HIGH PERFORMANCE CELL DEVELOPMENT USING SCANDIA DOPED ZIRCONIA ELECTROLYTE FOR LOW TEMPERATURE OPERATING

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The Sc_2O_3-ZrO_2 system with has higher electrical conductivity compared to the Y_2O_3-ZrO_2 system was examined in term of electrolyte components of the planar type SOFC. From the viewpoint of cost reduction and long term durability, the operation of SOFC at a low temperature is very attractive. To operate at a lower temperature, SOFC should have the following properties; [1] the electrolyte with high electrical conductivity and [2] thin electrolyte with high mechanical reliability [3] the new electrode material with higher activity compared to conventional material.

First, we changed the amount of Sc_2O_3 dopant. The bending strength measured by the three-point bending at room temperature as well as the electrical conductivity measured at 1000 °C is shown in **Fig. 1**. 3-4ScSZ shows the highest bending strength, because it had almost 100 % tetragonal phase. With increasing Sc_2O_3 dopant concentration, the bending strength decreased. On the other hand, the electrical conductivity increases with Sc_2O_3 dopant concentration. These results suggest that the cubic phase increases together with the Sc_2O_3 dopant concentration. To reduce the operating temperature, the conductivity needs to be higher than that of 4ScSZ, whereas to maintain reliability of the cell, the high value of bending strength is required. To consider the above result, the Sc_2O_3 dopant concentration seemed to be appropriate at 6 mol% in this system. **Fig. 2** shows *i-V* and *i-P* characteristics for 4ScSZ and 6ScSZ at 800 °C, using thick 140 μm electrolytes and LSM cathode, respectively. For the cell using 6ScSZ electrolyte, power density is approximately 0.6 W / cm^2 at 0.6 V. The value of area resistance calculated by *i-V* curve, is 0.48 Ωcm2 which is 75 % lower than in 4ScSZ.

Second, we changed the cell structure from electrolyte supported cell to anode supported cell. **Fig. 3** shows *i-V* and *i-P* characteristics for anode supported cells at 800 °C, using LSM LSCF cathodes. For the cell with LSM, the maximum power density is approximately 1.5 W / cm^2 (4 times as high as that for the 4ScSZ / LSM electrolyte supported cell), Be cause the *IR* drop is decreased since the electrolyte is 11ScSZ (with 3 times conductivity as high as that for 4ScSZ, and 1 / 7 as thick as in conventional electrolyte supported cells). Futhermore, we changed the cathode composition from $La_{0.8}Sr_{0.2}MnO_3$ (LSM) to $La_{0.8}Sr_{0.2}Co_{0.2}Fe_{0.8}O_3$ (LSCF), the power density approaches 2.4 W / cm^2 for the cell using LSCF (since cathode activation is increased).

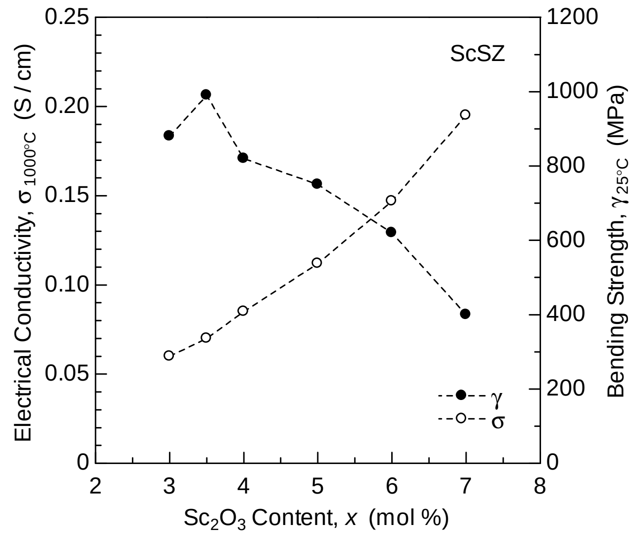

Fig. 1 Change of electrical conductivity and bending strength against Sc_2O_3 concentration.

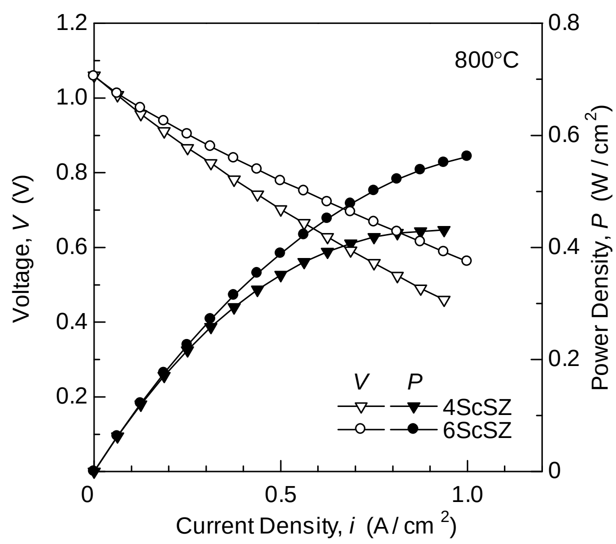

Fig. 2 Effect of ScSZ dopant concentration on *i-V* and *i-P* characteristics of electrolyte- supported cell.

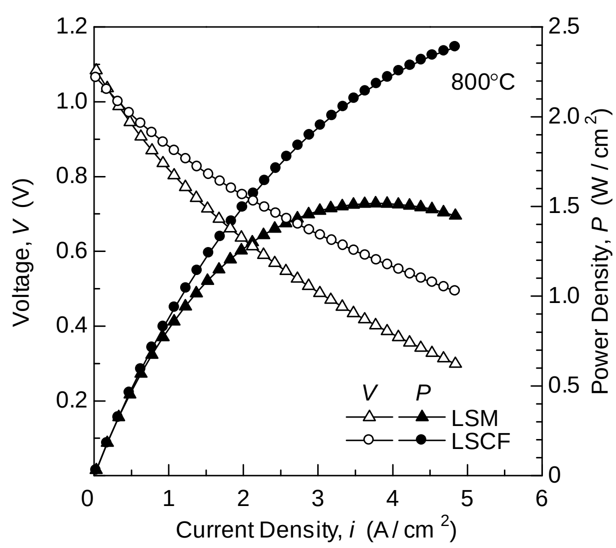

Fig. 3 Effect of cathode on *i-V* and *i-P* characteristics of anode- supported cell.