Jeffrey T. Miller

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Purdue University

2015-present **Davidson School of Chemical Engineering**

Professor of chemical engineering with research interests in the heterogeneous catalysis synthesis for production of energy and environmental protection. Catalytic reactions include alkane dehydrogenation with alloy metal nano-particles, zeolite conversions of light alkanes to fuels, and selective catalytic NO_x conversion for exhaust emissions. The group also has expertise in characterization of catalysts under realistic reaction conditions of high temperature and pressure, especially X-ray absorption spectroscopy and X-ray diffraction at the Advanced Photon Source, in situ infrared, UV-Vis, TEM, X-ray photoelectron spectroscopies at Purdue.

Argonne National Laboratory

2008-2014 **Chemical Science and Engineering**

Senior Scientist and group leader of the heterogeneous catalysis group developing, testing and characterizing new catalytic materials for energy production. Catalytic reactions include conversion of biomass and natural gas to transportation fuels. Catalytic materials include supported nano-particles and alloys; single site, supported heterogeneous catalysts, colloidal nano-particles and homogenous catalysts. Special interest in characterization of catalysts under realistic reaction conditions of high temperature and pressure, especially X-ray absorption spectroscopy at the Advanced Photon Source.

Industrial Chemical Engineering Experience

BP Chemicals Company

2007-2008 **Aromatic Technology Development**

Team leader for development of new selective oxidation catalyst: responsible for lab-scale preparation, optimization and intermediate scale-up. Additional responsibilities include analytical characterizations of the new catalyst.

1998-2006 **Para-Xylene Business Unit**

Team leader for development of proprietary catalysts: responsibilities include material synthesis, pilot plant evaluations, transfer of proprietary methods to catalyst manufacturer and plant demonstrations. Additional responsibilities include development of advanced separation processes.

AMOCO Oil Company

1994-1997 **Residual Oil Process Division**
Lead catalyst team for developed a new catalyst for conversion of asphalt to transportation fuels

1992-1994 **Fluid Catalytic Cracking Process Division**
Team leader for commercialization of a process for disposal of waste plastics to fuels

1988-1992 **Naphtha Reforming Process Division**
Team leader for the developed a new catalyst and process for conversion of light paraffins to aromatics

1985-1988 **Hydrotreating Process Division**
Commercialized catalyst and process improvements for a distillate hydrocracking process

1982-1985 **Synthetic Fuels Division**
Developed a catalyst and process to convert CO + H_2 to iso-paraffins or higher alcohols

1980-1982 **Synthetic Fuels Division**
Developed a two-stage, shale oil hydrocracking catalyst and process for production of jet fuel

Education

1980 **Oregon State University**, Corvallis, OR
Ph. D., Inorganic Chemistry Advisor: C.W. DeKock

1973 **University of New Mexico**, Albuquerque, NM
M. S., Inorganic Chemistry

1971 **Memphis State University**, Memphis, TN
B. S., Chemistry

Professional Activities and Awards

2021 Seed for Success Research Award from Purdue University
2020 Excellence in Research Award from Purdue University
2020 CISTAR Faculty Mentor Award
2018 Seed for Success Research Award from Purdue University
2012-14 Adjunct Professor of Chemical Engineering, Purdue University
2012 Pierre et Marie Curie Lectureship in Catalysis from the University of Paris
2010 F.G. Ciapetta Award in Catalysis from the North American Catalysis Society
2009 Excellence in Catalysis Award from the Metropolitan Catalysis Society of NY
2007 Member of NSF-DOE International Catalysis Assessment Committee
2006 Herman Pines Award in Catalysis from the Chicago Catalysis Society
2000-08 Officer in Chicago Catalysis Club
1998 Adjunct Professor, Department of Chemical Engineering, Univ. of Illinois at Chicago
1997-2004 Editorial Board, Applied Catalysis A: General
1997 Secretary of the North American Catalysis Society Meeting in Chicago

University and National Laboratory Collaborations

Bell, Alex, Dept. of Chemical and Biomolecular Engineering, University of California, Berkeley, CA 94720

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Wu, Yue, Dept. Chem. & Bio Eng., Iowa State University, Ames, IW 50010

Zhang, Guanghui, Department of Chemical Engineering, Dalian University of Technology, Dalian, CHINA

Publications

1. Tait, A.M.; Miller, J.T.; and Hensley, A.L.; "Direct Hydrocracking of Shale Oil," *Shale Oil Upgrading and Refining*, 100 (26), 73 (1983).
2. Miller, J.T. and Hineman, M.F.; "Non-First Order Hydrodenitrogenation Kinetics of Quinoline," J. Catal., 85, 117 (1984).
3. Miller, J.T. and Nevitt, T.D.; "Iso-paraffin Synthesis by Hydrogenation of Carbon Monoxide Over Cadmium Catalysts," J. Catal., 103, 512 (1987).
4. Hopkins, P.D.; Marshall, C.L.; Miller, J.T. and Raska, L.B.; "Hexane Cracking on Clean Zeolite Surfaces," *Stud. Surf. Sci. Catal., 38: Catalysis 1987*, eds. J.W. Ward, Elsevier, Amsterdam, 281 (1988).
5. Meyers, B.L.; Fleisch, T.H.; Ray, G.J.; and Miller, J.T.; "A Multi-technique Characterization of Dealuminated Mordenite," J. Catal., 110, 82 (1988).
6. Fleisch, T.H.; Zajac, G.W.; Meyers, B.L.; Ray, G.J.; and Miller, J.T.; "A Multi-technique Study of Coking in Zeolites," *Catalysis: Theory and Practice, Proc. Ninth Int. Catal. Cong. (Calgary*), Eds. M.J. Phillips and M. Ternan, Chem. Inst. Can., Ottawa, Vol. 1, 483 (1988).
7. Zajac, G.W.; Miller, J.T., Fleisch, T.H.; Meyers, B.L.; Ray, G.J.; "Electron Energy Loss Studies of Propylene Interactions in H-USY Zeolites," J. Catal., 115, 254 (1989).
8. Sajkowski, D.J.; Miller, J.T.; Zajac, G.W.; Morrison, T.I.; Chen, H.; and Fazzini, D.R.; "Phosphorus Promotion of Mo/Al_2O_3 Hydrotreating Catalysts," Appl. Catal., 62, 205 (1990).
9. Díez, F; Gates, B.C.; Miller, J.T.; Sajkowski, D.S.; and Kukes, S.G.; "Deactivation of a $NiMo/\gamma\text{-}Al_2O_3$ Catalyst: Influence of Coke on the Hydroprocessing Activity," I&EC Res., 29, 1999 (1990).
10. Vaarkamp, M.; van Grondelle, J.; Miller, J.T.; Sajkowski, D.J.; Modica, F.S.; Lane, G.S., Gates, B.C.; and Koningsberger, D.C.; "Platinum Clusters in Ba KL Zeolite: Characterization by Transmission Electron Microscopy, Hydrogen Chemisorption and X-Ray Absorption Spectroscopy," Catal. Lett., 6, 369 (1990).
11. Miller, J.T.; Meyers, B.L.; Ray, G.J.; " Xe NMR and Ar Quasi-Equilibrium Sorption Studies of Coked H-Y Zeolite," J. Catal., 128, 436 (1991).
12. Lane, G.S., Modica, F.S.; and Miller, J.T.; "Platinum/Zeolite Catalysts for Reforming n-Hexane: Kinetic and Mechanistic Considerations," J. Catal., 129, 145 (1991).
13. Miller, J.T.; Hopkins, P.D.; Meyers, B.L.; Ray, G.J.; Roginski, R.T.; Zajac, G.W.; and Rosenbaum, N.H.; "The Effect of Non-framework Aluminum on Acidity in Dealuminated Mordenite," J. Catal., 138, 115 (1992).
14. Vaarkamp, M.; Miller, J.T.; Modica, F.S.; Lane, G.S.; and Koningsberger, D.C.; Sulfur Poisoning of a Pt/Ba K-LTL Catalyst: A Catalytic and Structural Study Using Hydrogen Chemisorption and X-Ray Absorption Spectroscopy," J. Catal., 138, 675-685 (1992).
15. Vaarkamp, M.; Miller, J.T.; Modica, F.S.; and Koningsberger, D.C.; "The Influence of Metal-Support Interactions on the Whiteline Intensity," Jap. J. Appl. Phy., 32 (Suppl. 32-2, XAFS VII), 454 (1993).
16. Lane, G.S.; Miller, J.T.; Modica, F.S.; and Barr, M.K.; "Infrared Spectroscopy of Adsorbed Carbon Monoxide on Platinum/Non-acidic Zeolite Catalysts," J. Catal., 141, 465 (1993).

17. Miller, J.T.; Meyers, B.L.; Modica, F.S.; Lane, G.S.; Vaarkamp, M.; and Koningsberger, D.C.; "Hydrogen Temperature-Programmed Desorption (H_2 TPD) of Supported Platinum Catalysts," J. Catal., 143, 395 (1993).
18. Vaarkamp, M.; Modica, F.S.; Miller, J.T.; and Koningsberger, D.C.; "Influence of Hydrogen Pretreatment on the Structure of the Metal-Support Interface in Pt/Zeolite Catalysts," J. Catal., 144, 611 (1993).
19. Kappers, M.J.; Vaarkamp, M.; Miller, J.T.; Modica, F.S.; Barr, M.K.; van der Mass, J.H.; and Koningsberger, D.C.; "Ion-Dipole Interactions Between Adsorbed CO an Support Cations in Pt/K-LTL," Catal. Lett., 21, 235 (1993).
20. Sharma, S.B.; Meyers, B.L.; Chen, D.T.; Miller, J.T.; and Dumesic, J.A.; "Characterization of Catalyst Acidity by Microcalorimetry and Temperature-Programmed Desorption," Appl. Catal. A: Gen., 102, 253 (1993).
21. Triantafillou, N.D.; Miller, J.T.; and Gates, B.C.; "Ir Clusters in KL Zeolite: Characterization by Physical Methods and Catalyst Performance," ACS Div. Pet. Chem., Prep., 38 (4), 812 (1993).
22. Miller, J.T.; Modica, F.S.; Meyers, B.L.; and Koningsberger, D.C.; "The Role of Spillover Hydrogen in the Hydrogenolysis of Neopentane," ACS Div. Pet. Chem., Prep., 38 (4), 825 (1993).
23. Vaarkamp, M.; van Grondelle, J.; van Santen, R.A.; Miller, J.T.; Meyers, B.L.; Meyers, B.L.; Modica, F.S.; Lane, G.S.; and Koningsberger, D.C.; "The Influence of Hydrogen Pretreatment on the Structure and Catalytic Properties of a Pt/K-LTL Catalyst," *Proc. from the Ninth Int. Zeolite Conf., 1992 (Montreal)*, eds. R. von Ballmoos, J.B. Higgins and M.M.J. Treacy, Butterworth-Heinemann, Stoneham, vol. II, 433 (1993).
24. Vaarkamp, M.; Miller, J.T.; Modica; Lane, G.S.; and Koningsberger, D.C.; "The Relation Between Catalytic and Electronic Properties of Supported Platinum Catalysts: The Local Density of States as Determined by X-ray Absorption Spectroscopy, "*Stud. Surf. Sci. Catal., 75A: Proc. of the Tenth Int. Catal. Cong. (Budapest)*, Eds. Guczi, L.; Solymosi, F.; and Tetenyi, P., Elsevier Science Publishers, B.V., Amsterdam, 809 (1993).
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27. Koningsberger, D.C. and Miler, J.T.; "Local Structure Determination of Aluminum in Y Zeolite: Application of Low Energy X-ray Absorption Fine Structure Spectroscopy," Catal. Lett., 29, 77 (1994).
28. Vaarkamp, M.; Dijkstra, P.; van Grondelle, J.; Miller, J.T.; Modica, F.S.; Koningsberger, D.C.; and van Santen, R.A.; "Methylcyclopentane Ring Opening Over Supported Platinum Catalysts: The Effect of Hydrogen-to-Methylcyclopentane Ratio," J. Catal., 151, 330 (1995).
29. Triantafillou, N.D.; Miller, J.T.; and Gates, B.C.; "Iridium Clusters in K-LTL Zeolite: Structure and Catalytic Selectivity for n-Hexane Aromatization," J. Catal., 155, 131 (1995).

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31. Koningsberger, D.C. and Miller, J.T., "Withdrawal of Electron Density by Cations from Framework Aluminum in Y Zeolite Determined by Al EXAFS Spectroscopy," *Studies in Surface Science and Catalysis, 97:* Zeolites A Refined Tool for Designing Catalytic Sites," Proc. of the Int. Zeolite Symp., eds., L. Bonneviot and S. Kaliaguine, Elsevier Science Publishers, B.V., Amsterdam, Quebec (1995), 125.
32. Vaarkamp M., Mojet, B.L., Kappers, M.J., Miller, J.T. and Koningsberger, D.C.; "Hydrogen as a Modifier of the Structure and Electronic Properties of Platinum in Acidic Zeolite LTL: A Combined Infrared and X-Ray absorption Spectroscopy Study," J. Phys. Chem., 99, 16067 (1995).
33. Kappers, M.; Miller, J.T.; and Koningsberger, D.C.; "Deconvolution and Curve Fitting of IR Spectra for CO Adsorbed on Pt/K-LTL: Potassium Promoter and Adsorption Site Distribution," J. Phy. Chem., 100, 3227 (1996).
34. Triantafillou, N.D.; Deutsch, S.E.; Alexeev, O.; Miller, J.T.; and Gates, B.C.; "Ir/KLTL Zeolites: Structural Characterization and Catalysis of n-Hexane Reforming," J. Catal., 155, 131 (1995).
35. Miller, J.T.; Meyers, B.L., Barr, M.K., Modica, F.S.; and Koningsberger, D.C.; "Hydrogen Temperature Programmed Desorption in Platinum Catalysts: Decomposition and Isotopic Exchange by Spillover Hydrogen of Chemisorbed Ammonia," J. Catal., 159, 41 (1996).
36. Hopkins, P.D., Miller, J.T., Meyers, B.L., Ray, G.J., Roginski, R.T., Kuehne, M.A. and Kung, H.H., Appl. Catal., A, "Effect of Coke on Acidity and Cracking Activity of Ultrastable Y Zeolite," Appl. Catal. A: Gen., 136, 29 (1996).
37. Koningsberger, D.C. and Miller, J.T.; "The Effect of Steam Dealumination on the Local Aluminum Structure in H-USY Determined by Al EXAFS," in *Studies in Surface Science and Catalysis, 101B: Proc. of the Eleventh ICC,* eds., J.W. Hightower, W.N. Delgass, E. Iglesia, and A.T. Bell, Elsevier, Amsterdam, 841, (1996).
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39. Miller, J.T. and Koningsberger, D.C.; "The Origin of Sulfur Tolerance in Supported Platinum Catalysts: The Relationship Between Structural and Catalytic Properties in Acidic and Alkaline Pt/LTL," J. Catal., 162, 209-219 (1996).
40. Miller, J.T.; Lane, G.S.; and Modica, F.S.; "Pore Structure Effects on Ring Closure Selectivities in Platinum L-Zeolite Reforming Catalysts," J. Catal., 163, 106 (1996).
41. Vaarkamp, M., Miller, J.T., Modica, F.S., and Koningsberger, D.C., "On the Relation Between Particle Morphology, Structure of the Metal-Support Interface, and Catalytic Properties of Pt/γ-Al_2O_3," J. Catal., 163, 294 (1996).
42. Duetsch, S.E., Miller, J.T., Tomishige, K., Iwasawa, Y., Weber, W.A. and Gates, B.C., "Supported Ir and Pt Clusters: Reactivity with Oxygen Investigated by Extended X-ray Absorption Fine Structure Spectroscopy," J. Phy. Chem., 100, 13408 (1996).

43. Hunt, J.E., Winans, R.E., and Miller, J.T., "Characterization of Asphaltenes from Processed Resid," Prepts., ACS Div. Fuel Chem., 42(2), 427 (1997).
44. Kuehne, M.A., Kung, H.H., and Miller, J.T., "Effect of Steam Dealumination on HY Acidity and 2-Methylpentane Cracking Activity," J. Catal., 171, 293 (1997).
45. Babitz, S.M., Kuehne M.A., Kung H.H., and Miller, J.T., "The Role of Lewis Acidity in the Deactivation of USY Zeolites During 2-Methylpentane Cracking," Ind. Eng. Chem. Res., 36, 3027 (1997).
46. Kuehne, M.A.; Babitz, S.M.; Kung, H.H.; and Miller, J.T.; "Effect of Framework Al Content on HY Acidity and Cracking Activity," Appl. Catal. A: Gen., 166, 293 (1998).
47. Miller, J.T. and Pei, S.; "Hydrogenation and Deuterium Exchange by Spillover Hydrogen of Ethylbenzene Adsorbed on H-USY Zeolite," Appl. Catal. A: General, 168, 1 (1998).
48. Babitz, S.M.; Williams, B.A.; Kuehne, M.A.; Kung, H.H.; and Miller, J.T.; "Surface Equilibrium in Adsorption Microcalorimetry of Bases on H-USY," Thermochimica Acta, 312, 17 (1998).
49. Miller, J.T.; Glusker, E.; Peddi, R.; Zheng, T.; and Regalbuto, J.R.; "The Role of Acid Sites in Cobalt Zeolite Catalysts for Selective Catalytic Reduction of Lean NO_x," Catal. Lett., 51, 15-22 (1998).
50. Miller, J.T., Fisher, R.B., P. Thiyagarajan, R.E. Winans, and J.E. Hunt, "Sub-fractionation and Characterization of Mayan Asphaltene," Energy and Fuels, 12, 1290 (1998).
51. Williams, B.A., Babitz, S.M., Miller, J.T., Snurr, R.Q., and Kung, H.H., "An Explanation for the High Cracking Activity Observed in Steamed Y Zeolites," Proc., 12th Int. Zeolite Conference, M.M.M. Treacy, B.K. Marcus, M.E. Bisher, J.B. Higgins, eds., Materials Research Society, I, 465, (1998).
52. Williams, B.A., Babitz, S.M., Miller, J.T., Snurr, R.Q. and Kung, H.H., "The Roles of Acid Strength and Pore Diffusion in the Enhanced Cracking Activity of Steamed Y Zeolites," Appl. Catal. A: Gen., 177, 161 (1999).
53. Babitz, S.M., Williams, B.A., Miller, J.T., Snurr, R.Q., Haag, W.O. and Kung, H.H., "Monomolecular Cracking of n-Hexane on Y, MOR, ZSM-5 Zeolites," Appl. Catal. A: Gen.; 179, 71 (1999).
54. Miller, J.T., Fisher, R.B., van der Eerden, A.M.J., and Koningsberger, D.C., "Structural Determination by XAFS Spectroscopy of Non-Porphyrin Ni and V in Maya Residuum, Hydrocracked Residuum and Toluene Insoluble Solid," Energy and Fuels, 13, 719 (1999).
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58. Mojet, B.L.; Miller, J.T.; Ramaker, D.E.; Koningsberger, D.C.; "A New Model Describing the Metal-Support Interaction in Noble Metal Catalysts," J. Catal., 186, 373 (1999).

59. Regalbuto, J.R., T. Zheng and Miller, J.T., "The Bifunctional Nature of Zeolite Based Catalysts for Lean NO_x Reduction," Catal. Today, 54, 495-505 (1999).
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61. Hunt, J.E., Winans, R.E., Miller, J.T., and Thiyagarajan, P., "Contrast Variation Small Angle Neutron Scattering of Petroleum Asphaltene," in *Mat. Res. Using Cold Neutrons at Pulsed Neutron Sources*, F. Trouw, B. Marzec, and C.-K. Loong, eds., World Scientific Pub., 173 (1999).
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66. Kung, H.H., Williams, B.A., Babitz, S.M., Miller, J.T., Haag, W.O., and Snurr, R.Q.; "Enhanced Hydrocarbon Cracking Activity of Y Zeolites," Topics in Catalysis, 10, 59-64 (2000).
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74. Koningsberger, D.C., Ramaker, D.E., Miller, J.T., de Graaf, J., and Mojet, B.L., "The Direct Influence of the Support on the Electronic Structure of the Active Sites in Supported Metal Catalysts: Evidence from Pt-H Anti-Bonding Shape Resonance and Pt-CO FTIR Data," Topics in Catal., 15, 35 (2001).
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