CHAPTER VI

CONCLUSIONS AND SUGGESTION FOR FUTURE WORK

6.1 CONCLUSIONS

6.1.1 Effect of Metal Composition of Anode Catalyst

(a) From the investigation of the SmAlO catalysts in the SOFC reactor, the C_{2+} hydrocarbon and carbon monoxide were the major products, while the carbon dioxide was found at small amount of about 2-3%. The $Sm_{1.7}Al_{0.3}O_3$ showed the highest yield around 9.5% at $T = 1173$ K.

(b) The increase in the Al content resulted in the significant increase in the methane conversion and, on the contrary, the decrease in the C_{2+} selectivity.

(c) Dependence of the methane conversion on the Al content could be explained with the specific surface area. On the other hand, adding Al decreases the strength of basicity on the surface and, as a result, makes the catalyst less p-type conductive, thus reducing the C_{2+} selectivity.

(d) Nevertheless, the appropriate quantity of Al content ($Sm_{1.8}Al_{0.2}O_3$ and $Sm_{1.7}Al_{0.3}O_3$) could improve the C_{2+} formation a little at $T = 1173$ K and more apparently at $T = 1273$ K, it may be because the high basicity of the catalyst surface like Sm_2O_3 was poisoned readily to form a stable carbonate compound, and the Al content helped prevent the CO_2 poisoning.

(e) However, for all the SmAlO catalysts, the carbon decomposition compound was the major problem for operation like a general high temperature fuel cell. Further investigation needs to be carried out to understand and prevent it.

6.1.2 Effect of Operating Parameters

(a) The conversion increased significantly with the increasing temperature, while the C_{2+} selectivity decreased. However, at higher temperature, the incomplete combustion reaction was more favorable than the C_{2+} hydrocarbon formation, resulting in the markedly decrease in the C_{2+} yield.

(b) The increase in temperature caused the increase in voltage due to the change of reaction according to temperature, and the current increased when the temperature was increased, due to the less resistance of the YSZ and the anode catalyst.

(c) The methane conversion was decreased remarkably with increasing the methane composition, while the C_{2+} selectivity was slightly changed and CO was apparently decreased. The C_{2+} yield was decreased apparently with the increase of methane composition.

(d) The methane conversion decreased when gas flow rate was increased (or residence time was decreased), whereas the C_{2+} selectivity increased and the C_{2+} yield also increased gradually as increasing the gas flow rate. That was because the higher residence time (lower gas flow rate) resulted in the consecutive reforming reaction of methane with produced steam to form CO.

(e) The voltage was independent of the change of methane composition and gas flow rate (at more than 10 ml/min). The current decreased slightly as the methane composition was increased.

6.2 SUGGESTION FOR FUTURE WORK

From our study, it was found that a small amount of the second metal Al helps increase the methane conversion; however, the C_{2+} selectivity decreases. This resulted in a slight increase in the C_{2+} yield. A third metal might be added to improve the C_{2+} selectivity. It should be a metal that can increase the p-type conductive characteristic of the catalyst or can show less electronegativity. The alkali earth Sr and Ba have eletronegativity less than Sm and can resist the high temperature condition; therefore, they might improve the catalyst.

From the experimental results, the Al content can increase the specific area of the catalyst and then it raises the methane conversion but depresses the C_{2+} selectivity. The increase of oxygen ion transportation by supplying the positive potential (oxygen pumping) might, as the result, increases the catalytic performance.