Property of Ni-SDC Anodes for SOFC with H_2 and NH_3 Fuels

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Solid oxide fuel cells (SOFCs) are expected to be the next-gen distributed power generator because of their high-energy conversion efficiency and high fuel adjustability. Ni-cermets are commonly used for anode material, because of its high stability and low cost. SDC($Sm_{0.2}Ce_{0.8}O_{1.9}$) has a higher ionic conductivity compared to YSZ and also has a high electronic conductivity in a reducing atmosphere [1]. In fact, the higher anodic performance of Ni-SDC has been reported so far [2]. In this study, the Ni-SDC anodes were examined for H_2 and NH_3 fuels in SOFC.

Ni (x in wt%)-SDC (x=0, 10, 20, 30, 40, and 50) samples were synthesized in the reverse co-precipitation method with aqueous ammonia (ammonia co-precipitation method). and oxalic acid (oxalate co-precipitation method) using stoichiometric molar ratio of $Ni(NO_3)_2 \cdot 6H_2O$, $Sm(NO_3)_3 \cdot 6H_2O$, and $Ce(NO_3)_3 \cdot 6H_2O$. The precursor was calcined at 900 ^oC. The prepared Ni-SDC powders were deposited on $(ScO_{1.5})_{0.20}(CeO_2)_{0.01}(ZrO_2)_{0.79}$ (ScCSZ) electrolyte disk by means of electrophoretic deposition technique. The deposited film was sintered at 900 ^oC in air. Pt counter electrode was formed on the opposite side of the electrolyte disk. As a reference electrode, Pt wire was attached to cathode electrode. The three terminal cells were tested at 900^oC in H_2 (97%H_2+3%H_2O) and NH_3 fuels (6.5%NH_3/Ar).

Fig.1 shows maximum power densities (MPDs) of Ni(x)-SDCs prepared by the ammonia reverse co-precipitation method at 900^oC. Both in H_2 and NH_3 the Ni-loading did not significantly affect MPD value and 50wt% Ni-loading reduced the MPD value.

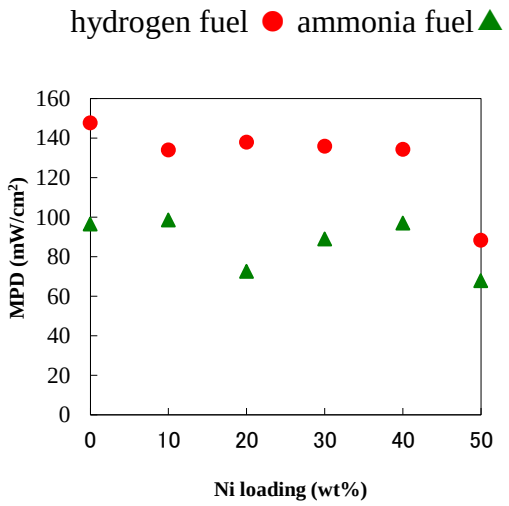

Fig. 1 MPD of Ni(x)-SDC prepared by ammonia co-precipitation method

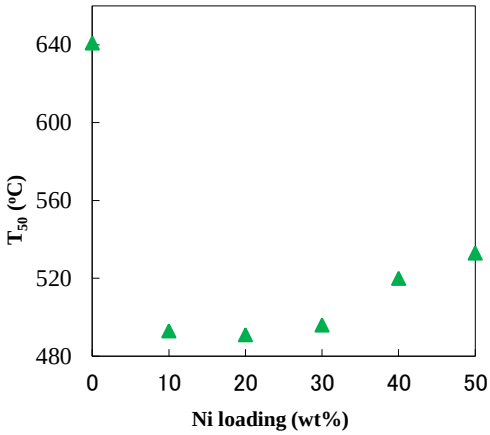

Fig. 2 Catalytic activities of Ni(x)-SDC prepared by ammonia co-precipitation method

Figure 2 shows the dependence of the loading amount of Ni on the catalytic activity (T_{50}: the temperature showing 50%-conversion) of Ni(x)-SDC prepared by the ammonia co-precipitation method. In NH_3 fuel, the low loading amount of Ni provided high catalytic activity. However, the difference of the catalytic activity is not a decisive factor of MPD at 900 ^oC.

We investigated the electrical properties and catalytic activities of Ni-SDC prepared by the oxalate co-precipitation method.

REFERENCES

[1] M. Asamoto, S. Miyake, A. Saito, H. Yamaura, H. Yahiro, Y. Itagaki, Y. Sadaoka, ECS Trans., 7 (2007) 1711.
[2] M. Asamoto, S. Miyake, Y. Itagaki, Y. Sadaoka, H. Yahiro, Catal. Today 139 (2008) 71.