CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The Au supported TiO_2 catalyst prepared by the deposition-precipitation method was tested for potential application for the PROX of CO in the presence of H_2. The preparation, storage and reactor conditions were varied in order to investigate an optimum and appropriate condition for the Au/TiO_2 catalyst.

The different calcination temperature and metal loading can provide different catalytic activity because both preparation conditions have the ability to modify the morphology of the catalyst. For example, TPR and UV-visible indicated that the increasing calcination temperature and metal loading can increase the Au^0, in the catalyst. Moreover, TEM images proved that the Au particle size has a significant influence on the catalytic activity. The Au/TiO_2 catalyst prefers to be active at a high operating temperature when the particle size of Au becomes large. Then the high calcination temperature and metal loading can increase the particle size of Au, so the decision of the optimum calcination temperature and metal loading was proved to be an important factor. From the overall result, the 1% wt Au loading and calcined at 200°C is an optimum preparation condition that provided the impressive catalytic activity at 30°C and worked economically with the low Au loading and calcination temperature.

The appropriate method to store the catalyst could not be neglected because light was proved to be extremely sensitive to the Au. According to our findings, the light has the ability to reduce the Au ions to Au^0 (as described in the TPR result) and increase the average Au particle size as shown in TEM images. Therefore, the container for the Au/TiO_2 catalyst should be nontransparent so as to avoid the effects of light.

Actually, the reactor condition is just as important as other parameters. Our research then studied the performance of the Au/TiO_2 catalyst operating in the single-stage and double-stage reactor with simulated reformate gas. The catalyst exhibited impressive catalytic activity in the single-stage processing. It can

completely remove the CO concentration from the H_2 reformate steam but it provided slightly low PROX selectivity. However, the presence of CO_2 and H_2O in the feed has a negative influence on the activity of the catalyst. Then the catalyst was tried in the double-stage reactor processing even though, there are many parameters for the operating in the double-stage reactor such as, O_2 and catalyst weight split ratio, and stage temperature for both reactors. From the experiment the 50/50 O_2 and weight split ratio and 30°C for the stage reactors is an optimum operating condition for the Au/TiO_2 catalyst in the double-stage reactor which can increase the PROX selectivity to approximately 80%. The double-stage reactor processing has an advantage on the PROX selectivity compared with the single-stage reactor processing.

Finally, the catalyst undertook the PROX reaction in the double-stage reactor with the real composition methanol reformates gas. It was able to reduce the CO content to only 200 ppm but it still not meet the specification of the PEM fuel cells. Because, the concentration of CO_2 and H_2O presence in the real composition reformate gas is very high. Therefore, the Au/TiO_2 catalyst needs more improvement for the operating with the real composition reformate gas for removing more CO concentration.

5.2 Recommendations

This research provided the optimum preparation condition and reactor condition (single-stage and double-stage reactor) for the Au/TiO_2 catalyst with the PROX reaction. This catalyst exhibited the most impressive catalytic activity for the operating in both processes. Nevertheless, the catalyst has poor stability and toleration for the presence of CO_2 and H_2O. If the catalyst could be improved these defects, the Au/TiO_2 would be capable of providing high catalytic activity for the PROX reaction in the real composition reformate gas.