Curriculum Vita
Robert J. Farrauto, Ph.D.
Professor of Practice
Columbia University

Personal

Birth Date: November 22, 1941 / New York City
Gender: Male
Citizenship: United States of America
Status: Married with two children/six grandchildren, two step-daughters

Education

Ph.D. Chemistry, 1968, Rensselaer Polytechnic Institute, Troy, New York
Advisor: David Aikens
B.S. Chemistry, 1964, Manhattan College, Bronx, New York

Employment Experience

September 2012- present: Professor of Practice, Columbia University, Earth and Environmental Engineering Department, Columbia University, in the City of New York

2005-August 2012: Adjunct Professor, Earth and Environmental Engineering Department, Columbia University, in the City of New York

2008-retired August 2012:Research Vice President, BASF Catalysts (formerly Engelhard), 25 Middlesex-Essex Turnpike, Iselin, New Jersey 08830

1995-2008: Research Fellow and Manager of Hydrogen and Fuel Cell Technology
Currently leads a team of 8scientists and engineers developing catalysts for hydrocarbon fuel processing for the generation of hydrogen and fuel cells. Our team has commercialized 25 new products for world wide markets.

1990-1995: Principle Scientist of Manager of Diesel Technology
Led a team of 20 scientists and engineers in the development of the first monolith-diesel oxidation catalyst for heavy duty trucks, buses and light duty vehicles for the US, Asian and European market. Total revenues have exceeds $200 million. Developed new nitric oxide catalysts and hydrocarbon traps for automobile catalytic converters

1976-1990: Manager of Chemical and Environmental Catalysts

Managed a team of scientists and engineers in the development of advanced three way catalysts for abating emissions from passenger car vehicles serving the US, Asian and European market. Farrauto led a team in the development of improved chemical catalysts for the production of nitric acid. Supervised a research team developing new catalysts for the hydrogenation of a wide variety of organic functional groups. Was responsible for establishing a materials characterization group serving the entire worldwide company needs for catalyst and materials product.

1974-1976 Research Scientist, Gulf Oil, Harmarville, PA

Catalyst development in upgrading petroleum and coal liquids to useful fuels and chemicals.

1968-1974 Research Scientist at Corning Glass Works, Corning New York

Catalyst development for base metal emission control catalysts

Recent Publications

1. Simson, A. Castaldi, M. and Farrauto, R. "Kinetic and process study for ethanol reforming using a Rh/Pt washcoated monolith catalyst" Applied Catalyst B: Environmental , "Kinetic and process study for ethanol reforming using a Rh/Pt washcoated monolith catalyst." *Applied Catalysis B: Environmental*, 89, (1-2), 2009, 58-64

2. Simson, A. Farrauto, R. and Casaldi, M "Catalyst deactivation and regeneration reforming ethanol/gasoline blends containing sulfur" Applied Catalysis B Environmental 106 (2011 295-303

3. Gruene, P, Belsova, A., Yegalup, T. Farrauto, R. And Castaldi, M "Dispersed calcium oxide as a reversible and efficient CO2-sorbent for intermediate temperatures. IE and C Research 50 (2011) 4042-4049

4. Zhang, Q and Farrauto, R. "Methanol steam reforming catalyst for portable power applications" Applied Catalysis A. General 2011

5. R. Farrauto, A. Schaefer, E. Schwab, H. Urtel "Hydrocarbon Reforming Catalysts and New Reactor Designs for Compact Hydrogen Generators" Oil and Gas Europe 2011.

6 .Simson, A. Waterman, E. Farrauto, R. J. and Castaldi , M "Kinetic and process study for ethanol reforming using a PtRh monolith catalyst" APCAT B: Environmental 89, (2009) 58

7. Kohn, M., Castaldi, M. and Farrauto, R "ATR and dry reforming of landfill gas over a Rh/ Al2O3 monolith catalyst" APCAT B: Environmental 94 (2010) 125

Total publications ~ 100, US patents 51

Awards

- 2008 Ciapetta Lectureship Award sponsored by the North /American Catalysis Society
- 2005 Catalysis and Reaction Engineering Practice Award from the American Institute of Chemical Engineers
- 2001 International Precious Metal Institute (IPMI) Award for Outstanding Contributions in the field of precious metal catalysis
- 1998 Cross Canada Lectureship Award sponsored by the Canadian Catalysis Society
- 1995 Teaching Excellence Award from the New Jersey Institute of Technology

Society Memberships

- Program Chairman for the 19th North American Catalysis Society Meeting, Philadelphia, PA 2005
- American Institute of Chemical Engineers (AIChE)
- American Chemical Society (ACS)
- International Precious Metal Institute

Plenary Lectures and from 2006-Present

- XX Reaction Engineering December 2012 "New Catalysts and reactor designs for the hydrogen economy, Luxembourg
- Mitsui Keynote lectureship Award, March 2009:"Automobile Catalysis: Past, Present and Future" . Tokyo, Japan
- Idecat, Porguellos, France "The Road to the Hydrogen Economy," May 2007
- Natural Gas Conversion Conference, Natal, "The Convergence of Fundamental and Applied Catalysis in Solving Industrial Problems." May 2007
- Mittasch Conference, BASF Ludwigshafen, Germany, "Advances in Environmental and Petroleum Catalysis by Engelhard" November 2006
- 13th Nordic Conference on Catalysis, Goteborg, Sweden "New Catalysts for the Hydrogen Economy" October 2008
- 50th Anniversary of the Japanese Catalysis Society "From the Internal Combustion Engine to the engine of the future: The Fuel Cell" November 2008

Books authored

Heck and Farrauto "Catalytic Air Pollution Control: Commercial Technology" Third edition, Wiley and Sons, Hoboken, NJ 2009

Bartholomew and Farrauto "Fundamentals of Industrial catalytic Processes" Second edition, Wiley and Sons, Hoboken, NJ 2006

Journal Publications (1973-Present)

1. R.J. Farrauto and W.L. Haynes, Cements from glass powders, Amer. Cer. Soc. (Bull) **52**(3), 276 (1973).

2. W. Morgan and R.J. Farrauto, Active sites on a copper chromite catalyst, J. Catal. **31**, 140 (1973).

3. W. Hertl and R.J. Farrauto, Mechanism of carbon monoxide and hydrocarbon oxidation on
a copper chromite catalyst, J. Catal. **29**, 352 (1973).

4. R.J. Farrauto and B.Wedding, Poisoning by SO_X of some base metal oxide auto exhaust catalysts, J. Catal. **33**, 249 (1973).

5. B. Wedding and R.J. Farrauto, Rapid evaluation of automotive exhaust oxidation catalysts with a differential scanning calorimeter, Ind. Eng. Chem. **13**, 45 (1974).

6. R.J. Farrauto, Determination and application of catalytic surface area measurements, AIChE J. **70**, 9 (1974).

7. R.J.Farrauto, Measuring catalytic surface area, Chem. Eng. Progr. **71**(1), 37 (1975).

8. R.D. Shoup, K. Hoekstra and R.J. Farrauto, Thermal stability of a copper chromite auto exhaust catalyst, Amer, Cer. Soc. (Bull) **54**(6), 576 (1975).

9. R.J. Farrauto, Adsorption studies on a nickel alumina methanation catalyst, J. Catal. **41**, 482 (1976).

10. C. Bartholomew and R.J. Farrauto, Chemistry of nickel-alumina catalysts, J. Catal. **45**, 41 (1976).

11. J. Patzer, R.J.Farrauto, and A. Montagna, Characterization of coal liquefaction catalysts using 1-methyl naphthalene as a model compound, Ind. Eng. Chem. Proc. Des. Dev. **18**, 625 (1979).

12. R. St.Amand, J. Williams and R.J. Farrauto, Application of metallorganic deposition for solar energy collectors, American Optical Society (AOS) Proc., 2nd Ann. Conf. Sept. (1979).

13. R.D. Lanam and R.J. Farrauto, Solar absorber coatings, Solar Energy Research (SERI) Proc., 2nd Ann. Conf. 1981.

14. R.J. Farrauto and M.H. Hobson, Catalyst characterization, Encyclopedia of Physical Science and Technology, Academic Press, **2**, 563 (1987).

15. R.J. Farrauto, M.H. Hobson and N. Brungard, Relationship between catalyst

characterization and performance, Catalysis of Organic Reactions, Marcel Dekker, **33**, 177 (1988).

16. R.J. Farrauto, R. McClung and A.B. Stotler, Precious metals in the petrochemical industry, Proc. 12th Intern. Prec. Metals Inst., 1988, pp.13.

17. J.C. Bonacci, R.J. Farrauto, and R.M. Heck, Catalytic incineration of hazardous wastes, Library for Environ. Sci., Gulf Publishing **1**(4), 130 (1988).

18. C.H. Lee and R.J. Farrauto, Catalyst deactivation due to transient behavior in nitric acid production, Ind. Eng. Chem. Res. **28**, 1 (1989).

19. R.J. Farrauto and H.C. Lee, Ammonia oxidation catalyst with enhanced activity, Ind. Eng. Chem. Res. **29**(7), 1125 (1990).

20. D.O. Simone, T. Kennelly, N. Brungard, and R.J. Farrauto, Reversible poisoning of palladium catalysts for combustion of methane, Appl. Catal. **70**, 87, (1987).

21. R.J. Farrauto, t. Kennelly, E. Waterman and M.H. Hobson, The catalytic chemistry of supported palladium for combustion of methane, Appl. Catal. **81**(2), 227 (1992).

22. J. Chen, R.M. Heck and R.J. Farrauto, Deactivation, regeneration and poison resistant commercial catalysts, Catal. Today **11**, 517-545 (1992).

23. R.J. Farrauto and J.J. Mooney, Reducing truck diesel emissions, Automotive Eng. **100** (2) 19 (1992).

24. R.J. Farrauto and J.J. Mooney, Effects of sulfur on catalytic diesel oxidation performance, SAE. 920557, Feb. (1992).

25. R.M.Heck, R.J. Farrauto andH.C. Lee, Ozone abatement in commercial aircraft, Catal.Today, **13**, 43-58 (1992).

26. S. Kovenklioglu, Z. Coa, D. Shah, R.J.Farrauto and E.Balko, Direct hydrodechlorination of toxic organics in waste water, AIChE J. **38**(7), 1003 (1992).

27. T. Yu, H. Shaw and R.J. Farrauto, Cataltyic oxidation of trichloroethylene over PdO catalyst on gamma-alumina, Am. Chem. Soc. Symp. Ser. 495, Catalytic Control of Air Pollution, chap. 11, (1992).

28. Y.Wang, H. Shaw and R.J. Farrauto, Catalytic oxidation of trace concentrations of trichloroethylene over 1.5% Pt on gamma-alumina, Am.Chem. Soc. Symp. Ser. 495, Catalytic Control of Air Pollution, chap 10 (1992).

29. R.J. Farrauto and R.M. Heck, Precious metals in industry, Encylopedia of Chemical Processing and Design, 1992.

30. R.J. Farrauto, R.M. Heck and B.K. Speronello, Catalysts and the environment, Chem. Eng. News, Sept. 7, 1992, p. 34.

31. R.J. Farrauto, K.E. Voss and R.M. Heck, A base metal oxide catalyst for reduction of diesel particulates, SAE 932720, Oct. 1992.

32. K.E. Voss, B. Yavuz, C. Hirt, and R.J. Farrauto, Performance characteristics of a novel diesel oxidation catalyst, SAE. 940239, Feb. 1994.

33. K.E. Voss, J. Lampert, R.J. Farrauto, G. Rice, and A. Punke, Catalytic oxidation of diesel particulates with base metal oxides, Catalysts for Air Pollution control 3 (CAPOC3), April, 1994.

34. R.J. Farrauto and R.M. Heck, Precious metals use in environmental catalysis, Intern. Precious. Metals Inst., June 1993.

35. R.M. Heck and R.J. Farrauto, Catalytic Air Pollution control: Commerical technology, Van Nostrand Reinhold, (1^{st} edition, New York, 1994.

36. R.J. Farrauto, M. Larkin, J. Fu and J. Feeley, Catalytic combustion for ultra-low emissions, Mat. Res. Soc. Symp. Proc. **344**, 101 (1994).

37. V. Bell, J,. Feeley, M. Deeba and R.J. Farrauto, In-situ high temperature studies of NO_X reduction with propylene over Cu/ZSM-5 catalysts, Catal. Lett. **29**, 15 (1994).

38. M.Deeba, R.J. Farrauto and Y.K. Lui, stabilization of Pt on SiO_2 promoted with lanthanum oxide and zirconium oxide, Appl. Catal. A, Gen.: **124**, 339 (1995).

39. J. Feeley, M.Deba, R.J. Farrauto, G. Beri, and A. Haynes, Lean NO_X reduction with hydrocarbons over Ga/S-ZrO_X and S-GaZr/Zeolite catalyts, Appl. Catal. B, Environ., **6**, 79 (1995).

40. R.J. Farrauto, J. Lampert, M. Hobson, and E. Waterman, Thermal decomposition and reformation of Pd catalysts, support effects, Appl. Catal. B, Environ., **6**, 263 (1995).

41. J. Feeley, M. Deeba and R.J. Farrauto, Abatement of NO_X from diesel engines: Status and technical challenges, SAE 950747 (1995).

42. M. Deeba, J. Feeley, R.J. Farrauto, N. Steinbock and A. Punke, Catalytic abatement of NO_X from diesel engines: Development of four way catalysts, SAE. 952491 (1995).

43. R.M. Heck and R.J. Farrauto, Automotive emission control: Present and future challenges, Autom. Eng. Feb. 1996.

44. R.J. Farrauto and K. Voss, Monolithic diesel oxidation catalyst, Appl. Catal. B, Enivron., **10**, 29 (1996).

45. M. Amiridis, T. Hang and R.J. Farrauto, A review of the selective catalytic reduction of nitric oxide by hydrocarbons, Appl. Catal. B, Environ., **10**, 203 (1996).

46. R.J. Farrauto, New applications in monolithic supported catalysts, React. Kin. Catal. Lett. **60**(2),233 (1997).

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50. R.M.Heck and R.J. Farrauto, Catalysis : Role of mass transfer and adsorption, Chemical Processing 61/No.11 (1998) 55

51. J. Feeley, M. Deeba and R.J. Farrauto, A catalytic NO_X management system for lean burn engines, Stud. Surf. Sci. Catal., Catalysis and Automotive Pollution Control IV, **116**, 529
(1998).

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55. R.J. Farrauto, The generation of hydrogen for the solid polymer membrane fuel cell, Comptes Rendus de l'Acad. Sci. Paris, Serie IIc, Chemie, 3 (2000).

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60. R.M. Heck, R.J. Farrauto and S. Gulati, The application of monoliths for gas phase reactions, Chem. Eng. J. 82 (2001) 149

61. Xinsheng Liu, Olga Korotkikh and Robert J. Farrauto, "Structural study of the selective catalytic oxidation of CO in hydrogen" in print Applied Catalysis A: General 226 (2002) 293-303

62. Shore, L. and Farrauto, R " PROX Catalysts for selective oxidation of CO for fuel cell applications" Encyclopedia of Fuel Cells, Wiley and Sons, 2002

63. Heck, R., Farrauto, R with Gulati, S "Catalytic Air Pollution Control: Commercial Technology" second edition, Wiley and Sons, NY 2002

64. Farrauto, R., Hwang, H. Ruettinger, W., Shore, L. Giroux, T., Liu, Y. and Ilinich, O. Annual Review of Materials Science, "New Material Needs for Hydrocarbon Fuel Processing : Generating Hydrogen for the PEM Fuel Cell" 33: 1-27 (2003)

65. Farrauto, R. "From the internal combustion engine to the fuel cell: moving towards the hydrogen economy, *Science and technology in catalysis for2002* Kodansha Elsevier, Tokyo, 2003: 21-38.

66. Farrauto, R. J. "Catalysts for Automobile Pollution Control, the State-of-the-art and Engine of the Future. Society of Automotive Engineering India 2003.

67. Ruettinger, W., Ilinich, O., Farrauto, R. J. " A new generation of water gas shift catalysts for fuel cell applications" Journal of Power Sources 118 (2003) 61

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69. Novochinskii, I, Song, C, Ma, X., Liu, X, Shore, L, Lampert, J. and Farrauto, R " Low-temperature H2S removal from steam-containing gas mixtures with ZnO for fuel cell applications. 2. Washcoated monolith. Energy and Fuels 2004, 18, 584-589

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72. Farrauto, R. J. "Introduction to solid polymer membrane fuel cells and reforming natural gas for the production of hydrogen" Applied Catalysis B: Environmental, 56 (2005) 3

73. Farrauto, R.J. "Industrial Catalysis: A practical Guide" Chapter in Riegels Handbook (11th edition), Kluwer Publishers, Amsterdam, the Netherlands 2005. In Press

74. Bartholomew, C and Farrauto, R.J. "Fundamentals of Industrial Catalytic Processes" Wiley and sons, second edition, New York 2006

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76. Farrauto, R. Liu,Y, Ruettinger, W. Ilinich, O. Giroux, T. "Precious Metal Monoliths for natural Gas Reforming" Catalysis Reviews, 49, 411 (2007) .

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78. Ruettinger, W., Liu, X., Xu, X and Farrauto, R. "Effect of Molybdenum and Rhenium promoters on the activity and stability of a Pt on ZrO2 WGS catalyst (Part 1)" Topic in Catalysis November 2008.

79. Dorazio, L., Ruettinger, W., Castaldi, M. and Farrauto, R. "Deactivation, regeneration and stable performance of a Pt, Mo, Re WGS catalyst for on-site hydrogen generation" Topics in Catalysis, November 2008 (Part 2)

80. Alerasool, S., Kelcar, C and Farrauto, R. "Rationale design for commercial catalysts" Wiley;VCH, in press

81. Farrauto, R. and Hoke, J. Automotive Emission Control: past. present and future *Handbook of Green Chemistry: Green Catalysis,* Edited by Paul Anastas, Vol 2, Chapter 9, 197-220. Wiley-VCH, Weinheim, Germany

82. Farrauto, R. " Building the Hydrogen Infrastructure for the hydrogen Economy" Hydrocarbon Engineering, in press

83. R. J. Farrauto and J. Hoke, Automobile Emission Control: Past, present and Future. In Green Catalysis Vol 2 edited by Paul Anastas, 197-220, 2009

83. Simson, A. Castaldi, M. and Farrauto, R. "Kinetic and process study for ethanol reforming using a Rh/Pt washcoated monolith catalyst" Applied Catalyst B: Environmental , 89 (2009) 58-64

85 Alerasool, S., Kelkar, C. and Farrauto, R.J. "Rational Design Strategies for Industrial Catalysis" in *Design of Heterogeneous Catalysis*, 83-110, edited by Umit Ozkan, Wiley-VCH, Weinheim, 2009

86.Heck, R. and Farrauto, R. J. with Gulati, S. *Catalytic Air Pollution Control: Commercial Technology*" 3rd edition, Wiley and Sons, Hoboken, NJ 2009

87. Kohn, M., Castaldi, M. and Farrauto, R "ATR and dry reforming of landfill gas over a Rh/ Al2O3 monolith catalyst" APCAT B: Environmental 94 (2010) 125

88. Eigelbaum, M, Farrauto, R. Castaldi, M. The impact of urea on the performance of metal exchanged zeolites for the selective catalytic reduction of NO*x*: Part I. Pyrolysis and hydrolysis of urea over zeolite catalysts, Applied Catalysis 97 (2010) Issues 1-2, 90-97

89 Eigelbaum, M, Castaldi, M. and Farrauto, R.J "The Impact of Urea on the Performance of Metal Exchanged Zeolites for the Selective Catalytic Reduction of NOx - Part II. Catalytic, FTIR, and NMR Studies, Applied Catalysis 97 (2010) Issues 1-2, 98-107

90 Dorazio, L, Ruettinger, W. Castaldi, M and Farrauto, R. J. "Deactivation, Regeneration and Stable Performance of a Pt,Mo,Re Water Gas Shift Catalyst for on-sight H2 Generation" Topics in Catalysis 51 (2008) (No. 1-4) 58-64

91 Ruettinger, W. Liu, X., Yu, X. and Farrauto, R. J. "Effect of Mo and Re Promoters on the Activity and stability of a Pt/ZrO2 water Gas Shift Catalyst" Topics in Catalysis 51 (2008) (No1-4) 60-67

92 Gruene, P, Belsova, A., Yegalup, T. Farrauto, R. And Castaldi, M "Dispersed calcium oxide as a reversible and efficient CO2-sorbent for intermediate temperatures. IE and C Research 50 (2011) 4042-4049

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96. Wade, J. and Farrauto, R. "Emission Control: Mobile and Stationary" in "Handbook of Metropolitan Sustainability" edited by Frank Zeman, Woodhead Publishing, London, 2012, pp. 260-312.

97. Tran, P. Chen, J and Farrauto, R "VOC Industrial Applications" edited Daniel Duprex, Elsevier, in press.

98. Farrauto, R. " Industrial Catalysis: A Practical Guide" Kent- Riegel Handbook, in press

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100. Hochmuth, J. Wassermann, K. and Farrauto, R. J ." Car Cleaning Catalysts" Handbook of Comprehensive Inorganic Chemistry,, Elsevier Publishing, in press

101. Zhang, Q, Shore, L. and Farrauto, R.J. "Selective oxidation of CO in H2 with a Cu, Fe, Pt monolith catalyst" International Journal of Hydrogen 37 (#14) July 2012 10874-10880

102. Ilinich, O, Liu, Y and Farrauto, R.J. "Kinetics of methanol steam reforming catalyst" Industrial and Engineering Chemical Research 52 (2013)638-644

103. Farrauto, Robert J. "Low temperature oxidation of methane"

Science 337 (2012) 659-660

104. Liu, Y., Farrauto, R. J. and Lawal, A. " ATR of glycerol" Chem. Engr. Science, 89,

15 Feb 2012, 31-3

US Patents (1972-Present)

1. US 3,743,525 Hydraulic cements from glass powders, R.J. Farrauto and W.L. Haynes.

2. US 3,720,527 Fast setting hydraulic cements from glass powders, R.J. Farrauto and W.L. Haynes.

3. US 3,870,658 Copper chromite / alumina catalyst having high temperature stability, R.J. Farrauto, K.Hoekstra, and R.D. Shoup.

4. US 4,416,916 Thin film solar energy collector, K. Aykan, R.J. Farrauto, RlD. Lanam and C. Jefferson.

5. US 4,321,300 Solar energy collector, R.J. Farrauto, C.F. Jefferson and R.D. Lanam.

6. European Patent 0161743 Nitric oxide abatement catalyst, R.M. Heck, C.D. Keith and R.J. Farrauto.

7. US 4,863,393 Low temperature lite off catalyst, R.J. Farrauto, H.C. Lee and W.R. Hatfield.

8. US 5,108,730 Room temperature lite off catalyst, H.C. Lee, R.J. Farrauto, and W.R. Hatfield.

9. US 4,893,465 Process conditions for operation of the ignition catalyst for natural gas combustion, R.J. Farrauto, T. Kennelly, M.C. Hobson and E. Waterman.

10. US 5,214,912 Process conditions for operation of ignition catalyst for natural gas combustion, R.J.Farrauto, T.Kennelly, E. Waterman and M.C. Hobson.

11. US 5,126,300 Praseodymium-Palladium binary oxide catalyst, methods of combustion and regeneration, T. Chou, t. Kennelly and R.J. Farrauto.

12. US 5,102,639 Praseodymium-Palladium binary oxide catalyst compositions containing the same and methods of use, T. Chou, T. Kennelly and R.J. Farrauto.

13. US 5,196,617 Direct catalytic hydrodechlorination of toxic organics in wastewater, S. Kovenklioglu, E. Balko, J. Hoke, R.J. Farrauto and G. Gramiccioni.

14. US 5,216,875 Catalysts for combustion of natural gas, T. Kennelly and R.J. Farrauto.

15. US 5,378,142 Combustion process using catalysts containing binary oxides, T. Kennelly, R.J. Farrauto, T. Chou, and J. Hochmuth.

16. US 5,474,441 Catalyst configuration for catalytic combustion, R.J. Farrauto, J. Feeley, D. Simone, Y.K. Lui and T. Kennelly.

17. US 5,462,907 CeO_2 containing diesel oxidation catalyst, R.J. Farrauto, K. Voss and R.M. Heck.

18. US 5,491,120 Oxidation catalyst with bulk ceria, a second metal oxide, and platinum, K. Voss, B. Yavuz, R.J. Farrauto and M. Galligan.

19. US 5,552,360 Substrate configuration for catalytic combustion systems, R.J. Farrauto.

20. US 5,580,535 System and method for abatement of food cooking fumes, J. Hoke, M. Larkin, R.J. Farrauto, K. Voss, R. Whitely, and L.M. Quick.

21. US 5,627,124 Ceria-alumina catalyst R.J. Farrauto, K. Voss and R.M. Heck.

22. US 5,750,458 Combustion catalysts containing binary oxides, T. Chou, T. Kennelly and R.J. Farrauto.

23. US 5,756,053 System and method for abatement of food cooking, J. Hoke, M. Larkin, R.J. Farrauto, K. Voss, R. Whitely and L.M. Quick.

24. US 5,776,423 Trimetallic zeolite catalyst for NO abatement, J. Feeley, R.J. Farrauto, M. Deeba and J. Lampert.

25. US 5,792,436 Method for using a regenerable catalyst trap, J. Feeley, R.J. Farrauto, M.Deeba and J. Lampert.

26. US 5,804,155 Basic zeolites / HC traps, M. Deeba and R.J. Farrauto.

27. US 5,863,851 Combustion catalysts containing binary oxides and processes using the same, T. Kennelly, T. Chou, and R.J. Farrauto.

28. US 5,874,057 Lean NO_X catalyst / trap method, M. Deeba, J. Feeley and R.J. Farrauto.

29. US 5,968,861 Trimetallic zeolite catalyst and method of NO_X abatement using the same, J. Feeley, M. Deeba and R.J. Farrauto.

30. US 6,074,973 Catalyzed hydrocarbon trap material and method, J. Lampert, M. Deeba and R.J. Farrauto.

31. US 6,080,377 Method of abating NO_X and a catalytic material, M. Deeba, J. Feeley and R.J. Farrauto

32. US 6,150, 291 Method of abating NOx and prearatin of catalytic materials J. Feely, M. Deeba and R. Farrauto

33. US 6,153,160, “Catalytic oxidation method” K. Voss, B. Yavuz, R. Farrauto, M. Galligan

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