Electrical property and electrode performance of brownmillerite oxide anode reaction active promoters for IT-SOFC anode

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Abstract

It has been found that the addition of $Ba_2In_2O_5$ (BIO) promoter to the anode layer of SOFC improves the electrode performance. In this study, we attempted to increase the formation of active sites by using infiltration method to add BIO uniformly and widely for further performance improvement. SEM observation confirmed the adhesion of particles that appeared to be BIO. XPS surface analysis showed that the peaks of Ba and In increased as the number of infiltrations increased, suggesting increased active site formation.

1.Introduction

Cermet materials consisting of Ni and 8% mol of Y_2O_3 stabilized ZrO_2 (8YSZ) are widely used as anodes in solid oxide batteries. Cermet materials are widely used as anodes in solid oxide fuel cells (SOFCs). Recently, it has been reported that the addition of an auxiliary catalyst to this anode improves the electrode performance.[1)] This promoter is based on $Ba_2In_2O_5$ (BIO). This indicates that BIO is expected to activate the anodic reaction. In order to further improve the electrode performance, it is necessary to add the promoter uniformly and widely into the anode layer. To find the best addition method of promoter may lead to further improvement of electrode performance. In this study, we attempted to increase the formation of active sites and improve the performance.

2.Experimental

The SOFC single cell was made by screen printing the anode and cathode materials on both sides of a YSZ solid electrolyte disk. For the cermet anode material, nickel oxide-and 8YSZ powder were mixed in a mass ratio of NiO : 8YSZ = 4:1. This anode slurry was printed on the electrolyte pellets in five times repetitions. The coated material was subjected to the first calcined at 1000°C-1h. With stirring, the solution was impregnated for 0.5h under reduced pressure and dried at 700°C for 5 and 10 times. After infiltration, calcined was at 1300°C for 1h, followed by reduction treatment at 800°C for 2h under H_2 gas atmosphere. SEM observation

was carried out to confirm the presence of BIO components. The cross-section of the anode cell was observed. In addition, XPS surface analysis was performed to clarify the existence of BIO.

3. Results and discussion

3.1 SEM

High-magnification SEM observations of anode layer cross sections for 0 and 10 times infiltrations samples are shown in Fig. 1. Large particles are expected to be Ni and angular particles are expected to be 8YSZ. In 10 times infiltration, fine particles were observed. We consider these to be particles of BIO components.

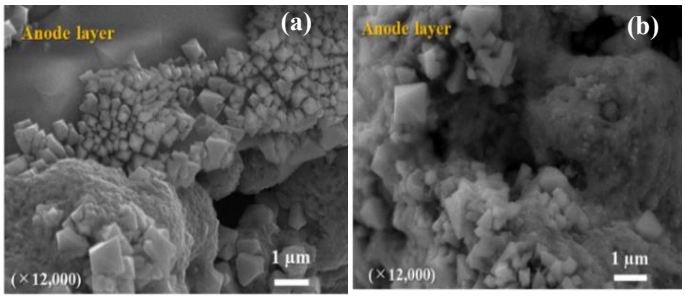

Fig. 1 SEM results (a) 0 time (b) 10 times

3.2 XPS surface analysis

XPS results of 0, 5 and 10 times infiltration is shown in Fig. 2. As the number of infiltrations increases, the peaks of Ba and In increase. It can be concluded that the infiltration condition of the anode layer in the SOFC single cell is sufficient because the cell is impregnated with BIO.

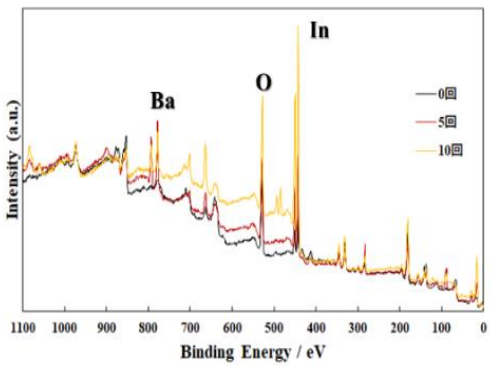

Fig. 2 XPS surface analysis results

4. Conclusions

From SEM observation results, small particles were observed after 10 times of infiltration. In addition, indicating that $Ba_2In_2O_5$ was impregnated into the SOFC single cell from XPS results. In the future, we plan to evaluate the electrode performance by the current interruption method and characterize the active site formation using XPS and defect structure simulation.

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References

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