

## REFERENCES

- Antos, G.J., and Aitani, A.M. (2004). Catalytic Naphtha Reforming: Science and Technology. New York: Marcel Dekker.
- Apesteguia, C.R., TrevizLq, S.M., Garetto, T.F., Plaza de los Reyes, J.F., and Parera, J.M. (1982). Sulfurization of Pt/Al<sub>2</sub>O<sub>3</sub>-Cl catalysts. IV. Adsorption sites of H<sub>2</sub>S on Al<sub>2</sub>O<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub>-Cl, and Pt/Al<sub>2</sub>O<sub>3</sub>-Cl. Reaction Kinetics and Catalysis Letters, 20(1-2), 1-6.
- Arteaga, G.J., Anderson, J.A., and Rochester, C.H. (1999). Effects of oxidation-reduction and oxychlorination-reduction cycles on Pt-Ge/Al<sub>2</sub>O<sub>3</sub> catalysts. Journal of Catalysis, 189(1), 195.
- Barrer, R.M. and Villiger, H. (1969). The crystal structure of the synthetic zeolite L. Zeitschrift fur Kristallographie, 128, 352-370.
- Bartholomew, C.H. (2001). Mechanisms of catalyst deactivation. Applied Catalysis A: General, 212, 17-60.
- Baur, W.H., and Fischer, R.X. (2006). Microporous and other framework materials with zeolite-type structures: Numerical Data and Functional Relationships in Science and Technology. Germany: Landolt-Börnstein.
- Beltramini, J.N., and Trimm, D.L. (1988). Role of germanium in bimetallic reforming catalysts. Reaction Kinetics and Catalysis Letters, 37(2), 293-299.
- Benitez, V., Boutzeloit, M., Mazzieri, V.A., Espeel, C., Epron, F., Vera, C.R., Marécot, P., and Pieck, C.L. (2007). Preparation of trimetallic Pt-Re-Ge/Al<sub>2</sub>O<sub>3</sub> and Pt-Ir-Ge/Al<sub>2</sub>O<sub>3</sub> naphtha reforming catalysts by surface redox reaction. Applied Catalysis A: General, 319, 210–217.
- Bernard, J.R. (1980). Proceedings of 5<sup>th</sup> International Conference on Zeolite, L.V.C. Ress (Ed), Heyden, London, 686.
- Bertolaccini, R.J., and Pellet R.J. (1980). Studies in surface Science and Catalysis, 6, 73.
- Biloen, P., Helle, J.N., Verbeek, H., Dautzenberg, F.M., and Sachtler, W.M.H. (1980). The role of rhenium and sulfur in platinum-based hydrocarbon-conversion catalysts. Journal of Catalysis, 63(1), 112-118.

- Biloen, P., Duatzenberg, F.M. and Sachtler, W.M. (1997). Catalytic dehydrogenation of propane to propene over platinum and platinum gold-alloys. Journal of Catalysis, 50, 77.
- Borgna, A., Garetto, T.F., and Apesteguía, C.R. (2000). Simultaneous deactivation by coke and sulfur of bimetallic Pt/Re(Ge, Sn)/Al<sub>2</sub>O<sub>3</sub> catalysts for *n*-hexane reforming. Applied Catalysis A: General, 197, 11–21.
- Boutzeloit, M., Benitez, V.M., Mazzieri, V.A., Espeel, C., Epron, F., Vera, C.R., Pieck, C.L., and Marécot, P. (2006). Effect of the method of addition of Ge on the catalytic properties of Pt-Re/Al<sub>2</sub>O<sub>3</sub> and Pt-Ir/Al<sub>2</sub>O<sub>3</sub> naphtha reforming catalysts. Catalysis Communications 7, 627–632.
- Briggs, D., and Seah, M.P. (1993). Practical Surface Analysis. Wiley.
- Burch, R. and Mitchell, A.J. (1983). The role of tin and rhenium in bimetallic reforming catalysts. Applied Catalysis, 6, 121-128.
- Charosset, H., Frety, R., Leclercq, G., Moroweck, B., Tournayan, L., and Varlou, J. (1979). Reaction Kinetics and Catalysis Letters, 10, 301.
- Coleto, I., Roldán, R., Jiménez-Sanchidrián, C., Gómez, J.P., and Romero-Salguero, F.J. (2007). Transformation of α-olefins over Pt-M (M = Re, Sn, Ge) supported chlorinated alumina. Fuel, 86, 1000-1007.
- Coq, B. and Figueras, F. (1984). Conversion of methylcyclopentane on platinum-tin reforming catalysts. Journal of Catalysis, 85, 197-205.
- Cortright, R.D. and Dumesic, J.A. (1994). Microcalorimetric, spectroscopic, and kinetic-studies of silica-supported Pt and Pt/Sn catalysts for isobutane dehydrocyclization. Journal of Catalysis, 148(2), 771-778.
- Cortright, R.D., Hill, J.M., and Dumesic, J.A. (2000). Selective dehydrogenation of isobutene over supported Pt/Sn catalysts. Catalysis Today, 55, 213-223.
- Crabb, E.M. and Ravikumar, M.K. (2001). Synthesis and characterization of carbon-supported PtGe electrocatalysts for CO oxidation. Electrochimica Acta, 46, 1033-1041.
- Davis, B.H., and Venuto, P.B. (1969). Paraffin dehydrocyclization : Distribution of aromatic products obtained with “nonacidic” supported Pt catalysts. Journal of Catalysis, 15(4), 363-372.

- Davis, R.J. (1993). Aromatization on zeolite L-supported Pt clusters. HCR Concise Review, 41-53.
- De Jongste, H.C., Ponec, V., and Gault, F.G. (1980). Influence of alloying Pt with Cu on the reaction mechanisms of hydrocarbon reforming reactions. Journal of Catalysis, 63, 398.
- Eley, D.D., Pines, H., and Weisz, P.B. (1983). Catalysis by alloys in hydrocarbon reactions. Advances in Catalysis, 32, 202.
- Fang, X., Li, F., and Luo, L. (1996). A study of platinum-thulium/KL zeolite reforming catalysts. Applied catalysis A, 146, 297-304.
- Fang, X., Li, F., Zhou, Q., and Luo, L. (1997). Effects of heavy rare earth addition on properties of KL zeolite-supported platinum reforming catalyst. Applied Catalysis A: General, 161, 227-234.
- Fukunaga, T., and Ponec, V. (1995). The nature of the high sensitivity of Pt/KL catalysts to sulfur poisoning. Journal of Catalysis, 157, 550-558.
- Fung, S.C., Tauster, S.J., and Koo, J.Y. (1990). US Patents No. 4925819.
- Fürchta, Á., Tungler, A., Szabób, S., and Sárkányc, A. (2001). *n*-octane reforming over modified catalysts I. The role of Sn, Te and Bi under industrial conditions. Applied Catalysis A: General, 226, 155-161.
- Grau, J.M., Daza, L., Seoane, X.L., and Arcoya, A. (1998). Effect of Ba and rare earths cations on the properties and dehydrocyclization activity of Pt/K-LTL catalysts. Catalysis Letters, 53, 161.
- Grbic, B., Radic, N., Markovic, B., Stefanov, P., Stoychev, D., and Marinova, Ts. (2006). Influence of manganese oxide on the activity of Pt/Al<sub>2</sub>O<sub>3</sub> catalyst for CO and *n*-hexane oxidation. Applied Catalysis B: Environmental, 64, 51.
- Hagen, J. (2006). Industrial Catalysis. Germany: WILEY-VCH Verlag GmbH & Co. KGaA Weinheim.
- Harandi, M.N. (1991). US Patent No. 5 030 782.
- Hill, J.M., Cortright, R.D., and Dumesic, J.A. (1998). Silica- and L-zeolite-supported Pt, Pt/Sn and Pt/Sn/K catalysts for isobutene dehydrogenation. Applied Catalysis A: General, 168, 9-21.

- Huang, C.-S., Sparks, D.E., Dabbagh, H.A., and Davis, B.H. (1992). Carbon-14 tracer study of the conversion of labeled *n*-propylcyclopentane during *n*-octane aromatization with a Pt-zeolite L catalyst. Journal of Catalysis, 134, 269.
- Huang, Z., Fryer, J.R., Park, C., Stirling, D., and Webb, G. (1998). Transmission electron microscopy, energy dispersive X-ray spectroscopy, and chemisorptions studies of Pt-Ge/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> reforming catalysts. Journal of Catalysis, 175, 226.
- Hughes, T.R., Buss, W.C., Tamm, P.W., and Jacobson, R.L. (1986). Aromatization of hydrocarbons over platinum alkaline earth zeolites. Studies in surface Science and Catalysis. Elsevier Science: Amsterdam, 28, 725.
- Jacobs, G., Padro, C., and Resasco D.E. (1998). Comparative study of *n*-hexane aromatization on Pt/KL, Pt/Mg(Al)O, and Pt/SiO<sub>2</sub> catalysts: clean and sulfur-containing feeds. Journal of Catalysis, 179, 43.
- Jacobs, G., Ghadiali, F., Pisanu, A., Padro C.L., Borgna, A., Alvarez, W.E., and Resasco, D.E. (1999). Characterization of the morphology of Pt clusters incorporated in a KL zeolite by vapor phase impregnation and incipient wetness impregnation: Influence of Pt particle morphology on aromatization activity and deactivation. Applied Catalysis A: General, 188, 79-98.
- Jacobs, G., Ghadiali, F., Pisanu, A., Padro, C.L., Borgna, A., Alvarez, W.E., and Resasco, D.E. (2000). Increased sulfur tolerance of Pt/KL catalysts prepared by vapor-phase impregnation and containing a Tm promoter. Journal of Catalysis, 191, 116-127.
- Jacobs, G., A., Alvarez, W.E., and Resasco, D.E. (2001). Study of preparation parameters of powder and palletized Pt/KL catalysts for *n*-hexane aromatization. Applied Catalysis A: General, 206, 267-282.
- Jao, R.-M., Leu, L.-J., and Chang J.-R. (1995). Effects of catalyst preparation and pretreatment on light naphtha isomerization over mordenite-supported Pt catalysts: Optimal reduction temperature for pure feed and for sulfur-containing feed. Applied Catalysis A: General, 135, 301-316.

- Jongpatiwut, S., Sackamduang, P., Rirksomboon, T., Osuwan, S., Alvarez, W.E., and Resasco, D.E. (2002). Sulfur- and water-tolerance of Pt/KL aromatization catalysts promoted with Ce and Yb. Applied Catalysis A: General, 230, 177–193.
- Jongpatiwut, S., Sackamduang, P., Rirksomboon, T., Osuwan, S., and Resasco, D.E. (2003). *n*-Octane aromatization on Pt/KL catalyst prepared by vapor-phase impregnation. Journal of Catalysis, 218, 1-11.
- Jongpatiwut, S., Trakarnroek, S., Rirksomboon, T., Osuwan, S., and Resasco, D.E. (2005). *n*-Octane aromatization on Pt-containing non-acidic large pore zeolite catalysts. Catalysis Letters, 100, 7-15.
- Ko, Y.S., and Ahn, W.S. (1999). Synthesis and characterization of zeolite L. Bulletin of the Korean Chemical Society, 20, 1-6.
- Komatsu, T., Mesuda, M., and Yashima, T. (2000). Aromatization of butane on Pt–Ge intermetallic compounds supported on HZSM-5. Applied Catalysis A: General, 194-195, 333-339.
- Lanh, H.D., Thoang, H.S., Lieske, H., and Volter J. (1984). Conversion of cyclohexane on bimetallic Pt-Sb/Al<sub>2</sub>O<sub>3</sub> catalysts. Applied Catalysis, 11.
- Lee, S.H., and Lee, H.I. (1994). The effect of catalyst modification on the catalytic activity in the dehydrocyclization of paraffins over Pt/γ-Al<sub>2</sub>O<sub>3</sub>. Korean Journal of Chemical Engineering, 11(3), 185-189.
- Lee, J. and Rhee H. (1998). Sulfur tolerance of zeolite beta-supported Pd-Pt catalysts for the isomerization of *n*-hexane. Journal of Catalysis, 177, 208–216.
- Li, F., Lu, W., Wu, G., and Li, J. (1994). A study of platinum—dysposium—KL zeolite catalyst. Journal of Alloys and Compounds, 207/208, 397.
- Li, Y., Stencel, J.M., and Davis, B.H. (1990). XPS studies of Pt-Sn naphtha reforming catalysts. Applied Catalysis, 64, 71-81.
- Llorca, J., Homs, N., Araña, J., Sales, J., De la Piscina, P.R. (1998). FTIR study of the interaction of CO and CO<sub>2</sub> with silica-supported PtSn alloy. Applied Surface Science, 134, 217-224.

- Macleod, N., Fryer, J.R., Stirling, D., and Webb, G. (1998). Deactivation of bi- and multimetallic reforming catalysts: influence of alloy formation on catalyst activity. *Catalysis Today*, 46, 37-54.
- Matar, S., Hatch, L. (1994). *Chemistry of petrochemical processes*. Texas: Gulf Publishing Company
- McVicker, G.B., Kao, J.-L., Ziemak, J.J., Gates, W.E., Robbins, W.E., Treacy, M.M.J., Rice, S.B., Vanderspurt, T.H., Cross, V.R., and Ghosh, A.K. (1993). Effect of sulfur on the performance and on the particle size and location of platinum in Pt/KL hexane aromatization catalysts. *Journal of Catalysis*, 139, 48.
- Meriaudeau, P. and Naccache, C. (1997). Dehydrocyclization of alkanes over zeolite-supported metal catalysts: Monofunctional or bifunctional route. *Catalysis Reviews*, 39(1&2), 5-48.
- Miller, J.T., and Shum, V.K. (1990). US Patents No. 4954245.
- Miller, J.T., and Koningsberger, D.C. (1996). The origin of sulfur tolerance in supported platinum catalysts: The relationship between structural and catalytic properties in acidic and alkaline Pt/LTL. *Journal of Catalysis*, 162, 209-219.
- M'Kombe, C.M., Dry, M.E., and O'Connor, C.T. (1997). Influent of preparation variables on the dispersion of platinum on zeolite KL. *Zeolites* 19, 175-179.
- Olah, G.A., and Molnár, A. (2003). *Hydrocarbon Chemistry*. Wiley-Interscience.
- Paal, Z., Matusek, K., and Muhler, M. (1996). Sulfur adsorbed on Pt catalyst: its chemical state and effect on catalytic properties as studied by electron spectroscopy and n-hexane test reactions. *Applied Catalysis A: General*, 149, 113-132.
- Passos, F.B., Aranda, D.A.G., Schmal, M. (1998). Characterization and catalytic activity of bimetallic Pt-In/Al<sub>2</sub>O<sub>3</sub> and Pt-Sn/Al<sub>2</sub>O<sub>3</sub> catalysts. *Journal of Catalysis*, 178, 478.
- Ponec, V., and Bond, G.C. (1995). *Catalysis by Metals and Alloys*. Elsevier: Amsterdam.

- Pradier, C.M., Margot, E., Berthier, Y., and Oudar, J. (1988). Hydrogenation of 1,3-butadiene on Pt(111): Comparison with results on Pt(110) and Pt(100). Applied Catalysis, 43(1), 177-192.
- Resasco, D.E., Durante, V.A., Kim, J., Larsen, G., and Haller, G.L. (1994). Spectroscopy in Catalysis: By J. W. Niemantsverdriet. VCH, Weinheim.
- Studies in Surface Science and Catalysis, 46(1), 321.
- Resasco, D.E., Padro, C.L., Jacobs, G., and Liu, H. (2000). US Patent No. 6096675.
- Sahoo, S.K., Rao, P.V.C., Rajeshwer, Dongara., Krishnamurthy, K.R., and Singh, I.D. (2003). Structural characterization of coke deposits on industrial spent paraffin dehydrogenation catalysts. Applied Catalysis A: General, 244, 311-321.
- Santos, M.C.S., Grau, J.M., Pieck, C.L., Parera, J.M., Fierro, J.L.G., Fígoli, N.S., and Rangel, M.C. (2005). The effect of the addition of Re and Ge on the properties of Pt/Al<sub>2</sub>O<sub>3</sub>. Catalysis Letters, 103(3-4).
- Sárkány, A., Lieske, H., Szilágyi, T., and Tóth, L. (1984). Proceedings of the Eighth International Congress on Catalysis, Berlin, Vol. II (Verlag Chemie, Weinheim, 613.
- Stevenson, S.A., Farmer, D.B., and Mitchell, S.F. (2008) US. Patents No. 20080255398.
- Tauster, S.J., Montagna, A.A., Steger, J.J., Fung, S.C., Cross, V.R., and Kao, J.L. (1986). US. Patents No. 4595670.
- Trakarnroek, S. *et al.* (2007). *n*-octane aromatization on Pt supported on novel zeolite. Ph.D. Dissertation, The Petroleum and Petrochemical College, Chulalongkorn University.
- Treacy, M.M.J. (1999). Pt agglomeration and entombment in single channel zeolites: Pt/LTL. Microporous and Mesoporous Materials, 28, 271-292.
- Vaarkamp, M., Miller, J. T., Modica, F. S., Lane, G. S., and Koningsberger, D. C. (1992). Sulfur poisoning of a Pt/BaK-LTL catalyst: A catalytic and structural study using hydrogen chemisorption and x-ray absorption spectroscopy. Journal of Catalysis, 138, 675-685.

- Westfall, G.A., Pezzanite, J.O., Davis, B.H., and Watkins, J. (1976). Paraffin dehydrocyclization: VI. The influence of metal and gaseous promoters on the aromatic selectivity. Journal of Catalysis, 42(2), 247-256.
- Zheng, J., Dong, J., Xu, Q., and Hu, C. (1996). The function of zeolite on Pt autoreduction and dispersion in Pt/L and Pt/ $\beta$  catalysts. Catalysis Letters, 37, 25-28.

## CURRICULUM VITAE

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### **Presentations:**

1. Paopahon, P., Jongpatiwut, S., Rirksomboon, T., Osuwan, S., and Resasco, D.E. (2010, March 22) Sulfur Tolerance of PtGe/KL Catalysts for *n*-Octane Aromatization. The 239<sup>th</sup> ACS National Meeting & Exposition, San Francisco, USA.

### **Proceedings:**

1. Paopahon, P., Jongpatiwut, S., Rirksomboon, T., Osuwan, S., and Resasco, D.E. (2010, April 22) Effect of Sulfur on *n*-Octane Aromatization over Sn- and Ge-promoted Pt/KL Catalysts. Proceedings of The 1<sup>st</sup> National Research Symposium on Petroleum, Petrochemicals, and Advanced Materials and The 16<sup>th</sup> PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

