CHAPTER V
CONCLUSIONS AND RECOMMENDATION

5.1 Conclusions

The effects of acidity and pore size of mesoporous were studied on the catalytic dehydration of bio-ethanol to heavy hydrocarbons. The reaction was performed at 450 °C under atmospheric pressure with 0.5 h^{-1} of liquid hourly space velocity (LHSV).

The various Si/Al_2 ratios (Si/Al_2 = 27, 37, and 300) of H-Beta were used to study the effects of acid density and acid strength. As a result, the different acid density and acid strength also obviously affected to the product distribution. The primary product of bio-ethanol dehydration reaction is ethylene gas. Then, it might be converted to larger hydrocarbons if catalysts had a sufficient acid density and acid strength. Increasing Si/Al_2 ratio reduces the acid density and acid strength of H-Beta zeolite. Hence, H-Beta with the Si/Al_2 of 300, which has the lowest acid density and acid strength, produced ethylene (94.6 wt%) mainly. The moderate acid density and acid strength of H-Beta with the Si/Al_2 of 37 provided a large amount of oil (7.27 wt%) that mostly consisted of large hydrocarbons (C_9- and C_{10}^+ aromatics). Nevertheless, the highest acid strength of H-Beta with the Si/Al_2 of 27 might convert large hydrocarbons (C_9- and C_{10}^+ aromatics) to smaller hydrocarbons (Benzene, Toluene, and Xylene) via cracking reaction. Moreover, gallium- and germanium oxide-modified H-Beta catalysts enhanced C_{10}^+ aromatics production, and significantly increased kerosene and gas oil in oil.

The hierarchical mesoporous zeolite with hexagonal structure (MSU) was synthesized by using Cetyltrimethylammonium bromide (CTAB) as a mesoporous template. Meso pore size of MSU was around 27.9 Å. For the activity, MSU can extremely increase large hydrocarbons (C_9- and C_{10}^+ aromatics) production, and also enhanced kerosene and gas oil in oil when compared with microporous H-Beta that has the Si/Al_2 ratio of 300 with the similar acid density and acid strength. So, the meso-pore of MSU actually improved large hydrocarbons production in bio-ethanol dehydration process. Both gallium- and germanium oxide-modified MSU enhanced

oil production. Moreover, C_{10}^{+} aromatics were increased by using 5GeMSU, and the oil mainly consisted of kerosene. For 5GaMSU, oxygenates were produced as a main product.

5.2 Recommendation

From the results, the moderate acid density and acid strength are important factors for product distribution of bio-ethanol dehydration. Furthermore, large pore sizes of MSU also improved larger hydrocarbon products (C_{10}^{+} aromatics production). Thus, if acid density and acid strength of MSU are improved, larger hydrocarbons may be produced in a large amount.