CHAPTER IV

CONCLUSIONS

4.1 Conclusions

$Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$, $PrSrCoO_4$ and $PrSrNiO_4$ were synthesized by the sol gel and hydrothermal methods using various chelating agents. In case of $La_{0.7}Sr_{0.3}Ga_{0.7}Fe_{0.2}Mg_{0.1}O_{3-\delta}$ and $La_{0.8}Sr_{0.2}Ga_{0.8}Mg_{0.15}Co_{0.05}O_{3-\delta}$, their synthesized powders were accomplished by the hydrothermal method. In addition, LSGFM was achieved by using either citric acid or glycine combined with citric acid as a chelating agent. For the LSGCM, its chelating agent was citric acid.

XRD patterns of PSC and PSN revealed main phase of tetragonal K_2NiF_4–type whereas BSCF showed single phase with cubic ABO_3–type structure. Moreover, the crystallite sizes of perovskites synthesized by hydrothermal method were smaller than those obtained by the sol gel method. In case of LSGFM, the main phase of ABO_3 was shown when it was prepared with citric acid and glycine-citric acid chelating ligands. For LSGCM, the single phase was obtained by using citric acid as a chelating agent. However, the trace number of $SrLaGaO_4$ and unidentified peaks also appeared.

Morphology of the perovskite sintered discs were characterized by SEM. The particle sizes of perovskite powders synthesized by hydrothermal method were smaller and more homogeneous than those of the sol gel method. Particularly, H-BSCFs showed great reduction in both of crystallite and particle sizes. H-BSCF specimens synthesized by the hydrothermal method had many pores than those prepared with the sol gel method, because the powders obtained from the hydrothermal method were smaller than those of the sol gel method Thus, they would be fused together easily. The sintered disc of PSC showed crack-free and no porosity except H-PSC-G disc that had many pores. For PSN, its grain was in small spherical shape with many pores. In case of LSGFM and LSGCM, H-LSGFM-MC contained more uniform and smaller grains than H-LSGFM-GC. Additionally, LSGCM showed larger grain and higher density than LSGFM.

For all S-BSCF prepared with different chelating agents, its electrical conductivity represented semi–conducting behavior. The S-BSCF-EC showed the maximum conductivity of 61.2 S/cm whereas S-BSCF-H_5 exhibited the minimum conductivity of

47.2 S/cm at 550°C. However, the conductivity of H-BSCF specimens was lower than that of S-BSCF. Chelating agents had slightly effect on specific conductivity of PSC that also exhibited semi–conductor behavior. Moreover, H-PSC-G showed highest conductivity of 202.6 S/cm at 800°C. In case of PSN, it was revealed that the conductivity of PSN decreased with temperature, demonstrating that these oxides behaved as metallic materials. H-PSN-EC showed the maximum conductivity value of 854.5 S/cm at 27°C. For LSGFM and LSGCM materials, the maximum electrical conductivity of H-LSGFM-GC (0.32 S/cm at 800°C) was higher than that of H-LSGFM-MC (0.26 S/cm at 800°C) and H-LSGCM-MC exhibited the conductivity of 0.0246 S/cm at 800°C.

For thermal expansion results, the TEC values of BSCF prepared by the hydrothermal method were smaller than these of the sol gel method. TEC values of PSC were 19.7471(H-PSC-H_5) and 19.9749x10^{-6}(°C)$^{-1}$(H-PSC-H_5). In addition, PSN synthesized by hydrothermal method had small amount of oxygen loss in its structure, thus TEC values were small as 13.8377-11.8786x10^{-6}(°C)$^{-1}$(H-PSN-H_5) and 14.6297-12.1900x10^{-6}(°C)$^{-1}$(H-PSN-EC). In case of the TEC values of H-LSGFM-MC and H-LSGFM-GC, they were 14.1057-16.6132x10^{-6}(°C)$^{-1}$ and 14.6827-16.2688x10^{-6}(°C)$^{-1}$. However, H-LSGCM-MC had TEC value of 5.4556-14.0485x10^{-6}(°C)$^{-1}$. Thus, in term of starting material cost, LSGFM and LSGCM synthesized with nitrate or acetate as a starting material were worthwhile than those using oxide compounds.

In conclusion, S-BSCF-EC, H-PSC-G, H-PSN-EC, H-LSGFM-MC and H-LSGCM-MC are good candidates for SOFC materials.

4.2 Suggestion

From experiment results, the future work should be focused on the following:

1. To determine oxygen permeability of S-BSCF-EC, H-PSC-G, H-PSN-EC, H-LSGFM-MC and H-LSGCM-MC.
2. To study of the performance of S-BSCF-EC, H-PSC-G, H-PSN-EC, H-LSGFM-MC and H-LSGCM-MC specimens used as a cathode and electrolyte (for LSGFM-MC and H-LSGCM-MC) on the single cell.