carbonates was prepared in producing SDCC powder [3]. The SDC, Li_2CO_3 and Na_2CO_3 powder were ball-milled for 24 hours and dried overnight in oven then heat-treated at 680°C.

Next, commercial LSCF powder was mixed with SDCC (50:50 (wt.%)) using via wet milling techniques ball-milled in propanol medium. The resultant powder produced were then grinded using agate mortar and calcined in furnace at 750°C. Ag powder was added via dry mixing method of 100 rpm with amount of 1, 2, 3, 4 and 5 wt%. The resultant powder then press become pellets and sintered at 500, 550 and 600°C

The compositions of each element exist in LSCF-SDCC powders before and after calcined were analyzed using scanning electron microscopy-EDS mapping (SEM-EDS mapping) (JEOL-JSM 7600F, Japan).

The XRD analysis was conducted to analysed the phase purity of composite cathode LSCF-SDCC-Ag.

Results

Fig. 1 shows the EDS mapping of composite cathode powder LSCF-SDCC-Ag with Ag amount of 2 wt%.

Fig. 2 shows XRD patterns of composite cathode LSCF-SDCC and LSCF-SDCC-Ag (1-5 wt%) before sinter and Fig 3 shows XRD patterns of composite cathode LSCF-SDCC and LSCF-SDCC-Ag (1-5 wt%) after sinter at 550°C.

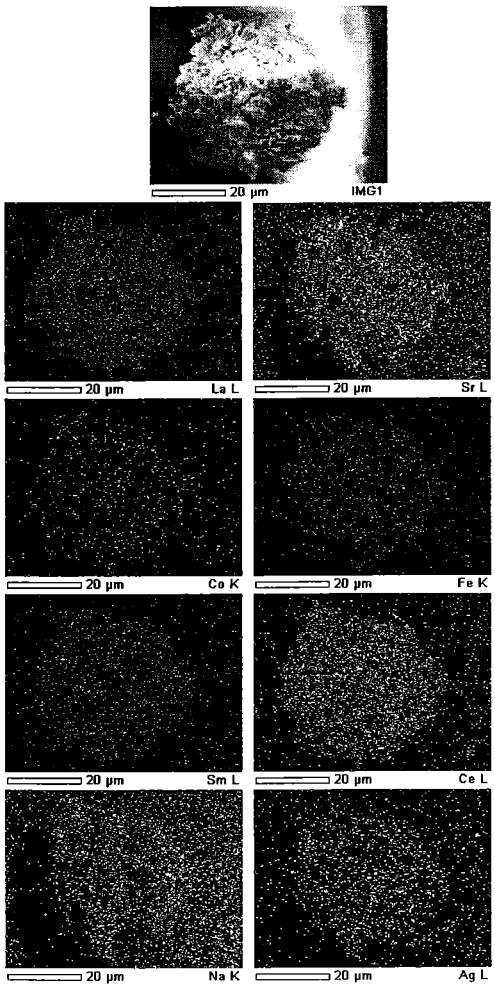

Fig.1: EDS mapping of composite cathode powder LSCF-SDCC-Ag with Ag amount of 2 wt%

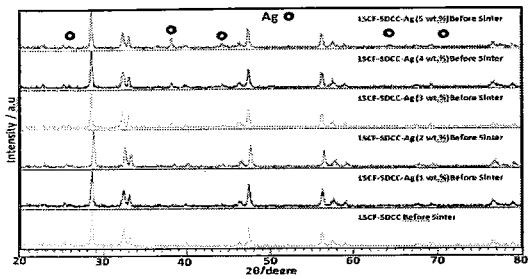

Fig. 2: shows XRD patterns of composite cathode LSCF-SDCC and LSCF-SDCC-Ag (1-5 wt%) before sinter.

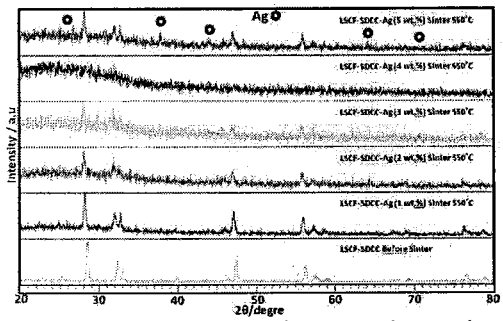

Fig. 3: XRD patterns of composite cathode LSCF-SDCC and LSCF-SDCC-Ag (1-5 wt%) after sinter at 550°C.

Conclusion

Composite cathodes powders LSCF-SDCC-Ag produce via wet milling method were developed. Composite cathode powders LSCF-SDCC-Ag before and after calcined able to maintain the phase purity since there are no remarkable secondary constituent detected via XRD analysis. EDS mapping shows that all the elements were distribute uniformly via wet milling method provide better composite powder for LTSOFC cathode materials.

References

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