REFERENCES

1. Barbier, S. Appl. Catal. 23 (1986) 225.
2. Tanabe, K., Misono, M., Ono, Y., and Hideshi, H. New Solid Acids and Bases Studies in Surface in Science and Catalysis, Elsevier, Amsterdam, 51 (1989) 340-341.
3. Pieck, C. L.,Jablonsky, E.,Parera, J. M., Frety, R., and Lefebre, F. Ind. Eng. Chem Res. 31 (1992) 1017.
4. Ibarra, J. V., Royo, C., MonZon, A., and Santamaria, J. Vib. Spectrosc. 9 (1995) 191.
5. Cabrol, R. A. and Oberlin,A. J. Catal. 89 (1984) 256.
6. Chang,T.S. ,,Rodriguez, N. M., and Baker, T. B. J. Catal. 123 (1990) 486.
7. Tracz, E. , Scoltz, R., and Borowiecki, T. Appl. Catal. 66 (1990) 133.
8. Espinat, D., Dexpert, H., Freund, E., Martino, G., Couzi, M., Lespade, R., and Cruege, F. Appl. Catal. 16 (1985) 343.
9. Gallezot, P., Leclerq, C., Barbier, J., and Marecott, P. J. Catal. 116 (1989) 164.
10. Diez, F., Gates, B. C., Miller, J. T., Sajkowski, F. J., and Kukes, S. G. Ind. Eng. Chem. Res. 29 (1990) 1999.
11.Niemantsverdriet, J., and Langeveld, A. D. van Fuel 65 (1986) 1396.
12. Acharya, D.R., Allen, A. J., and Hughes, R. Ind. Eng. Chem. Res. 29 (1990) 1119.
13.Praserthdam, P., Chaisuk, C., and Kanchanawanichkun, P. Res. Chem. Intermed. 24 (1998) 605-612.
14.Barbier, J., Churin, E., and Marecot, P. J. Catal. 126 (1990) 228.
15. Parera, J. M., Verderone, R. J., Pieck, C. L., and Traffano, E. M. Appl. Catal. 23 (1986) 15.
14.Querini, C. A., Figoli, N. S., and Parera, J. M. Appl. Catal. 52 (1989) 249.
15. Figoli, N. S., Beltramini, J. N., Martinelli, E. E., Sad, M. R., and Parera, J. M. Appl. Catal. 5 (1983) 19.
16. Querini, C. A., and Fung, S. C. J. Catal. 141 (1993) 389.

17. Magnoux, P., and Guisnet, M. Appl. Catal. 38 (1988) 341.

18. Duprez, D., Hadj-Aissa, M., and Barbier,,J. Appl. Catal. 49 (1989) 67.

19. Duprez, D., Hadj-Aissa,M., and Barbier,J. Appl. Catal. 49 (1989) 75.

22. Barbier, J. Catalyst Deactivation (1987) 1-17.

23. Beltramini, J., and Trimm, D. L. Appl. Catal. 113 (1987) 31.

24. Praserthdam, P., Panchareon, U., and Tscheikuna, J., Kenkyu Hokoku-Asahi Garasu Zaidan 313 (1992) 61.

25. Lin, L., Tao, Z., Jingling, Z., and Zhusheng, X. Appl. Catal. 67 (1990) 11-23.

26. Chen, L., and Chen, F. L. Ind. Eng. Chem. Res. 29 (1990) 534-539.

27. Kunatippapong, S. Determination of irreversible coke deposition of platinum active site of propane dehydrogenation catalyst. Dr. Eng. Dissertation, Chulalongkorn University (1995).

28. Jaikaew, B. Effect of alkali metals in dehydrogenation catalysts for coke formation. M. Eng. Thesis, Chulalongkorn University (1995).

29. Lim, N. Effect of promoters on coke formaton on metal site of propane dehydrogenation catalysts M. Eng. Thesis, Chulalongkorn University (1996).

30. Beltramini, J. N., Martinelli, E. E. , Churin, E. J., Figoli, N. S., and Parera, J. M. Applied Catalysis (1983) 43-55

31. Barbier, J., Corro, G., and Zhang, Y. Appl. Catal. 13 (1985) 245-255.

32. Parera, J. M. Catalyst Deactivation (1991) 103.

33. Pieck, C. L. Appl. Catal. 55 (1989) 1-10.

34. Beltramini, J. N., Wessel, T. J., and Datta, R. Catalyst Deactivation (1991) 119.

35. Daisuke, N., and Tomoya, S. Ind. Eng. Chem. Res. 31 (1992) 14 - 19.

36. Querini, C. A., and Fung, S. C. Applied Catalysis A:General 117 (1994) 53-74

37. Sergio de Miguel, Alberto Castro, and Osvaldo Scelza Catalysis Letter 36 (1996) 201-206

38. Jackson, S. D., Greufell, J., Matheson, I. M., Munro, S., Raval, R., and Webb, G. Catalyst Deactivation (1997) 167-174.

39. Larsson, M., Henriksson, N., and Andersson, B. Catalyst Deactivation (1997) 673-680.

40. Cristina, L. Padro', Sergio R. de Miguel, Alberto A. Castro, and Osvaldo A. Scelza Catalyst Deactivation (1997) 191-198.

41. Liu, K., Fung, S. C., Ho, T.C., and Rumschitzki, D.S. Catalyst Deactivation (1997) 625-638.

42. Amornchanthanakorn, S. Coke formation on dehydrogenation catalysts M. Eng. Thesis, Chulalongkorn University (1992).

43. Saengpoo, A. Combustion of coke on dehydrogenation catalysts M. Eng. Thesis, Chulalongkorn University (1995).

44. Pieck, C. L. et.al. Appl. Catal. 55 (1989) 1-10.

45. Odd, A. B., Anders, H., and Edd, A. B. Catalysis Today 24 (1995) 361-364.

46. Larsson, M., Hulten, M., Blekkan, E.A., and Andersson, B. J. Catal. 164 (1996) 44-53.

47. Minh, C. L. Chaoen, L., and Trevor, C. B. Catalyst Deactivation (1997) 383-390.

48. Satterfield, Charles N. Heterogeneous Catalysts in Practice McGraw-Hill Chemical engineering series, United States of America (1980).

49. Hughes, R., Deactivation of Catalyst (1984).

50. Butt, John B., and Petersen, Eugene E. Activation,Deactivation and Poisoning of Catalyst Academic press, Inc. (1988).

51. Franck, J. P., and Martino, G.P. Deactivation and Poisoning of Catalyst Martinus Nighott, The Hague (1982).

52. Gates, B.C., Katzer, J.R., and Schuit, C.A. Chemistry of Catalytic Processes McGraw-Hill, New York (1979) 184.

53. Cooper, B.J., and Trimm, D.L. Catalyst Deactivation Elsevier, Amsterdam (1980).

54. Guenin, M., Breysse, M., and Frety, R., Molec, I. J. Catal. 119 (1984) 15.

55. Broekhoven, E. H., Van, Schoonhoven, I. W. F. M., and Ponec, V. Surf. Sci. 899 (1985) 156.

56. Parera,J. M., Figoli, N. S., Jablonski, E. L., Sad, M. R., and Beltramini, J. N., in Catalyst Deactivation (B. Delmon and G. F. Froment, eds.) , Elsevier, Amsterdam (1980).

57. Figoli, N. S., Sad, M. R., Beltramini, J. N., Jablonski, E. L., and Parera, J. M. Ind. Eng. Chem. Prod. Res. Dev. 545 (1980) 19.

58. Verderone, R. J., Pieck, C. L., Sad, M. R., and Parera, J. M. Appl. Catal. 239 (1986) 21.

59. Parera, J. M., Traffano, E. M., Musso, J. C., and Pieck, C. L. in Spillover of Adsorbed Species (Pajonk, G. M., Teichner, S. J., and Germain, J. E., eds.), Elsevier, Amsterdam (1983).

60. Barbier, J. P., Morales, A., Marecot, P., and Maurel, R. Bull. Soc. Chim. Belg. 88 (1979) 569.

61. A' deladim, A., Thesis, ENSPM Rueil-Malmaison France (1982).

62. Espinat, D., Thesis ENSPM, Rueil-Malmaison, France (1982).

63. Franck, J. P., and Martino, G. in Progress in Catalyst Deactivation (Figueiredo, ed.) Martinus Nijhoff, The Hague (1982).

64. Volter, J., and Kurscher, U. Appl. Catal. 8 (1983) 167.

65. Pacheco, M. A., and Petersen, E. E. J. Catal. 96 (1985) 499.

66. Jossens, L. W.,and Petersen, E. E. J. Catal. 76 (1982) 265.

67. Somorjai, G. A. Adv. Catal. 2 (1977) 26.

68. Franck, J. P., and Martino, G. P. Deactivation of Reforming Catalysts in Jacques Ouder, " Deactivation and Poisoning of Catalysis " , Chemical Industries, Marcel dekker, Inc. 120 (1985).

69. Shum, V. K., Butt, J. B., and Schtjer, W. M. H. Appl Catal. 141 (1984) 11.

70. Trimm, D. L. Catalyst design for reduced coking Appl. Catal. 5 (1983) 263.

71. George, A. O. Hydrocarbon Chemistry John Wiley & Sons, INC. (1995) 119.

72. Fung,S.C., and Querini,C.A. J. Catal. 138 (1992) 240-254.

73. Reid, R. C. The Properties of Gases and Liquids McGraw-Hill Book Company (1977) 629-654.

APPENDIX A

Set the partial vapor pressure of reactants to the requirement by adjust the temperature of saturator following the antoine equation [73]:

$$\log P = A - \frac{B}{(T + C)}$$

When P = vapor pressure of reactant, mm Hg

T = temperature, ^{o}C

A, B and C = constants

The value of constants are in table A-1

Table A-1 The value of constant

Reactant	A	B	C
n-Pentane	15.8333	2477.07	-39.94
1-Pentene	15.7646	2405.96	-39.63
n-Hexane	15.8366	2697.55	-48.78
1-Henxene	15.8089	2654.81	-47.30
n-Heptane	15.8737	2911.32	-56.51
1-Heptene	15.8894	2895.51	-53.97
n-Octane	15.9426	3120.29	-63.63
1-Octene	15.9630	3116.52	-60.39

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

APPENDIX B

CALCULATION OF CATALYST PREPARATION

The sample calculation shown below is for 0.3wt.%Pt-0.3wt.%Sn-0.6wt.%K/γ-Al_2O_3 catalyst. The hydrochloric acid is also added to the impregnating solution by 5wt% of the alumina support. The alumina support weight used for all preparation is 2 grams.

If X grams of alumina support is used, so each 100 grams of the catalyst is composed of

	Platinum	0.3	g.
	Tin	0.3	g.
	Potassium	0.6	g.
	Hydrochloric acid	0.05 x X	g.
	Alumina support	X	g.
then	0.3 + 0.3 + 0.6 + (0.05xX) + X	= 100	g.
	X	= 94.0952	g.

The platinum compound used is chloroplatinic acid ($H_2PtCl_6.6H_2O$), its molecular weight is 517.92, and the platinum content in the compound is 37.67 wt %. The stock solution of chloroplatinic acid has the concentration of 1 g in 25 ml. of water.

The tin compound used is stannous chloride dihydrate ($SnCl_2.2H_2O$), its molecular weight is 118.69, and the tin content in the compound is 51.02 wt.%.

The potassium compound used is potassium nitrate (KNO_3), its molecular weight is 101, and potassium content is 38.61 wt.%. The stock solution of potassium nitrate has the concentration 3 g in 25 ml. of water.

Concentration of hydrochloric acid solution is 37 % volume by volume, its density is 1.19 kilogram per liter.

The calculation procedure of the amount of each ingredients for the required composition of the 0.3 wt.% Pt- 0.3 wt.% Sn- 0.6 wt.% K catalyst shows below.

For two grams of alumina support used :

1) Platinum required	= (0.3x2)/94.10	g.
	= 6.37×10^{-3}	g.
Chloroplatinic acid required	= $6.37 \times 10^{-3} \times 100 \times 25/37.67$	ml.
	= 0.4232	ml.
2) Tin required	= 2x0.3/94.0952	g.
	= 6.376×10^{-3}	g.
Stannous chloride dihydrate required		
	= $6.376 \times 10^{-3} \times 100/51.02$	g.
	= 0.0125	g.
3) Potassium required	= 2x0.6/94.0952	g.
	= 0.0128	g.
Potassium nitrate required	= 0.0128x100x25/(38.61x3)	ml.
	= 0.2763	ml.
4) Hydrochloric and solution required		
	= 2x0.05	g.
	= 0.1	g.
The amount of hydrochloric and by volume		
	= 0.1/(1.190x0.37)	ml.
	= 0.2271	ml.

As the pore volume of the alumina support is 1 ml./g., the total volume of impregnating solution that must be used is 2 ml. by the requirement of dry impregnation method, the de-ionized water is added until the volume of impregnating solution is 2 ml. as equal to the volume of the alumina pore volume.

APPENDIX C

CALIBRATION CURVE OF CARBON DIOXIDE CONTENT

Table C.1 Detected area and estimated weight of carbon by feeding 100 % CO_2 0.405 ml/min mixed with helium in various flow rate through porapak Q column on GC 8AIT at 110 °C detector temperature and 90°C column temperature, using (1 ml) sampling loop

Carbon content (mg.)	**Average area (a.u.)**
0.003844	11,200
0.002188	4,900
0.001557	2,930
0.001071	1,792

The assumption of gas content calculation was based on the ideal gas law. Therefore, the data fitted with linear equation can be expressed below:

Amount of carbon (mg), $Y = 3*10^{-7}(\text{Area, X})+0.0006$

where least square error, $R^2 = 0.9934$

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

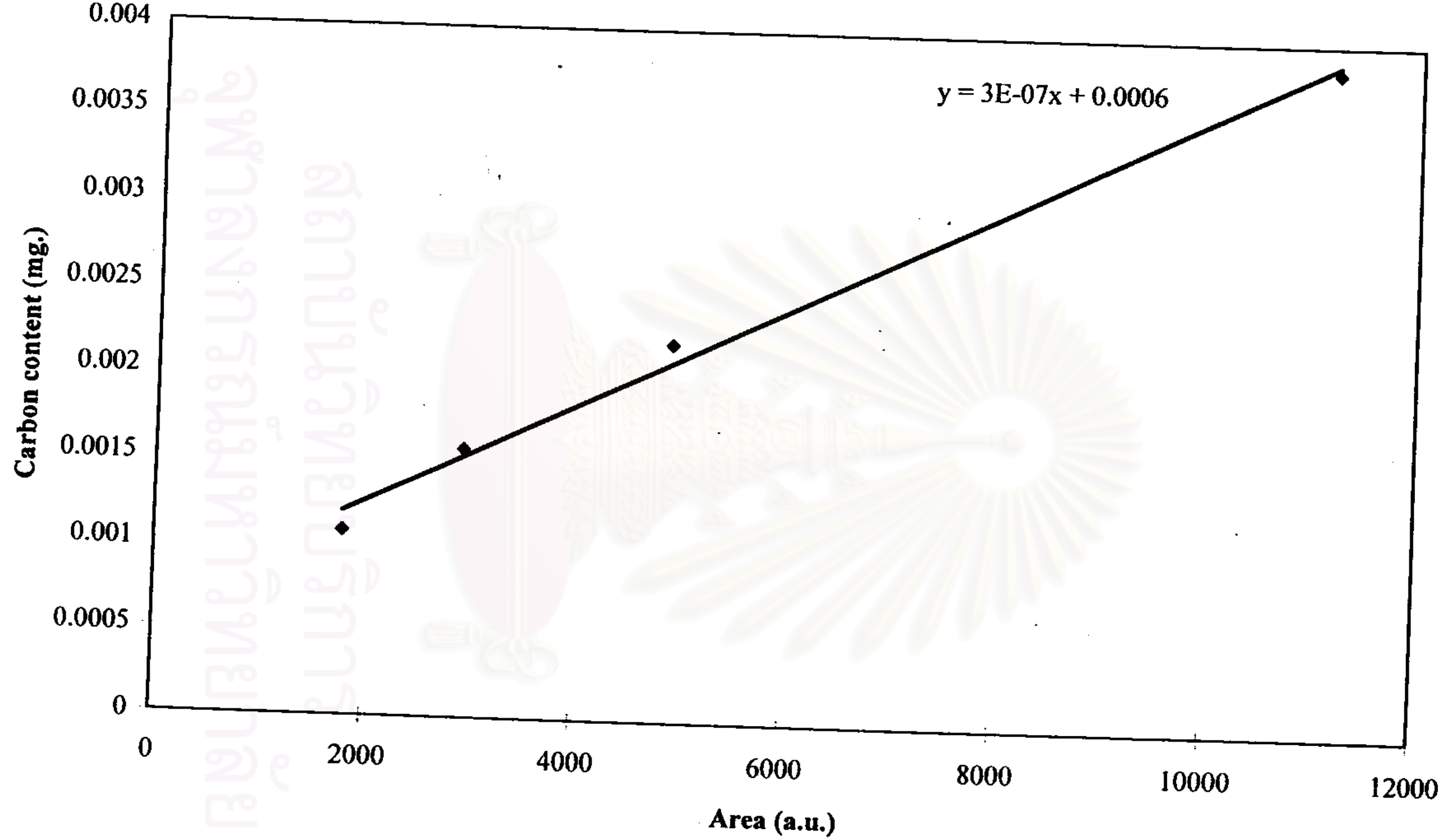

Figure C.1 Calibration curve of carbon dioxide on GC 8 AIT

APPENDIX D

SPECIFICATION OF ALUMINA SUPPORT (Al_2O_3) TYPE KNH-3 FROM SUMITONO ALUMINIUM SMELTING CO.,LTD.

Chemical Composition (weight percent)	
Al_2O_3	60-70 %
SiO_2	30-35 %
Fe_2O_3	0.3-0.5 %
TiO_2	0.5-0.7 %
CaO	0.1-0.2 %
MgO	0.2-0.4 %
Na_2O	0.3-0.4 %
K_2O	0.2-0.3 %
ZrO_2 + HfO_2	0.03-0.04 %

Physical Properties	
Bulk Density (g/cc)	1.3-1.5
Apparent Specific Gravity	3.1-3.3
Packing Density (lb/ft^3)	20-25
Por Volume (cc/g)	1.0-1.3
Surface Area (m^2/g)	340-350

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

APPENDIX E

Temperature programmed oxidation curve

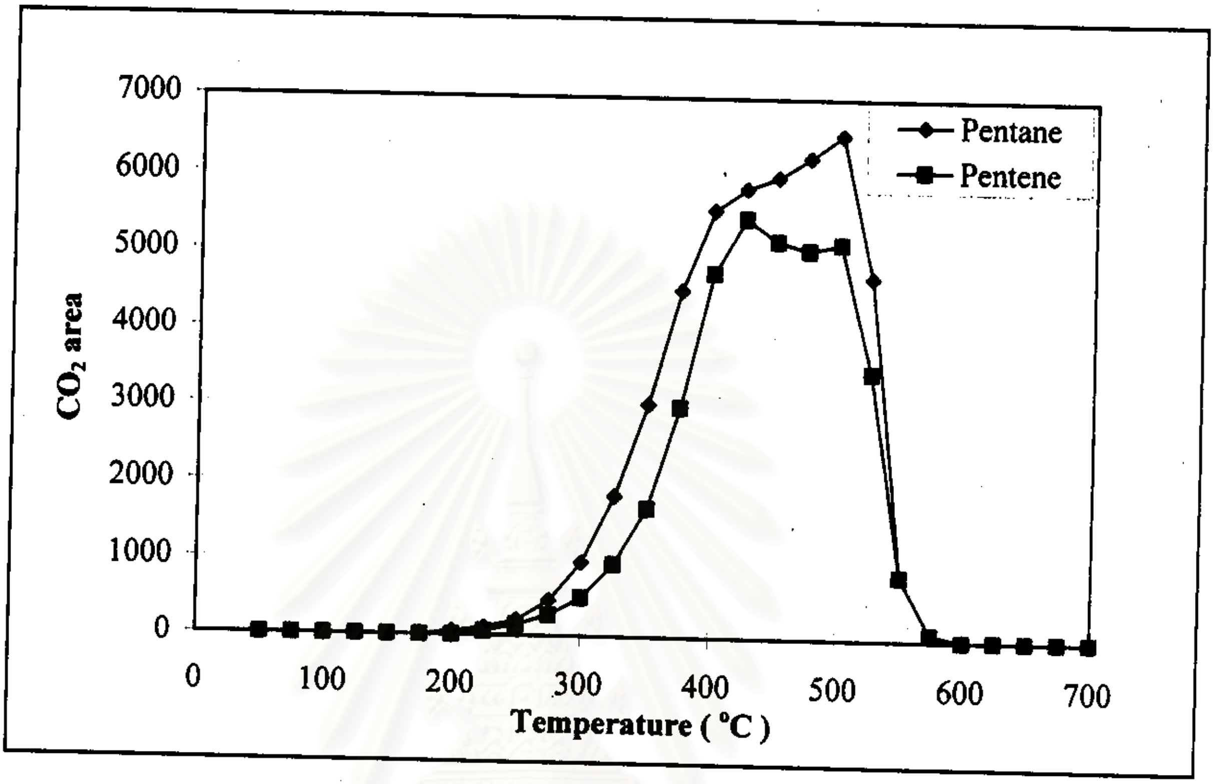

Figure E.1 TPO spectra for pentane and pentene dehydrogenation over 0.09 g. of 0.3%Pt 0.3% Sn 0.6%K /Al_2O_3 at 250 °C, 120 min., GHSV 22500 hr^{-1}.

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

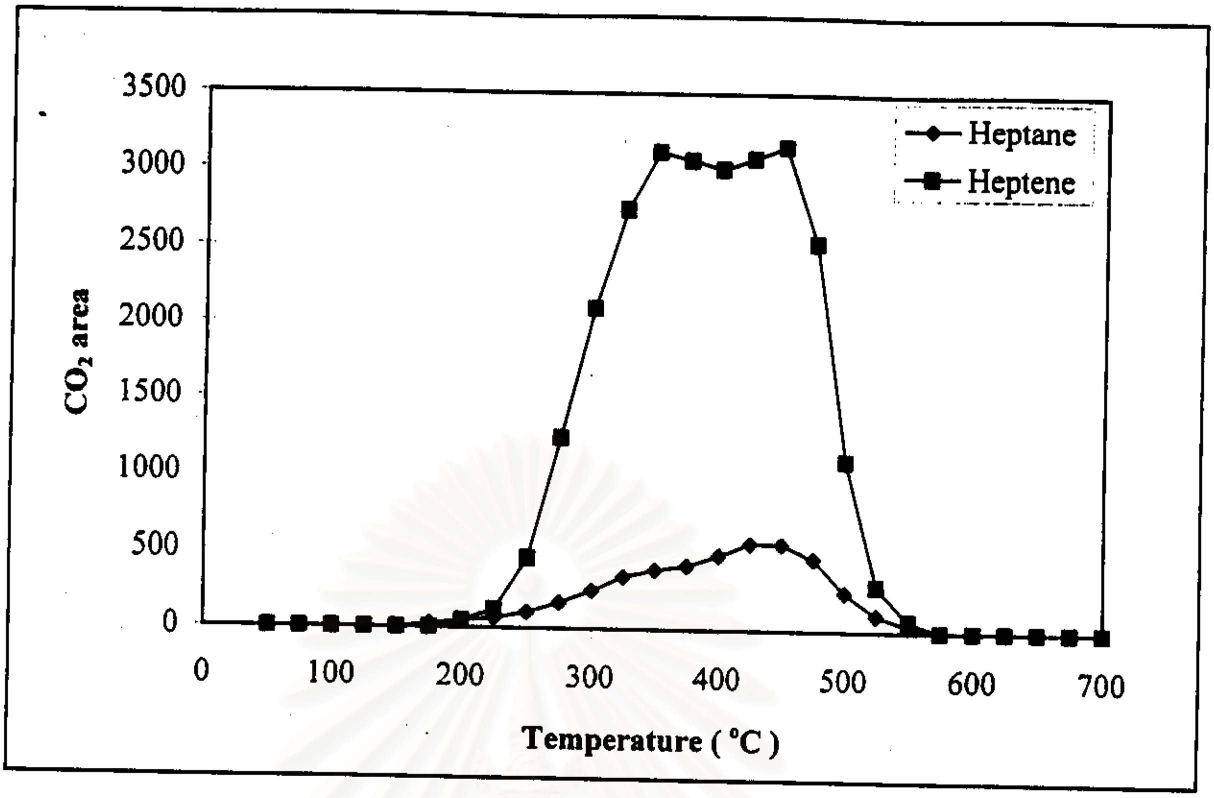

Figure E.2 TPO spectra for heptane and heptene dehydrogenation over 0.09 g. of 0.3%Pt 0.3% Sn 0.6%K /Al_2O_3 at 250 °C, 120 min., GHSV 22500 hr^{-1}.

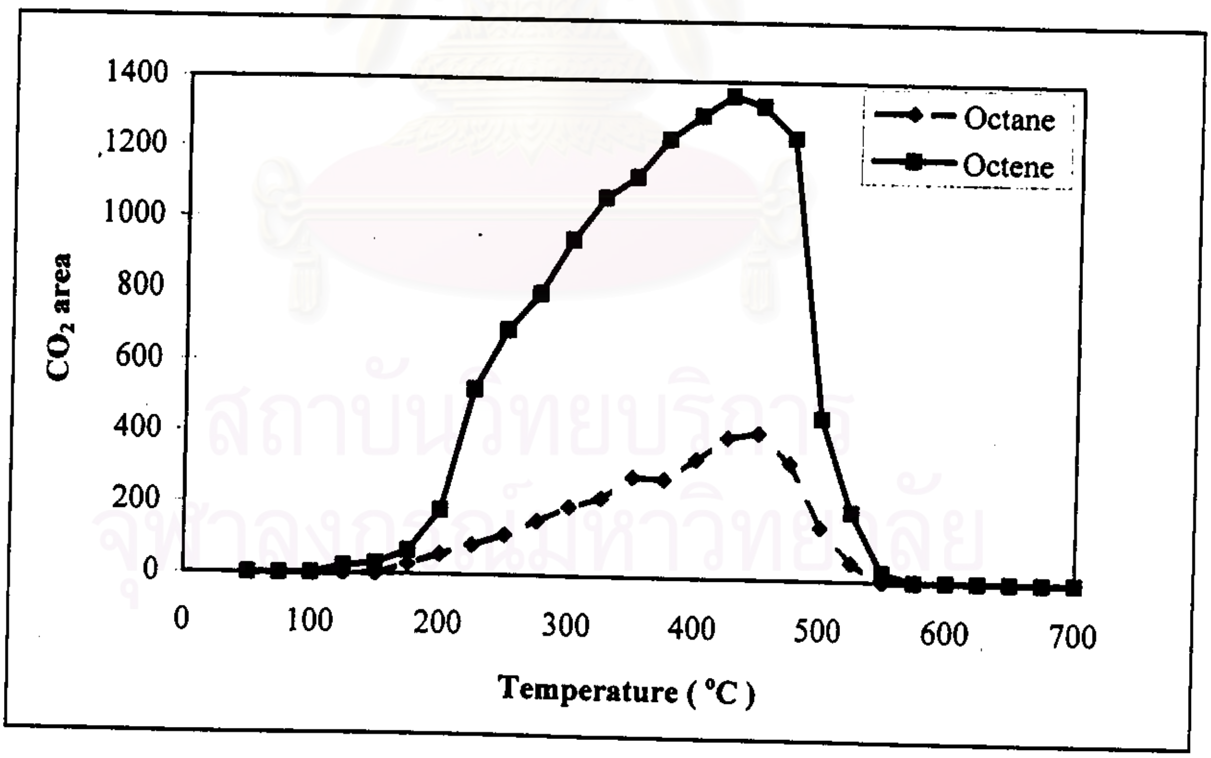

Figure E.3 TPO spectra for octane and octene dehydrogenation over 0.09 g. of 0.3%Pt 0.3% Sn 0.6%K /Al_2O_3 at 200 °C, 120 min., GHSV 22500 hr^{-1}.

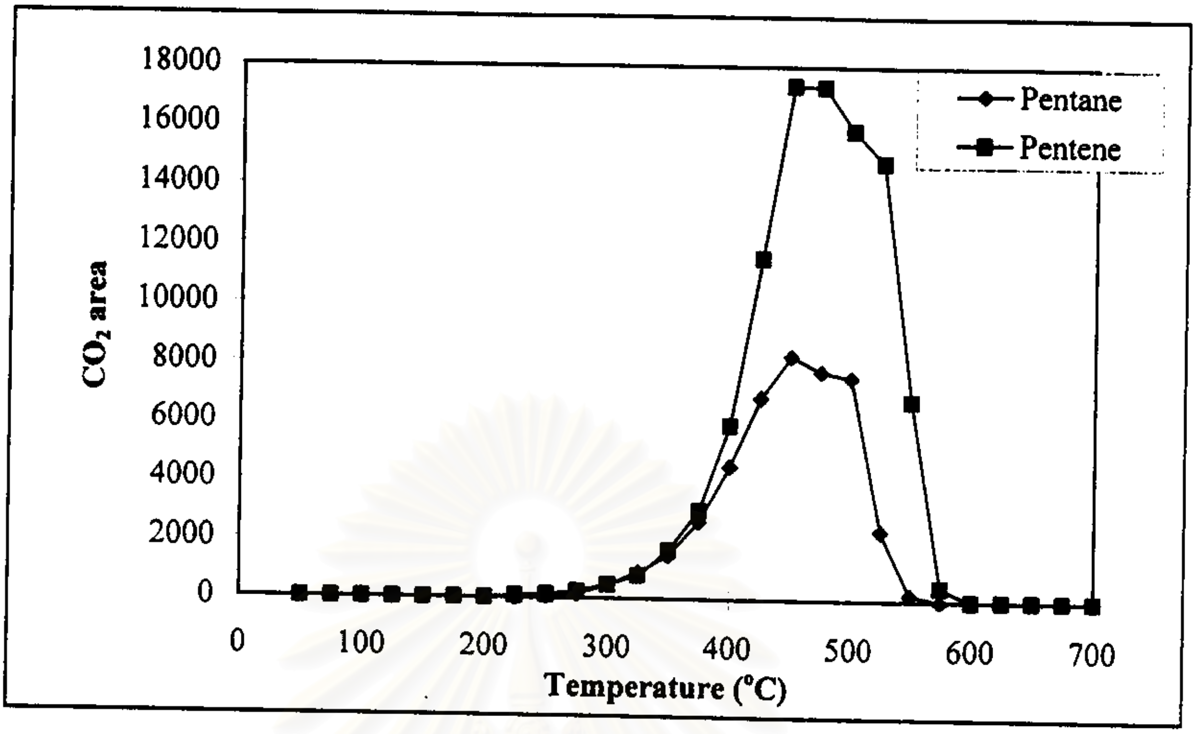

Figure E.4 TPO spectra for pentane and pentene dehydrogenation over 0.09 g. of 0.3%Pt 0.3% Sn 0.6%K /Al_2O_3 at 500 °C, 120 min., GHSV 22500 hr^{-1}.

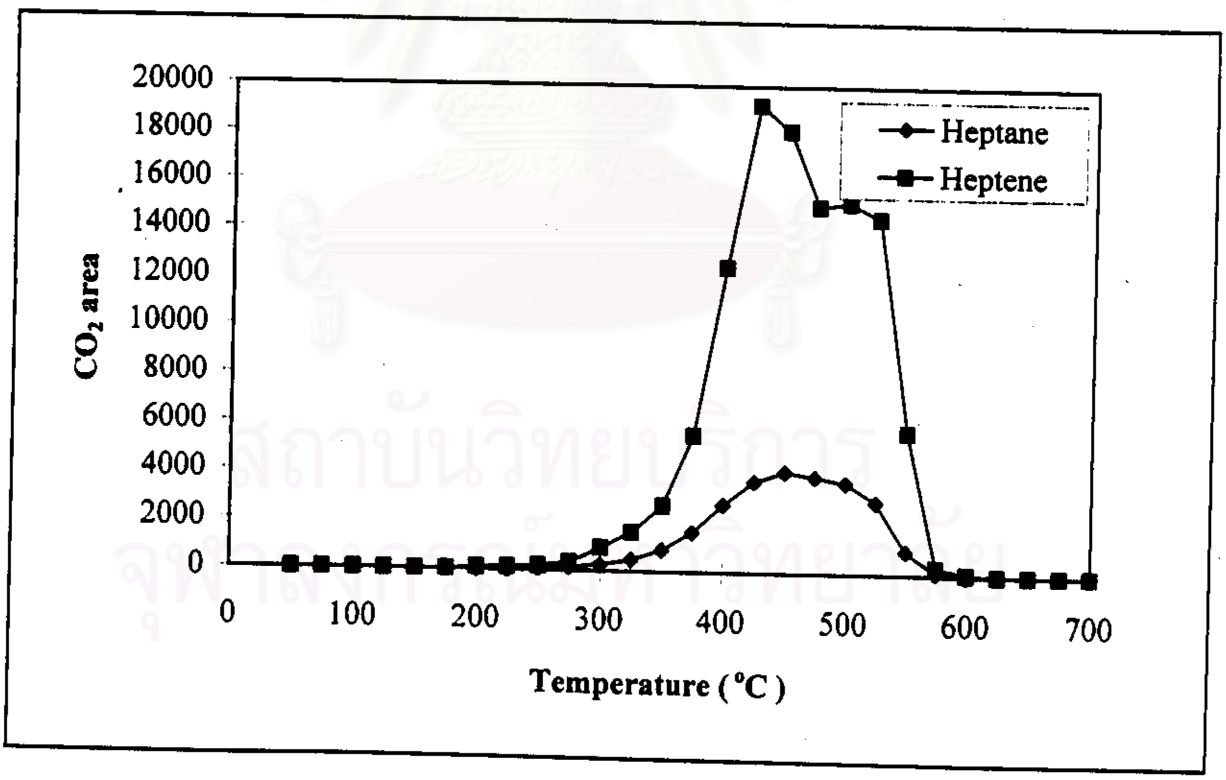

Figure E.5 TPO spectra for heptane and heptene dehydrogenation over 0.09 g. of 0.3%Pt 0.3% Sn 0.6%K /Al_2O_3 at 500 °C, 120 min., GHSV 22500 hr^{-1}.

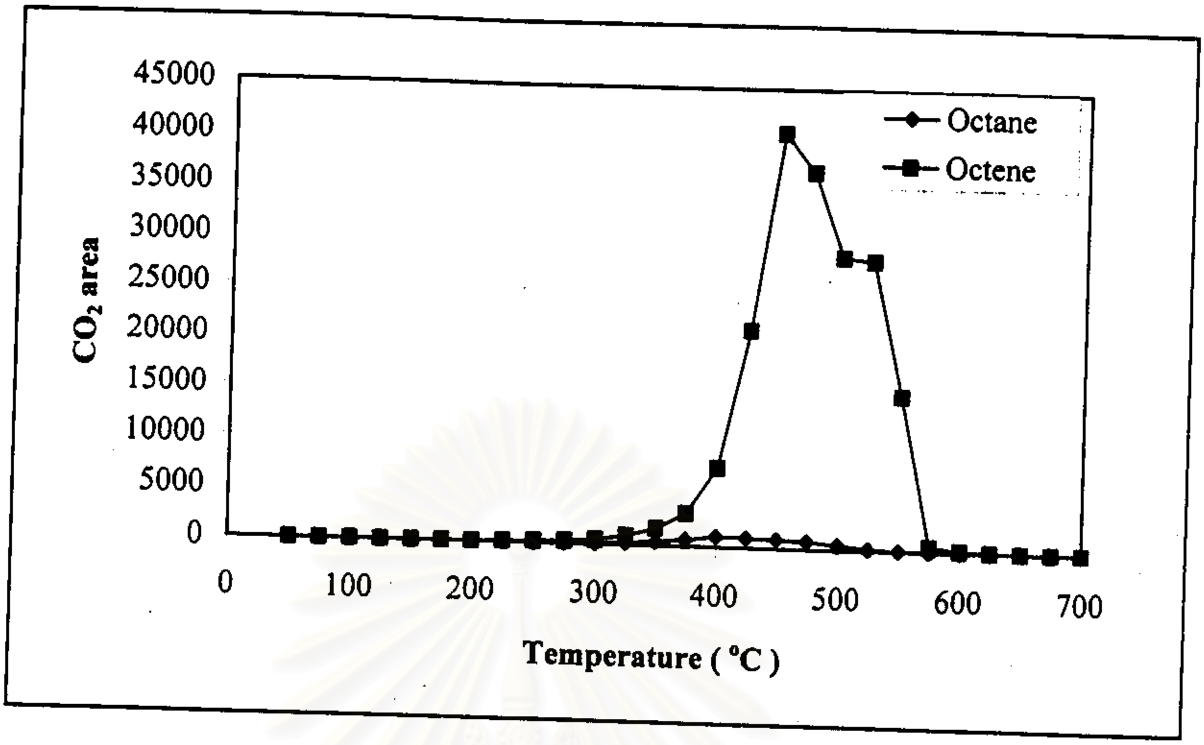

Figure E.6 TPO spectra for octane and octene dehydrogenation over 0.09 g. of 0.3%Pt 0.3% Sn 0.6%K /Al_2O_3 at 500 °C, 120 min., GHSV 22500 hr^{-1}.

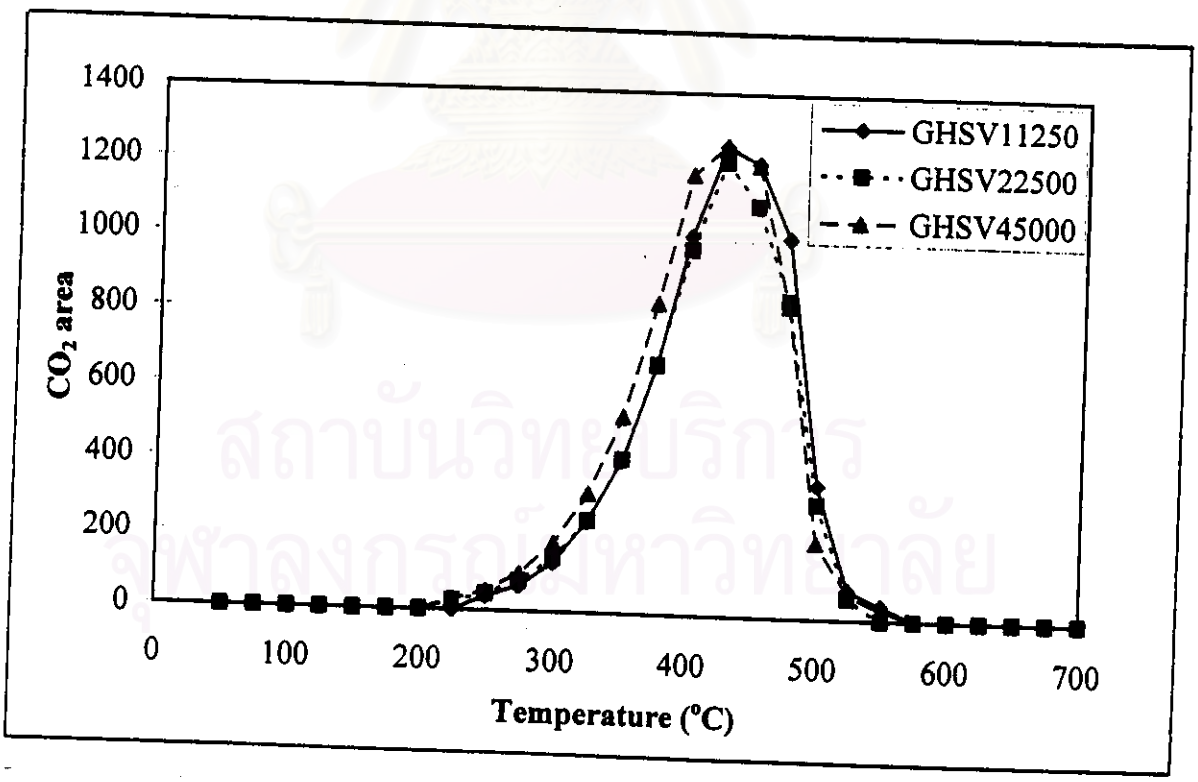

Figure E.7 TPO spectra for propane dehydrogenation over 0.09 g. of 0.3%Pt 0.3% Sn 0.6%K /Al_2O_3 at 500 °C, 120 min..

VITA

Miss Wilaiwan Yuangsawatdikul was born in Yala on March 13, 1974. She graduated high school from Satit School Prince of Songkhla University in 1991 and recceived her Bacheler degree of Chemical Engineering from the Faculty of Engineering, Chulalongkorn University in 1995.

หอสมุดกลาง สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย