Synthesis of Composite Particles for SOFC Anodes by Spray Pyrolysis and the Intermediate Temperature Cell Performance

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The operation of solid oxide fuel cells (SOFCs) at intermediate temperatures between 600˚C and 800˚C gives some advantages (*i.e.* extensive selection of low-cost and high performance component materials, high flexibility of SOFC structure *etc.*). Since lowering the operation temperature increase not only the ohmic loss but also the polarization loss at the anode and the cathode, it is necessary to develop highly active electrodes that show sufficiently low polarization at intermediate temperatures. We have developed Ni-$Ce_{0.8}Sm_{0.2}O_{1.9}$(SDC) cermet anode that shows high cell performance at temperatures below 800˚C, by using highly dispersed NiO-SDC composite particles synthesized by spray pyrolysis method. The synthetic conditions of the NiO-SDC composite particles, however, should be investigated further to realize the optimized anode property.

We synthesized NiO-SDC composite particles using the starting solutions containing the components for NiO-SDC and various amounts of nitric acid. Fig.1 shows the relationship between pH values of the solutions and the amounts of nitric acid(60 wt%) in the 500ml starting solutions for spray pyrolysis synthesis of NiO-SDC. It was found that the particles had different morphology, specific surface area, and particle density, depending on the pH values of the starting solutions. The particles were printed onto the lanthanum gallate-based electrolyte and sintered, followed by reduction of NiO to Ni to give porous Ni-SDC cermet anode. Fig.2 shows the variation of SOFC power density (0.3 A/cm^2, 750˚C) with the amounts of the addition of nitric acid. Fig.3 shows the relationship between the voltage loss of SOFC and the amounts of nitric acid. These results revealed that the high and consistent cell performance was obtained when the particles were synthesized using the solutions with low pH values (pH values < 0.5). This behavior is considered to be related to the difference of the property of NiO-SDC composite particles.

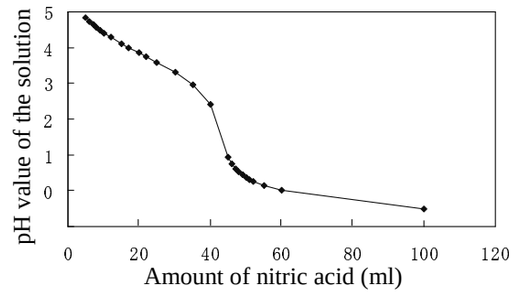

Fig.1 The relationship between pH values of the starting solutions and the amounts of nitric acid in the starting solutions for spray pyrolysis of NiO-SDC.

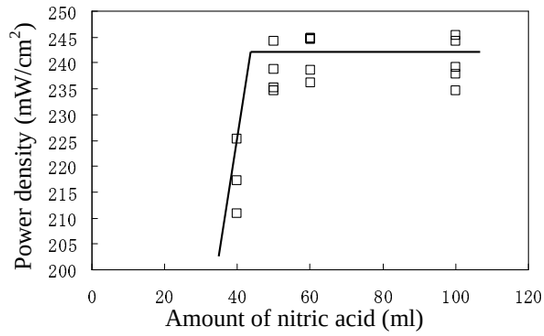

Fig.2 The relationship between SOFC power density (0.3 A/cm^2, 750˚C) and the amounts of nitric acid in the starting solutions.

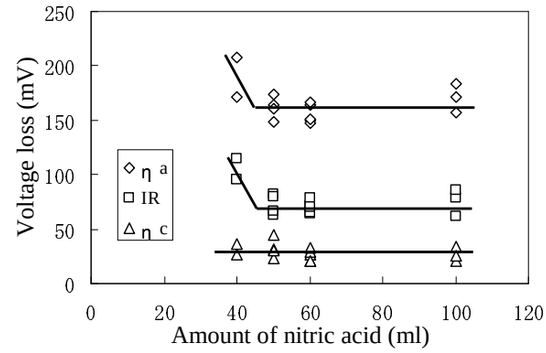

Fig.3 The relationship between the voltage loss of SOFC (IR: ohmic loss, η_a: anodic polarization, and η_c: cathodic polarization) with 0.3 A/cm^2 at 750˚C and the amounts of nitric acid.