

CHAPTER VI

CONCLUSIONS AND FURTHER STUDY

In general, the overall objective of this dissertation is to obtain a better understanding of the field of catalyst deactivation, by the development of extension of the methodology for modelling coking formation. As a result of the present dissertation program, the following conclusions can be drawn :

1. Synergistic effect of tin and lithium for propane dehydrogenation .

1.1 The increase of Pt loading from 0.30 wt % to 1.00 wt % for Pt/Al₂O₃ catalyst enhances the dehydrogenation performance of the catalyst and also increases total coke deposits on catalyst.

1.2 The increase of tin loading from 0.10 wt % to 1.00 wt % to Pt/Al₂O₃ catalyst enhances the dehydrogenation performance and also increases total coke deposits on catalyst , except at higher temperature (> 600 °C), more Sn/Pt ratio (> 1) the dehydrogenation activity is decreased. At 500 °C when tin content is higher then 0.60 wt% the total coke deposits on catalyst is decreased.

1.3 For the Pt-Sn/Al₂O₃ catalyst, the increase of lithium loading from 0.30 wt % to 1.00 wt % enhances the dehydrogenation performance and at 600 °C every Li/Pt ratio the catalyst performance is the maximum and also decreases total coke deposits on catalyst.

1.4 Comparison of performance for various catalysts the results

show that $\text{Pt-Sn-Li/Al}_2\text{O}_3 > \text{Pt-Sn/Al}_2\text{O}_3 > \text{Pt/Al}_2\text{O}_3$ catalyst.

1.5 The catalyst performance is decreased when operate at higher hydrogen to hydrocarbon ratio.

1.6 The proposed function of lithium and tin are textural, structural, and alloy function.

2. Determination of coke deposition on active metal site of catalyst by active metal site regeneration method .

2.1 The coke deposits on the metal site of the catalyst with $\text{H}_2/\text{HC} = 0$, the result shows that :

Total coke on metal site	: $\text{Pt/Al}_2\text{O}_3 > \text{Pt-Sn/Al}_2\text{O}_3 > \text{Pt-Sn-Na/Al}_2\text{O}_3$
Irreversible coke on metal site	: $\text{Pt-Sn/Al}_2\text{O}_3 > \text{Pt/Al}_2\text{O}_3 > \text{Pt-Sn-Na/Al}_2\text{O}_3$
Reversible coke on metal site	: $\text{Pt/Al}_2\text{O}_3 > \text{Pt-Sn-Na/Al}_2\text{O}_3 > \text{Pt-Sn/Al}_2\text{O}_3$

2.2 Total coke and irreversible deposit on the metal site at lower hydrogen/hydrocarbon ratio are higher than at higher hydrogen/hydrocarbon ratio .

2.3 For $\text{Pt/Al}_2\text{O}_3$ and $\text{Pt-Sn/Al}_2\text{O}_3$ catalysts, reversible coke deposits on the metal site at lower hydrogen /hydrocarbon ratio is lower than at higher hydrogen/hydrocarbon ratio but $\text{Pt-Sn-Na/Al}_2\text{O}_3$ gives the opposite result.

2.4 In the range of 480-600 °C. The reversible coke deposits on the metal site is constant though the temperature is changed.

2.5 At time on stream reaches steady state, the coke deposits on metal active site remains constant.

2.6 The model of coke formation is proposed and shows that the reversible coke and the irreversible coke can grow on both metal site and acid site of support. The coke precursor, the reversible coke and the irreversible coke can migrate to the acid site of alumina.

2.7 The regeneration model is proposed that the reversible coke on the metal active site can be removed by 1 % oxygen in helium gas at 250 °C and the irreversible coke on metal active site can be totally removed by 1% oxygen in helium gas at 500 °C.

Although some aspects of catalyst deactivation were examined in this dissertation, many interesting and important problems still remain. The following areas are therefore recommended for further study :

1. More work is necessary to examine the synergistic effect of promoters on Pt/Al₂O₃ catalyst with different catalyst characterization methods at higher temperature and higher promoter/Pt ratio, including conductivity measurement apparatus and surface structure determination apparatus in order to find out the function of promoter at different condition.

2. Extension of the nature formation for irreversible and reversible coke on acid site of support will also be of interest, since support is the main site for coke coverage in order to propose the method to remedy catalyst deactivation.