# CHAPTER V
# RESULTS AND DISCUSSION

Temperature Programmed Oxidation of coke on catalysts was studied for the amount of coke on catalysts from carbon nano-tube lab. The catalysts investigated were as follow:

## 5.1 Table of Catalyst

| Symbol | Type of catalysts(carrier gas, Temperature© | Coke Amount (%(w/w)) |
|---|---|---|
| $H_1$ | CoMo 1:1/MgO($CH_4$,750) | 12.60 |
| $H_2$ | CoMo 1:1/MgO(CO,750) | 14.65 |
| $H_3$ | CoMo 1:1/MgO($CH_4$+CO,750) | 12.37 |
| $H_4$ | CoMo 1:2/MgO($CH_4$,750) | 8.43 |
| $H_5$ | CoMo 1:2/MgO(CO,750) | 13.83 |
| $H_6$ | CoMo 1:2/MgO($CH_4$+CO,750) | 11.82 |
| $H_7$ | CoMo 2:1/MgO($CH_4$,750) | 13.75 |
| $H_8$ | CoMo 2:1/MgO(CO,750) | 11.35 |
| $H_9$ | CoMo 2:1/MgO($CH_4$+CO,750) | 27.18 |
| $I_1$ | FeMo 1:1/MgO($CH_4$,750) | 20.49 |
| $I_2$ | FeMo 1:1/MgO(CO,750) | 7.63 |
| $I_3$ | FeMo 1:1/MgO($CH_4$+CO,750) | 16.13 |
| $I_4$ | FeMo 1:2/MgO($CH_4$,750) | 13.84 |
| $I_5$ | FeMo 1:2/MgO(CO,750) | 6.66 |
| $I_6$ | FeMo 1:2/MgO($CH_4$+CO,750) | 21.70 |
| $I_7$ | FeMo 2:1/MgO($CH_4$,750) | 18.60 |
| $I_8$ | FeMo 2:1/MgO(CO,750) | 5.49 |
| $I_9$ | FeMo 2:1/MgO($CH_4$+CO,750) | 14.52 |

## 5.2 TPO spectrum

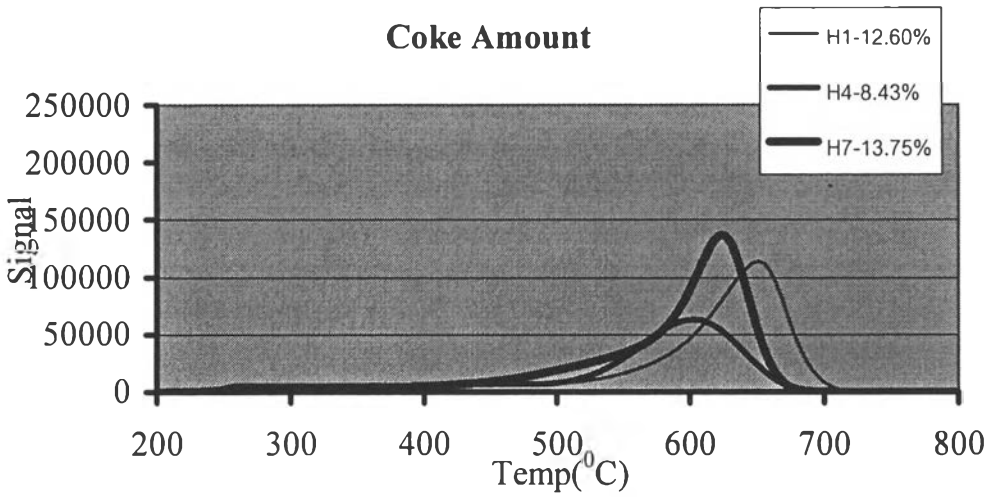


**Figure 5.2.1** TPO curves of $H_1$,$H_4$ and $H_7$.

**Table 5.2.1** % coke amount of $H_1$,$H_4$ and H7

| Co:Mo / Carier Gas | | 1:1 | 1:2 | 2:1 |
|---|---|---|---|---|
| Case 1 | CH4 | H1 | H4 | H7 |
| | Coke Amount (%) | 12.60 | 8.43 | 13.75 |

According to the experimental results, 3 TPO curves significantly depict that coke on CoMo/Mgo is an amorphous due to evidently smooth curve. In the first case, when Co-Mo ratio increase from 1:1 to 2:1 in ratio, the quantity of coke will grow up from 12.6% to 13.75%. In contrary, if the ratio of Co-Mo is reduced from 1:1 to 2:1, the quantity of coke will distinctly decrease from 12.6% to 8.43%.

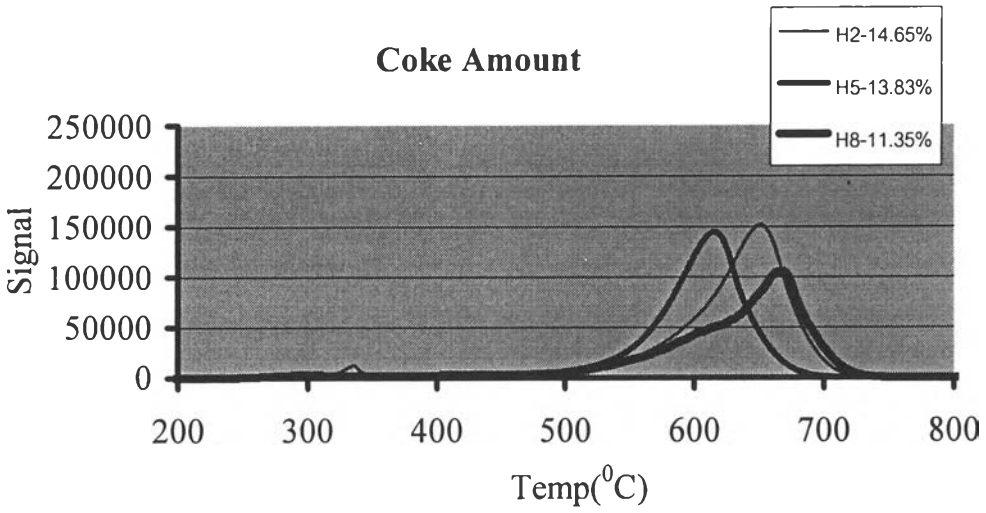


**Figure 5.2.2** TPO curves of H2,H5 and H8.

**Table 5.2.2** % coke amount of H2,H5 and H8

| | Co:Mo / Carier Gas | 1:1 | 1:2 | 2:1 |
|---|---|---|---|---|
| Case 1 | CO | H2 | H5 | H8 |
| | Coke Amount (%) | 14.65 | 13.83 | 11.35 |

The second case, the smooth three curves points that the coke on CoMo/Mgo is an amorphous. In term of coke quantity, the Co-Mo ratio is reduced from 1:1 to 1:2 resulting in decreasing value of 14.65% to 13.83%. Oppositely, constantly increasing of Co-Mo ratio from 1:1 to 2:1 caused the quantity of coke still remains reducing.

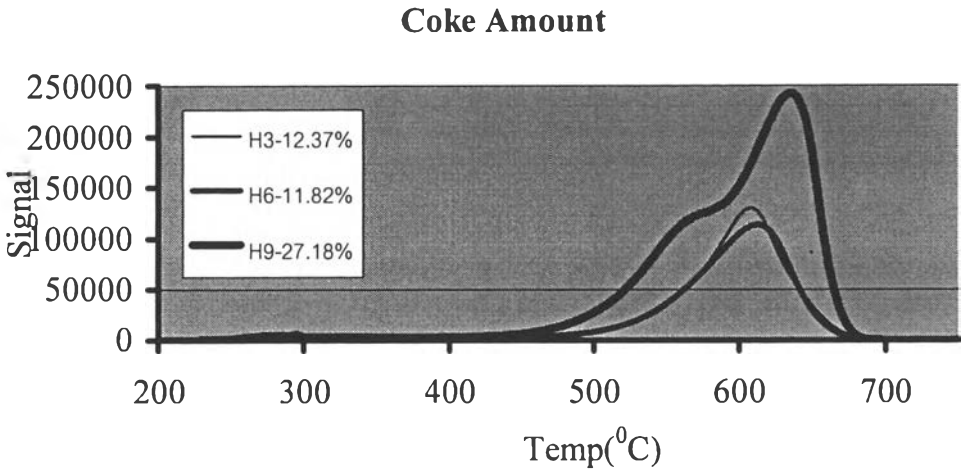


**Figure 5.2.3** TPO curves of H3,H6 and H9.

**Table 5.2.3** % coke amount of H3,H6 and H9

| Co:Mo / Carier Gas | | 1: 1 | 1 :2 | 2: 1 |
|---|---|---|---|---|
| Case 3 | $CH_4$+CO | H3 | H6 | H9 |
| | Coke Amount (%) | 12.37 | 11.82 | 27.18 |

In case of the third, the advent of involving H3 and H6 graphs characteristic presents graph in smooth. These significantly depict that coke/catalyst is an amorphous, theoretically. Obscurely, there are two peaks in H9 graph resulting a couple of coke, amorphous and single wall, respectively. Consider coke quantity, the less of Co-Mo ratio from 1:1 to 1:2, the less of coke quantity from 12.37% to 11.82%. While the Co-Mo ratio increases from 1:1 to 2:1, the coke quantity also increases from 12.37% to 27.18%, twice as much as the first case.

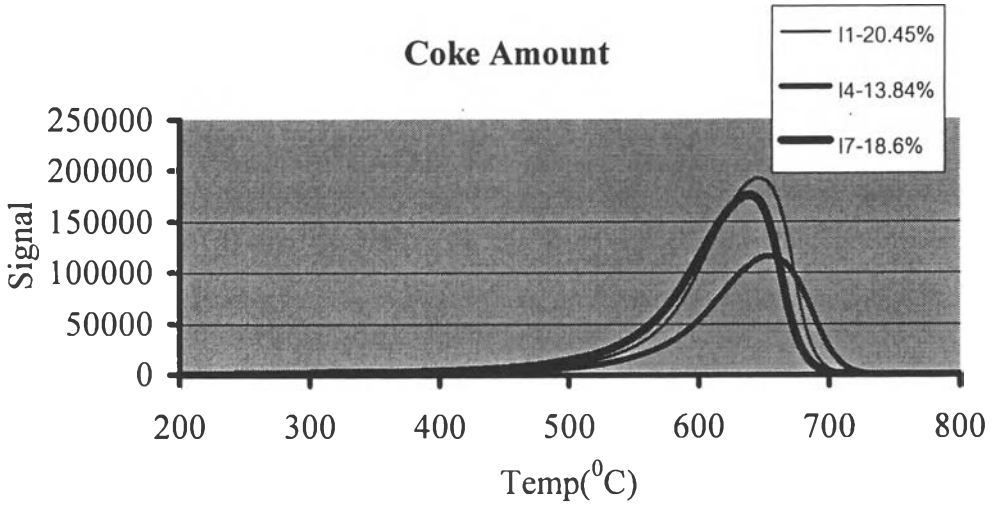


**Figure 5.2.4** TPO curves of I1,I4 and I7.

**Table 5.2.4** % coke amount of I1,I4 and I7

| Fe:Mo / Carier Gas | .1: 1 | .1 :2 | .2: 1 |
|---|---|---|---|
| Case 4 $CH_4$ | I1 | I4 | I7 |
| Coke Amount (%) | 20.49 | 13.84 | 18.60 |

In the fourth case, all three graphs are smooth illustrated the coke on CoMo/MgO is an amorphous in theory. Concerning coke quantity, the ratio of Fe-Mo is reduced from 1:1 to 1:2 for which the coke quantity is just reduced from 20.49% to 13.84%. On the contrary, the ratio of Fe-Mo increases from 1:1 to 2:1 for which the coke quantity is just reduced from 20.49% to 18.60%.

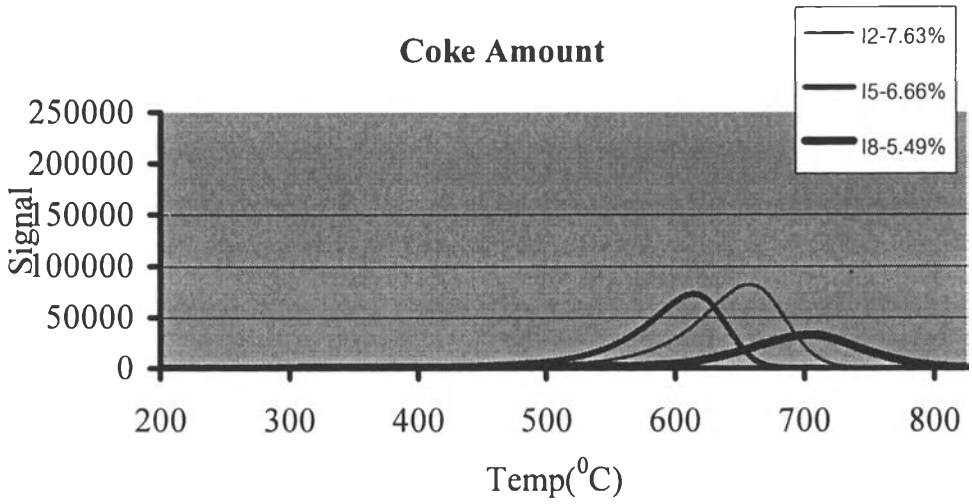


**Figure 5.2.5** TPO curves of I2, I5 and I8 .

**Table 5.2.5** % coke amount of I2, I5 and I8

| | Fe:Mo / Carier Gas | .1: 1 | .1 :2 | .2: 1 |
|---|---|---|---|---|
| Case 5 | CO | I2 | I5 | I8 |
| | Coke Amount (%) | 7.63 | 6.66 | 5.49 |

In the fifth case, all three graphs are smooth illustrated the coke on CoMo/MgO is an amorphous in theory. Concerning coke quantity, the ratio of Fe-Mo is reduced from 1:1 to 1:2 for which the coke quantity is just reduced from 7.63% to 6.66%. On the contrary, the ratio of Fe-Mo increases from 1:1 to 2:1, the coke quantity is reduced from 7.63% to 5.49%.

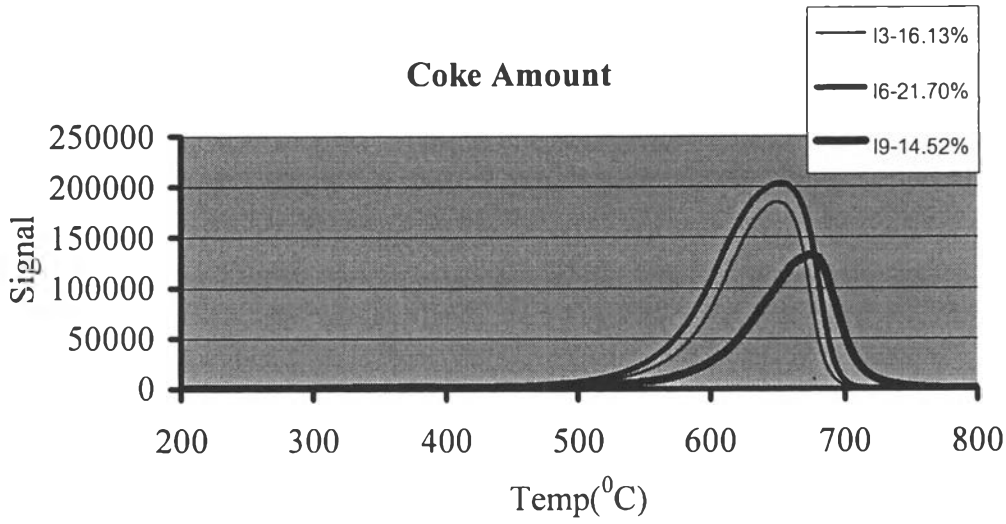


**Figure 5.2.6** TPO curves of I3, I6 and I9.

**Table 5.2.6** % coke amount of I3, I6 and I9

| | Fe:Mo / Carier Gas | .1: 1 | .1 :2 | .2: 1 |
|---|---|---|---|---|
| Case 6 | $CH_4$+CO | I3 | I6 | I9 |
| | Coke Amount (%) | 16.13 | 21.70 | 14.52 |

The final can be implied that coke on I3, I6 and I9 are amorphous coke. There are smooth lines on 3 curves that are indicator. From Co- Mo ratio increasing, I6 has the largest area, result in, the highest amount of coke.