

## CHAPTER V

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

This research is the studies about hydrogen production by autothermal system and the oxidation of iso-octane as well. Three various Ni amounts (5, 10 and 15 wt%) over  $\text{Ce}_{0.75}\text{Zr}_{0.25}\text{O}_2$  catalysts prepared by sol-gel and impregnation methods are used in the reaction, which iso-octane was fed as feedstock. The effects of temperature, oxygen ratio and steam ratio were investigated in this studies.

The effects of nickel addition and preparation on catalysts were observed by catalyst characterization. TPR results show that, when compared with the same nickel loading, the impregnated catalyst is easier to be reduced than the sol-gel catalyst at the low temperature region. At temperature above 400°C, the sol-gel catalyst was more reduced than the impregnation catalyst. This was confirmed by the comparison of light off temperature of the Ni loadings by sol-gel and impregnated catalysts. For 15 %Ni/ $\text{Ce}_{0.75}\text{Zr}_{0.25}\text{O}_2$ , It was observed that the impregnated catalyst had the lower light off temperature than that of sol-gel catalyst. However, at high temperature, the higher conversion was obtained from the sol-gel catalysts.

All three various Ni (5, 10 and 15 wt%) loaded over  $\text{Ce}_{0.75}\text{Zr}_{0.25}\text{O}_2$  catalysts were tested for the catalytic activity on iso-octane oxidation at  $\text{O}_2/\text{C}$  of 1. For both loading methods, it was found that 15%Ni/ $\text{Ce}_{0.75}\text{Zr}_{0.25}\text{O}_2$  catalysts exhibited the highest catalytic activity for iso-octane oxidation.

For the autothermal study, 15%Ni/ $\text{Ce}_{0.75}\text{Zr}_{0.25}\text{O}_2$  prepared by sol-gel method was found to have better product ratio than that prepared impregnation method.  $\text{H}_2/\text{CO}$  product ratio was influenced by increasing steam concentration while it was slightly affected by a rise in  $\text{O}_2/\text{C}$ . This is indicated that ceria acts as an oxygen storage. Therefore, 15%Ni/ $\text{Ce}_{0.75}\text{Zr}_{0.25}\text{O}_2$  prepared by sol-gel method would be a good catalyst for iso-octane in the autothermal system. It not only enhances the autothermal reaction, but also reduces the coke formation.

Lastly, the temperature profile inside an autothermal system was also proved that this system could reduce the operation temperature. The temperature profile of catalyst bed was roughly used to predict the occurrence reactions inside reactor.

## **5.2 Recommendations**

In order to have the best design of the autothermal system reactor, the mechanism should be investigated. The mechanism is interesting for hydrogen production in a large scale, which is the development of a hot spot reactor. The hot spot reactor is a combination of steam reforming system and partial oxidation system in one single reactor. The CO and CO<sub>2</sub> by-products will be separated from hydrogen before leaving the reactor. Moreover, the effect of other types of metal such as Pt and Pd should be studied.