

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Au-Cu/CeO₂-ZrO₂ catalyst has been studied to produce hydrogen from oxidative steam reforming of methanol (OSRM). The pure (CeO₂ and ZrO₂) and mixed (CeO₂-ZrO₂) supports were prepared by precipitation and co-precipitation techniques, respectively. The deposition-precipitation (DP) technique was used to deposit the gold and copper to the support. Several parameters that affected to the catalytic activity of catalysts such as support composition (Ce/(Ce+Zr) atomic ratio), support preparation, Au/Cu atomic ratio, total metal loading, and calcination temperature were chosen for study. The present study demonstrated that the 3 wt% Au/Ce_{0.75}Zr_{0.25}O₂ catalyst highly active as compared to 3 wt% Au supported on other supports which different (Ce/(Ce+Zr)) atomic ratios. This may be due to the high amount of Au cationic species, as confirmed by TPR technique. The 3 wt% gold was loaded on support which prepared by co-precipitation technique gave higher catalytic performance than support prepared by sonochemical (SN) technique. The optimization of Au/Cu atomic ratio on 3 wt% Au-Cu/Ce_{0.75}Zr_{0.25}O₂ catalyst showed that the Au/Cu atomic ratio of 3:1 exhibited high catalytic activity. This may be correlated to the interaction between Au and Cu which modified the catalytic properties of Au. From TPO result, it could be seen that small amount of coke was formed on 3 wt% 3Au1Cu/Ce_{0.75}Zr_{0.25}O₂ catalyst as compared to 3 wt% Au/Ce_{0.75}Zr_{0.25}O₂ catalyst. Moreover, the 3Au1Cu/Ce_{0.75}Zr_{0.25}O₂ catalyst calcined at 300 °C with 5 wt% total metal loading was considered as an optimum condition for using in OSRM. At the optimum condition, the methanol conversion of 99.61% and hydrogen yield of 62.39% were obtained. The highest activity was attributed to the presence of active sites and the amount of gold content in this catalyst. For the side reactions, the result revealed that during OSRM other reaction mechanisms, such as methanol decomposition (DM) and steam reforming of methanol (SRM) were occurred.

5.2 Recommendations

The prepared catalysts had significant effects to the catalytic activity. Therefore, the catalyst should be prepared in the same batch for using in long term.

The investigation of the oxidation state of Au had interested due to the relation between the catalytic activity and the oxidation state. X-ray photoelectron spectroscopy (XPS) was recommended to define the oxidation state of Au in catalysts.