## *Curriculum vitae* of Dr. Alexander M. Klibanov

**Nationality**: Naturalized U.S. Citizen (1983)

**Education**: 1974 Ph.D. in Chemical Enzymology, Moscow University

1971 M.S. in Chemistry, Moscow University

**Honors**:

2015 Tau Beta Pi's Leonardo Da Vinci Lecturer, MIT

2007-11 and 2014 Novartis Chair Endowed Professorship, MIT

2012-13 Roger and Georges Firmenich Endowed Professorship, MIT

2011 MIT Biological Engineering Senior Class Faculty Award

2006 Distinguished GRUM Lecturer in Drug Discovery & Development, University of Montreal (Canada)

2004 UNAM Distinguished Lecturer, National University of Mexico (Mexico City)

2001 Walter Enz Lecturer in Pharmaceutical Chemistry, University of Kansas

2001 Elected a Corresponding Fellow of the Royal Society of Edinburgh (Scotland's National Academy of Science and Letters)

2000 Merck Distinguished Lecturer, Rutgers University

2000 Top 20 Biotechnology & Bioengineering Papers of the Last Forty Years

1998 Robert Lutz Lecturer, University of Virginia

1996 Perkin-Elmer Distinguished Lecturer, University of Pittsburgh

1995 Elected to the National Academy of Sciences of the U.S.A.

1995 Nathan O. Kaplan Memorial Lecturer in Biological Chemistry, University of California at San Diego

1994 R.W. Johnson PRI Lecturer, Pharmaceutical Research Institute

1994 Warren McCabe Lecturer, North Carolina State University



**Petitioner's Exhibit 1004**
**Clean Chemistry v. EnviroTech**
**IPR2025-01472 – Page 001**

1993 Elected to the National Academy of Engineering of the U.S.A.

1993 Arthur C. Cope Scholar Award of the American Chemical Society

1993 Biotechnology Divisional Lectureship Award of the Institute of Food Technologists

1992 Charles Sabat Lecturer, Rutgers University

1992 Elected a Founding Fellow of the American Institute for Medical and Biological Engineering

1992 Louis C. Jordy Research Scholar Lecturer, Drew University

1991 International Enzyme Engineering Award

1991 Marvin J. Johnson Award of the American Chemical Society

1990 Monsanto Lecturer, Ohio State University

1990 NRC Distinguished Lecturer, Academia Sinica (Taiwan)

1989 Ipatieff Prize of the American Chemical Society

1989 Backer Lecturer, Groningen University (Holland)

1988 Dow Lecturer, University of Ottawa (Canada)

1987 Distinguished Scholar Lecturer, Hope College

1986 Leo Friend Award of the American Chemical Society

1984 Who's Who in Frontier Science and Technology

1984 Sohio Lecturer, Case Western Reserve University

1982 American Men and W omen of Science

1981-1983 Henry L. Doherty Career Development Professorship, MIT

1975 U.S.S.R. Ministry of Higher Education Prize



**Petitioner's Exhibit 1004**
**Clean Chemistry v. EnviroTech**
**IPR2025-01472 – Page 002**

**Professional Experience**:

| | |
|---|---|
| 2019-present | Novartis Chair Professor Emeritus of Chemistry and Bioengineering, MIT |
| 2014-2019 | Novartis Chair Professor of Chemistry and Bioengineering, MIT |
| 2012-2013 | Roger and Georges Firmenich Professor of Natural Products Chemistry Department of Chemistry, MIT |
| 2007-2011 | Novartis Chair Professor of Chemistry and Bioengineering, MIT |
| 2000-2019 | Professor of Bioengineering |
| | Department of Biological Engineering, MIT |
| 1988-2019 | Professor of Chemistry |
| | Department of Chemistry, MIT |
| 1987-1988 | Professor of Applied Biochemistry |
| | Department of Applied Biological Sciences, MIT |
| 1983-1987 | Associate Professor of Applied Biochemistry |
| | Department of Applied Biological Sciences (formerly Department of Nutrition and Food Science), MIT |
| 1979-1983 | Assistant Professor of Applied Biochemistry |
| | Department of Nutrition and Food Science, MIT |
| 1977-1979 | Postdoctoral Associate, Department of Chemistry University of California at San Diego |
| 1974-1977 | Research Chemist |
| | Department of Chemistry, Moscow University |

**Current Journal Editorial/Advisory Boards**:

"Biocatalysis and Biotransformation", "Applied Biochemistry and Biotechnology", "Open Chemistry Journal", "Biotechnology Progress", "Biotechnology & Bioengineering", "Microbial Biotechnology", "Open Journal of Pharmacology", "Nanocarriers", "Journal of Antivirals and Antiretrovirals", "Open Access Academic Books in Chemistry", "Journal of Biological Chemistry and Molecular Pharmacology", "Archives of Natural Products and Medicinal Chemistry", "Recent Patents in Biotechnology", "Current Pharmaceutical Biotechnology", and "Archives of Medical Biotechnology", "International Journal of Drug Design, Delivery and Safety"

**Professional Societies**:

U.S. National Academy of Sciences, U.S. National Academy of Engineering, American Chemical Society, American Institute for Medical and Biological Engineering

**Current Research Interests**:

Drug synthesis and modification

Medicinal and formulation chemistry

Protein and nucleic acid delivery

Antimicrobial polymers

Enzymes as catalysts in organic syntheses

Stabilization and formulation of macromolecular pharmaceuticals

**Publications**:

1. Varfolomeyev, S.D., Klibanov, A.M., Berezin, I.V. 1971. Light-initiated enzymic activity caused by photostereoisomerization of *cis*-4-nitrocinnamoyl-α-chymotrypsin. FEBS Lett. 15: 118 -120.

2. Varfolomeyev, S.D., Klibanov, A.M., Martinek, K., Berezin, I.V. 1972. Light-sensitive catalysts. 4-Nitrocinnamoyl residue as a chromophoric reporter group in the α-chymotrypsin active center. Dokl. Acad. Nauk SSSR 203: 616-619.

3. Klibanov, A.M., Samokhin, G.P., Martinek, K., Berezin, I.V. 1974. Mechanochemistry of catalytic systems. Regulation by a mechanical action of the enzymatic properties of α-chymotrypsin covalently attached to a nylon fiber. Dokl. Acad. Nauk SSSR 218: 715-718.

4. Berezin, I.V., Varfolomeyev, S.D., Klibanov, A.M., Martinek, K. 1974. Light and ultrasonic regulation of α-chymotrypsin catalytic activity. Proflavin as a light- and sound- sensitive competitive inhibitor. FEBS Lett. 39: 329-331.

5. Berezin, I.V., Klibanov, A.M., Martinek, K. 1974. The mechanochemistry of immobilized enzymes. How to steer a chemical process at the molecular level by a mechanical device. Biochim. Biophys. Acta 364: 193-199.

6. Berezin, I.V., Klibanov, A.M., Goldmacher, V.S., Martinek, K. 1974. Mechanochemistry of catalytic systems. Regulation by a mechanical action of the enzymatic activity of trypsin entrapped in polyacrylamide gel. Dokl. Acad. Nauk SSSR 218: 367-370.

7. Klibanov, A.M., Martinek, K., Berezin, I.V. 1974. The effect of ultrasound on α-chymotrypsin. A novel approach to studying conformational transitions in active centers of enzymes. Biochemistry SSSR 39: 878-887.

8. Berezin, I.V., Klibanov, A.M., Klyosov, A.A., Martinek, K., Svedas, V.K. 1975. The effect of ultrasound as a new method of studying conformational transitions in enzyme active centers. pH- and temperature- induced conformational transitions in the active center of penicillin amidase. FEBS Lett. 49: 325-328.

9. Berezin, I.V., Klibanov, A.M., Martinek, K. 1975. Kinetic and thermodynamic aspects of catalysis by immobilized enzymes. Russ. Chem. Revs. 44: 17-47.

10. Martinek, K., Goldmacher, V.S., Klibanov, A.M., Berezin, I.V. 1975. Denaturing agents (urea, acrylamide) protect enzymes against irreversible thermoinactivation: a study with native and immobilized α-chymotrypsin and trypsin. FEBS Lett. 51: 152-155.

11. Martinek, K., Klibanov, A.M., Tchernysheva, A.V., Berezin, I.V. 1975. The stabilization of α-chymotrypsin by entrapment in polymethacrylate gels. Dokl. Acad. Nauk SSSR 223: 233-236.

12. Tchernysheva, A.V., Goldmacher, V.S., Klibanov, A.M., Martinek, K., Berezin, I.V. 1975. The catalytic activity and thermostability of α-chymotrypsin oligomers entrapped in cross-linked polymeric gels. Bull. Moscow Univ. 19: 428-431.

13. Tchernysheva, A.V., Martinek, K., Klibanov, A.M., Mevkh, A.T., Berezin, I.V. 1975. The catalytic properties and thermostability of α-chymotrypsin in different polymethacrylate gels. Izvestia Acad. Nauk SSSR, Ser. Khim. No. 8: 1764-1768.

14. Klibanov, A.M., Samokhin, G.P., Martinek, K., Berezin, I.V. 1976. Enzymatic mechano-chemistry: a new approach to studying the mechanism of enzyme action. Biochim. Biophys. Acta 438: 1-12.

15. Berezin, I.V., Klibanov, A.M., Samokhin, G.P., Martinek, K. 1976. Mechanochemistry of immobilized enzymes: a new approach to studies in fundamental enzymology. Regulation by a mechanical device of the catalytic properties of enzymes covalently attached to elastic polymeric supports. Meth. Enzymol. 44: 558-571.

16. Berezin, I.V., Klibanov, A.M., Goldmacher, V.S., Martinek, K. 1976. Mechanochemistry of immobilized enzymes: a new approach to studies in fundamental enzymology. Regulation by a mechanical device of the catalytic activity of enzymes trapped in polyacrylamide gel. Meth. Enzymol. 44: 571-576.

17. Klibanov, A.M., Kazanskaya, N.F., Larionova, N.I., Martinek, K., Berezin, I.V. 1976. A comparative study of the dynamic structures of the active centers of proteolytic enzymes by the ultrasonic method. The effect of ultrasound on α-trypsin, ß-trypsin, and trypsinogen. J. Bioorg. Chem. (Russ.) 2: 828-836.

18. Martinek, K., Goldmacher, V.S., Klibanov, A.M., Torchilin, V.P., Smirnov, V.N., Chazov, E.I., Berezin, I.V. 1976. Thermal stabilization of α-chymotrypsin by covalent attachment to a complementary surface of a polymeric matrix. Dokl. Acad. Nauk SSSR 228: 1468-1471.

19. Poglazov, B.F., Samokhin, G.P., Klibanov, A.M., Levitsky, D.I., Martinek, K., Berezin, I.V. 1977. Mechanochemistry of the myosin molecule. Dokl. Acad. Nauk SSSR 234: 482-485.

20. Berezin, I.V., Klibanov, A.M., Samokhin, G.P., Goldmacher, V.S., Martinek, K. 1977. Mechanosensitive and sound-sensitive systems as chemical amplifiers of weak signals. In: Biomedical Applications of Immobilized Enzymes and Proteins (T.M.S. Chang, ed.), vol. 2, pp. 237-251, Plenum Press, New York.

21. Klibanov, A.M., Samokhin, G.P., Martinek, K., Berezin, I.V. 1977. A new mechanochemical method of enzyme immobilization. Biotechnol. Bioeng. 19: 211-218.

22. Martinek, K., Klibanov, A.M., Samokhin, G.P., Semenov, A.M., Berezin, I.V. 1977. Preparative enzymatic synthesis in biphasic water-organic systems. J. Bioorg. Chem. (Russ.) 3: 696-702.

23. Klibanov, A.M., Samokhin, G.P., Martinek, K., Berezin, I.V. 1977. A new approach to preparative enzymatic synthesis. Biotechnol. Bioeng. 19: 1351-1361.

24. Martinek, K., Klibanov, A.M., Goldmacher, V.S., Berezin, I.V. 1977. The principles of enzyme stabilization. I. Increase in thermostability of enzymes covalently bound to a complementary surface of a polymeric support in a multipoint fashion. Biochim. Biophys. Acta 485: 1-12.

25. Martinek, K., Klibanov, A.M., Goldmacher, V.S., Tchernysheva, A.V., Mozhaev, V.V., Berezin, I.V., Glotov, B.O. 1977. The principles of enzyme stabilization. II. Increase in thermostability of enzymes as a result of multipoint non-covalent interactions with a polymeric support. Biochim. Biophys. Acta 485: 13-28.

26. Torchilin, V.P., Maksimenko, A.V., Smirnov, V.N., Martinek, K., Klibanov, A.M., Berezin, I.V. 1978. The principles of enzymes stabilization. III. The effect of the length of intramolecular cross-linking agents on the thermostability of enzymes. Biochim. Biophys. Acta 522: 277-283.

27. Samokhin, G.P., Klibanov, A.M., Martinek, K. 1978. Photochemical immobilization of enzymes. Bull. Moscow Univ. 19: 433-436.

28. Poglazov, B.F., Samokhin, G.P., Klibanov, A.M., Levitsky, D.I., Martinek, K., Berezin, I.V. 1978. The effect of mechanical stretching of myosin rod part (fragment LMM + HMM S-2) on the ATPase activity of myosin. Biochim. Biophys. Acta 524: 245-253.

29. Klibanov, A.M., Semenov, A.N., Samokhin, G.P., Martinek, K. 1978. Enzymatic reactions in water-organic solutions. The criterion for selecting optimal organic co-solvents. J. Bioorg. Chem. (Russ.) 4: 236-242.

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35. Klibanov, A.M. 1979. Stabilization of enzymes by immobilization. Anal. Biochem. 93: 1-25.

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39. Klibanov, A.M., Alberti, B.N., Morris, E.D., Felshin, L.M. 1980. Enzymatic removal of toxic phenols and anilines from waste waters. J. Appl. Biochem. 2: 414-421.

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46. Klibanov, A.M., Alberti, B.N., Zale, S.E. 1982. Enzymatic synthesis of formic acid from H2 and CO2 and production of hydrogen from formic acid. Biotechnol. Bioeng. 24: 25-36.

47. Maneepun, S., Klibanov, A.M. 1982. Stabilization of microbial proteases against autolysis using acylation with dicarboxylic acid anhydrides. Biotechnol. Bioeng. 24: 483-486.

48. Klibanov, A.M., Giannousis, P.P. 1982. Geometrically specific oxidation of ß-arylacroleins catalyzed by xanthine oxidase: the preparative potential. Biotechnol. Lett. 4: 57-60.

49. Alberti, B.N., Klibanov, A.M. 1982. Preparative production of hydroquinone from benzoquinone catalyzed by immobilized glucose oxidase. Enzyme Microb. Technol. 4: 47-49.

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54. Klibanov, A.M., Alberti, B.N., Marletta, M.A. 1982. Stereospecific oxidation of aliphatic alcohols catalyzed by galactose oxidase. Biochem. Biophys. Res. Commun. 108: 804-808.

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57. Klibanov, A.M. 1983. Biotechnological potential of the enzyme hydrogenase. Process Biochem. 18: 13-16.

58. Pelsy, G., Klibanov, A.M. 1983. Remarkable positional (regio-) specificity of xanthine oxidase and some dehydrogenases in the reactions with substituted benzaldehydes. Biochim. Biophys. Acta 742: 352-357.

59. Klibanov, A.M. 1983. Stabilization of enzymes against thermal inactivation. Adv. Appl. Microbiol. 29: 1-28.

60. Klibanov, A.M., Chendrasekhar, A., Alberti, B.N. 1983. Enzymatic separation of *cis* and *trans* isomers of alicyclic alcohols. Enzyme Microb. Technol. 5: 265-268.

61. Klibanov, A.M. 1983. Immobilized enzymes and cells as practical catalysts. Science 219: 722-727.

62. Pelsy, G., Klibanov, A.M. 1983. Preparative separation of α- and ß-naphthols catalyzed by immobilized sulfatase. Biotechnol. Bioeng. 25: 919-928.

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64. Klibanov, A.M., Tu, T.-M., Scott, K.P. 1983. Peroxidase-catalyzed removal of phenols from coal conversion wastewaters. Science 221: 259-261.

65. Atlow, S.C., Bonadonna-Aparo, L., Klibanov, A.M. 1984. Dephenolization of industrial wastewaters catalyzed by polyphenol oxidase. Biotechnol. Bioeng. 26: 599-603.

66. Cambou, B., Klibanov, A.M. 1984. Preparative production of optically active esters and alcohols using esterase-catalyzed stereospecific transesterifications in organic media. J. Am. Chem. Soc. 106: 2687-2692.

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100. Margolin, A.L., Klibanov, A.M. 1987. Peptide synthesis catalyzed by lipases in anhydrous organic solvents. J. Am. Chem. Soc. 109: 3802-3804.

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102. Margolin, A.L., Tai, D.-F., Klibanov, A.M. 1987. Incorporation of D-amino acids into peptides via enzymatic condensation in organic solvents. J. Am. Chem. Soc. 109: 7885-7887.

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**Invited Lectures:**

1. Gordon Conference on Immobilized Enzymes, Complexes, and Cells (Plymouth, NH). August 1978.

2. 5th International Conference on Enzyme Engineering (Henniker, NH). August 1978.

3. Miles Laboratories (Elkhart, IN). February 1980.

4. Gordon Conference on Immobilized Species (Henniker, NH). August 1980.

5. Novo Laboratories (Wilton, CT). October 1980.

6. Corning Glass Works Co. (Corning, NY). October 1980.

7. Stauffer Chemical Co. (Dobbs Ferry, NY). December 1980.

8. DuPont Experimental Station (Wilmington, DE). January 1981.

9. Dow Chemical Co. (Wayland, MA). April 1981.

10. Cetus Corp. (Berkeley, CA). April 1981.

11. Exxon Research & Engineering Co. (Linden, NJ). April 1981.

12. Meeting of the American Solar Energy Society (Philadelphia, PA). May 1981.

13. 6th International Conference on Enzyme Engineering (Kashikojima, Japan). September 1981.

14. Genex Corp. (Rockville, MD). October 1981.

15. ILP Symposium for Senior Executives (London, England). November 1981.

16. California Institute of Technology (Pasadena, CA). December 1981.

17. Symposium of the American Society for Microbiology (Atlanta, GA). March 1982.

18. Kodak Research Center (Rochester, NY). March 1982.

19. Repligen Corp. (Cambridge, MA). April 1982.

20. Symposium on the Biological Basis of New Developments in Biotechnology (Minneapolis, MN). May 1982.

21. Meeting of the Biochemical Society (Oxford, England). July 1982.

22. Meeting of the American Chemical Society (Kansas City, MO). September 1982.

23. Rotenburger Symposium on Enzyme Technology (Kassel, Germany). September 1982.

24. Genetics Institute (Boston, MA). September 1982.

25. Meeting of the American Institute of Chemical Engineers (Los Angeles, CA). November 1982.

26. G.D. Searle Co. (Chicago, IL). October 1982.

27. Halcon International Research Center (Montvale, NJ). October 1982.

28. International Workshop on Immobilized Enzymes and Cells (Bangkok, Thailand). December 1982.

29. Amoco Research Center (Naperville, IL). January 1983.

30. University College London (London, England). May 1983.

31. International Conference on Biotechnology Biotech ‘83 (London, England). May 1983.

31. Tufts University Workshop on Immobilized Enzymes and Proteins (Medford, MA). June 1983.

32. Gordon Conference on Organic Reactions and Processes (New Hampton, NH). July 1983.

33. Symposium “Biocatalysis: New Discoveries and Uses”, Meeting of the American Society for Industrial Microbiology (Sarasota, FL). August 1983.

34. Monsanto Co. (St. Louis, MO). September 1983.

35. Pasteur Biosciences ‘83 Conference (Paris, France). September 1983.

36. 7th International Conference on Enzyme Engineering (White Haven, PA). September 1983.

38. University of Iowa (Iowa City, IA). October 1983.

37. CPC Moffett Technical Center (Summitt-Argo, IL). December 1983.

38. General Foods Co. (Dobbs Ferry, NY). December 1983.

39. U.S. National Bureau of Standards (Gaithersburg, MD). April 1984.

40. Millipore Corp. (Bedford, MA). April 1984.

41. Technical University of Munich (Munich, F.R.G.). May 1984.

42. Danish Academy of Technical Sciences (Copenhagen, Denmark). May 1984.

43. Novo International Biotechnology Symposium (Copenhagen, Denmark). May 1984.

44. CRA Scientific Conference (St. Charles, IL). June 1984.

45. Gordon Conference on Immobilized Species in Biotechnology (Plymouth, NH). August 1984.

46. Meeting of the American Chemical Society (Philadelphia, PA). August 1984.

47. International Biotechnology Conference Biotech ‘84 (Washington, DC). September 1984.

48. Staley Manufacturing Co. (Decatur, IL). October 1984.

49. Case Western Reserve University (Cleveland, OH). October 1984.

50. IMC Corp. (Terre Haute, IN). October 1984.

51. Syracuse University (Syracuse, NY). November 1984.

52. National University of Mexico (Mexico City, Mexico). November 1984.

53. National Starch & Chemical Corp. (Bridgewater, NJ). November 1984.

54. Mead Corp. (Chillicothe, OH). November 1984.

55. Hebrew University of Jerusalem (Jerusalem, Israel). November 1984.

56. U.S. Army Chemical R&D Center (Aberdeen Proving Ground, MD). December 1984.

57. Allied Corp. (Morristown, NJ). December 1984.

58. Bristol Laboratories (Syracuse, NY). January 1985.

59. University of Rochester (Rochester, NY). January 1985.

60. G.D. Searle Co. (Chicago, IL). February 1985.

61. Welcome Research Laboratories (Research Triangle Park, NC). February 1985.

62. UCLA Symposium on Protein Structure, Folding and Design (Keystone, CO). April 1985.

63. International Conference on Application of Biocatalysts in Organic Synthesis (Noordwijkerhout, Holland). April 1985.

64. Guido Donegani Research Institute (Novara, Italy). April 1985.

65. Hoffmann-LaRoche Co. (Basel, Switzerland). April 1985.

66. Pittsburgh-Cleveland Catalysis Society Meeting (Pittsburgh, PA). May 1985.

67. Ethyl Corp. (Baton Rouge, LA). May 1985.

68. Stony Brook Symposium on Protein Engineering (Stony Brook, NY). May 1985.

69. Amgen Corp. (Thousand Oaks, CA). June 1985.

70. Gordon Conference on Applied Microbiology (New London, NH). August 1985.

71. International Congress of Biochemistry (Amsterdam, Holland). August 1985.

72. IUPAC Congress (Manchester, England). September 1985.

73. International Enzyme Engineering Conference (Helsingor, Denmark). September 1985.

74. Biotechnica ‘85 (Hannover, West Germany). October 1985.

75. Biotec 85 (Dusseldorf, West Germany). October 1985.

76. Smith Kline & French Co. (Philadelphia, PA). November 1985.

77. Exxon Corporate Research (Anandale, NJ). December 1985.

78. Pennsylvania State University (University Park, PA). December 1985.

79. Georgetown University (Washington, DC). February 1986.

80. Columbia University (New York, NY). February 1986.

81. Upjohn Co. (Kalamazoo, MI). February 1986.

82. UNIDO Workshop on Biotechnology (Trieste, Italy). March 1986.

83. Enericherche (Monterotondo, Italy). March 1986.

84. EEC Biomolecular Engineering Meeting (Compiegne, France). April 1986.

85. ACS Conference on Chemical Aspects of Biotechnology (Gaithersburg, MD). May 1986.

86. Biotech ‘86 Europe International Conference (London, England). May 1986.

87. IUPAC International Symposium on Organic Chemistry in Technological Perspective (Jerusalem, Israel). June 1986.

88. University of Tel-Aviv (Ramat-Aviv, Israel). June 1986.

89. Annual Meeting of the Canadian Biochemical Society (Guelph, Canada). June 1986.

90. International Symposium on Biologically Engineered Polymers (Cambridge, England). July 1986.

91. TNO Institute of Applied Chemistry (Zeist, The Netherlands). August 1986.

92. IUPAC International Symposium on the Chemistry of Natural Products (The Hague, The Netherlands). August 1986.

95. American Chemical Society National Meeting (Anaheim, CA). September 1986.

93. Catalytica Annual Science and Technology Symposium (San Jose, CA). September 1986.

94. International Conference on Enzyme Engineering (Cambridge, England). September 1986.

95. Ohio State University (Columbus, OH). October 1986.

96. Michigan State University (Lansing, MI). October 1986.

97. Biotechnology Process Engineering Symposium (Cambridge, MA). October 1986.

98. University of Delaware (Newark, DE). November 1986.

99. American Red Cross Blood Research Institute (Bethesda, MD). November 1986.

100. International Symposium on Biocatalysis in Non-Aqueous Solvents (Wageningen, The Netherlands). December 1986.

101. University of Trondheim (Trondheim, Norway). December 1986.

102. Colgate-Palmolive Research Center (Piscataway, NJ). January 1987.

103. International Paper Co. (Tuxedo Park, NY). January 1987.

104. University of Massachusetts (Amherst, MA). February 1987.

105. American Society for Microbiology Biocatalysis Symposium (Atlanta, GA). March 1987.

106. Hope College (Holland, MI). March 1987.

107. Pfizer Corporate Research Center (Groton, CT). April 1987.

108. OBBS Symposium on Protein Engineering (Ottawa, Canada). April 1987.

109. University of Texas (Austin, TX). April 1987.

110. Florida Catalysis Conference (Palm Coast, FL). May 1987.

111. PPG Industries (Barberton, OH). May 1987.

112. Abbott Laboratories (North Chicago, IL). May 1987.

113. American Oil Chemists Society Symposium on Lipases (New Orleans, LA). May 1987.

114. Argonne National Laboratory (Argonne, IL). June 1987.

115. Canadian Chemical Conference (Quebec City, Canada). June 1987.

116. Squibb Co. (New Brunswick, NJ). June 1987.

117. FEBS Annual Meeting (Ljubljana, Yugoslavia). July 1987.

118. L'Oreal Research Institute (Paris, France). July 1987.

119. International Symposium on Biointeractions (Cambridge, England). July 1987.

120. Eli Lilly Co. (Indianapolis, IN). August 1987.

121. Upjohn Co. (Kalamazoo, MI). September 1987.

122. International Enzyme Engineering Conference (Santa Barbara, CA). October 1987.

123. Shell Development Co. (Houston, TX). October 1987.

124. DuPont Experimental Station (Wilmington, DE). October 1987.

125. University of Helsinki (Helsinki, Finland). November 1987.

126. International Conference on Bioreactors and Biotransformations (Gleneagles, Scotland). November 1987.

127. Sandoz Co. (Basel, Switzerland). November 1987.

128. University of Waterloo (Waterloo, Canada). December 1987.

129. Norwegian Biochemical Society Annual Meeting (Bejito, Norway). January 1987.

130. Rutgers University (New Brunswick, NJ). February 1988.

131. University of Ottawa (Ottawa, Canada). February 1988.

132. Boston Biomedical Research Institute (Boston, MA). March 1988.

133. Princeton University (Princeton, NJ). March 1988.

134. Royal Society of Chemistry Meeting (Kent, England). April 1988.

135. Stanford University (Stanford, CA). May 1988.

136. University of Graz (Graz, Austria). May 1988.

137. Belgian Organic Chemistry Symposium (Ghent, Belgium). May 1988.

138. Dow Chemical Co. (Midland, MI). May 1988.

139. Michigan State University (Lansing, MI). May 1988.

140. American Chemical Society Meeting (Toronto, Canada). June 1988.

141. Proctor & Gamble Co. (Cincinnati, OH). June 1988.

142. International Congress of Biochemistry (Prague, Czechoslovakia). July 1988.

143. International Biotechnology Symposium (Paris, France). July 1988.

144. Gordon Conference on Catalysis (Newport, RI). August 1988.

145. Conference on Biocatalytic Synthesis of Organic Compounds (Saratoga, NY). August 1988.

146. International Symposium on Thermodynamics Applied to Biological Systems (Santa Margherita, Italy). September 1988.

147. Cornell University (Ithaca, NY). September 1988.

148. Eastman Kodak Co. (Kingsman, TN). September 1988.

149. Symposium on Biotechnology Challenges in the Food Industry (Williamsburg, VA). October 1988.

150. University of California at Irvine (Irvine, CA). October 1988.

151. UCSF Symposium on Protein and Drug Design (San Francisco, CA). October 1988.

152. Boston University (Boston, MA). October 1988.

153. Wayne State University (Detroit, MI). November 1988.

154. Kyoto Symposium on Frontiers in Biocatalysis (Kyoto, Japan). November 1988.

155. Rohm & Haas Co. (Spring House, PA). January 1989.

156. Block Drug Co. (Jersey City, NJ). January 1989.

157. State University of New York (Albany, NY). March 1989.

158. Scripps Clinic and Research Foundation (La Jolla, CA). April 1989.

159. Texas A&M University (College Station, TX). May 1989.

160. University of Texas (Austin, TX). May 1989.

161. International Congress of Food Engineering (Cologne, F.R.G.). May 1989.

162. University of Groningen (Groningen, The Netherlands). June 1989.

163. Gordon Conference on Enzymes, Coenzymes, and Metabolic Pathways (Meridan, NH). July 1989.

164. American Peptide Symposium (La Jolla, CA). July 1989.

165. International Symposium on Prospects in Protein Engineering (Haren, The Netherlands). August 1989.

166. Connaught Laboratories (Toronto, Canada). September 1989.

167. University of Georgia (Athens, GA). October 1989.

168. Spanish National Congress of Biochemistry (Alicante, Spain). October 1989.

169. Symposium on Receptor- and Enzyme- Based Drug Design (Chapel Hill, NC). October 1989.

170. Wesleyan University (Middletown, CT). November 1989.

171. University of Wisconsin (Madison, WI). February 1990.

172. Merck Sharp & Dohme Research Laboratories (Rahway, NJ). February 1990.

173. International Symposium on Biochemical Engineering (Stuttgart, F.R.G.). March 1990.

174. University of Geneva (Geneva, Switzerland). March 1990.

175. University of Lausanne (Lausanne, Switzerland). March 1990.

176. University of Bern (Bern, Switzerland). March 1990.

177. University of Fribourg (Fribourg, Switzerland). March 1990.

178. International Conference on Protein Stability (Cambridge, England). March 1990.

179. AFRC Institute of Food Research (Reading, England). March 1990.

180. Lehigh University (Bethlehem, PA). April 1990.

181. Biotechnology Research Institute (Montreal, Canada). April 1990.

182. Ohio State University (Columbus, OH). April 1990.

183. Pharmaceutical Manufacturers Association Annual Meeting (St. Louis, MO). April 1990.

184. International Conference on Industrial Use of Enzymes (Chicago, IL). May 1990.

185. Korea Advanced Institute of Science and Technology (Seoul, Korea). June 1990.

186. Academia Sinica and National Taiwan University (Taipei, Taiwan). June 1990.

187. Gordon Conference on Biocatalysis (Plymouth, NH). June 1990.

188. IUPAC Conference on Organic Synthesis (Helsinki, Finland). July 1990.

189. International Conference on Solution Chemistry (Ottawa, Canada). August 1990.

190. Gordon Conference on Biomolecular Recognition (Plymouth, NH). August 1990.

191. University of Naples (Naples, Italy). September 1990.

192. International Conference on Water and Life (Crans-sur-Sierre, Switzerland). September 1990.

193. International Symposium on Thermodynamic Basis of Protein Structure and Function (Kansas City, MO). October 1990.

194. Johns Hopkins University (Baltimore, MD). October 1990.

195. Institute of Medicine Workshop on Microheterogeneity of Biological Macromolecules (Arlington, VA). November 1990.

196. U.S.-Japan Biotechnology Conference (Honolulu, HI). January 1991.

197. Ciba-Geigy Corp. (Summit, NJ). February 1991.

198. City University of New York (New York, NY). March 1991.

199. Rensselaer Polytechnic Institute (Troy, NY). March 1991.

200. Bristol-Myers Squibb Co. (Wallingford, CT). April 1991.

201. British Biochemical Society Meeting (Reading, England). April 1991.

202. University of California at Berkeley (Berkeley, CA). April 1991.

203. California Institute of Technology (Pasadena, CA). April 1991.

204. Merck, Sharp & Dohme Research Laboratories (West Point, PA). May 1991.

205. Bristol-Myers Squibb Research Institute (Princeton, NJ). May 1991.

206. International Conference on Biocatalysis (Orlando, FL). June 1991.

207. U.S. Army Research, Development and Engineering Center (Natick, MA). July 1991.

208. Gordon Conference on Natural Products (Plymouth, NH). July 1991.

209. Lederle-Praxis Biologicals Co. (Sanford, NC). July 1991.

210. International Biochemistry Congress (Jerusalem, Israel). August 1991.

211. American Chemical Society Meeting (New York, NY). August 1991.

212. International Enzyme Engineering Conference (Kona, HI). September 1991.

213. University of Lowell (Lowell, MA). October 1991.

214. Rutgers University (Piscataway, NJ). November 1991.

215. International Symposium on Enzymes in Organic Synthesis (New Delhi, India). January 1992.

216. International BioSymposium Nagoya '92 (Nagoya, Japan). January 1992.

217. International Symposium on Biomolecules in Organic Solvents (Taxco, Mexico). February 1992.

218. Rockefeller University (New York, NY). March 1992.

219. Symposium on Molecular Chirality of the Pharmaceutical Society of Japan (Tokyo, Japan). April 1992.

220. Conference on Enzymes in Organic Chemistry of the Dutch Chemical Society (Wageningen, The Netherlands). April 1992.

221. International Symposium on Bioprocessing of Coal (Clearwater Beach, FL). May 1992.

222. Exxon Workshop on New Leads in Coal Depolymerization (Montgomery, TX). May 1992.

223. Italian Symposium on Biochemical Biotechnology (Capri, Italy). June 1992.

224. Gordon Conference on Biocatalysis (Meriden, NH). July 1992.

225. FEBS Meeting (Dublin, Ireland). August 1992.

226. International Biotechnology Symposium (Washington, DC). August 1992.

227. International Symposium Bio Japan '92 (Yokohama, Japan). August 1992.

228. Texas College of Osteopathic Medicine (Fort Worth, TX). October 1992.

229. Rutgers University (Newark, NJ). October 1992.

230. Schering-Plough Co. (Bloomfield, NJ). November 1992.

231. International Symposium ISOPOW -V: *Properties of Water in Foods* (Peniscola, Spain). November 1992.

232. Carlsberg Laboratory (Copenhagen, Denmark). November 1992.

233. International Food Technology Conference (The Hague, The Netherlands). November 1992.

234. Singapore Institute of Standards and Industrial Research (Singapore). November 1992.

235. Drew University (Madison, NJ). December 1992.

236. Northeastern University (Boston, MA). January 1993.

237. Ciba Corning Diagnostics Corp. (Irvine, CA). January 1993.

238. University of Kansas (Lawrence, KS). January 1993.

239. 6th International Symposium on Recent Advances in Drug Delivery Systems (Salt Lake City, UT). February 1993.

240. Pennsylvania State University (University Park, PA). March 1993.

241. Northwestern University (Evanston, IL). March 1993.

242. International Symposium on Technologies for the Production of Enantiomerically Pure Chemicals (Amelia Island, FL). March 1993.

243. Gordon Conference on Bioanalytical Sensors (Ventura, CA). March 1993.

244. Pharmaceutical Manufacturers Association Analytical R&D/Pharmaceutical Development Subsections Joint Annual Meeting (Lake Buena Vista, FL). April 1993.

245. University of Massachusetts Symposium on Breakthrough Technologies: *Paradigms for a New Century* (Amherst, MA). May 1993.

246. Parke-Davis Corp. (Ann Arbor, MI). May 1993.

247. NutraSweet Co. (Mt. Prospect, IL). June 1993.

248. IGT/GRI Workshop on Novel Concepts for the Production of Regio- and Stereospecific Compounds (Chicago, IL). June 1993.

249. Northeast Regional Meeting of the American Chemical Society (Boston, MA). June 1993.

250. Institute of Food Technologists' Biotechnology Meeting (Chicago, IL). July 1993.

251. Annual Meeting of Department of Energy's Biological and Chemical Technology Research Program Principal Investigators (Tiburon, CA). July 1993.

252. Allied-Signal Corp. (Des Plains, IL). July 1993.

253. American Chemical Society Meeting (Chicago, IL). August 1993.

254. University of Illinois at Urbana-Champaign (Urbana, IL). September 1993.

255. International Enzyme Engineering Conference (Deauville, France). September 1993.

256. Queens College (Flushing, NY). November 1993.

257. Exxon Chemical Research Meeting (Galveston, TX). November 1993.

258. Hoffmann-LaRoche Co. (Nutley, NJ). December 1993.

259. U.S.-Japan Symposium on Drug Delivery (Maui, HI). December 1993.

263. North Dakota State University (Fargo, ND). February 1994.

260. Annual Meeting of the American Institute for Medical and Biological Engineering (Washington, DC). March 1994.

261. Rhone-Poulenc Rorer Symposium on Visions in Chemistry (Collegeville, PA). May 1994.

262. International Flavors & Fragrances R&D (Union Beach, NJ). May 1994.

263. Istituto degli Ormoni (Milan, Italy). June 1994.

264. Gordon Conference on Enzymes, Coenzymes, and Metabolic Pathways (Meriden, NH). July 1994.

265. Annual Meeting of Department of Energy's Biological and Chemical Technology Research Program Principal Investigators (Denver, CO). July 1994.

266. William S. Johnson Symposium in Organic Chemistry (Stanford, CA). October 1994.

267. R.W. Johnson Pharmaceutical Research Institute (Spring House, PA). October 1994.

268. International Congress of Biochemical Engineering (Mexico City, Mexico). October 1994.

269. National University of Mexico (Mexico City, Mexico). October 1994.

270. DuPont Merck Pharmaceutical Co. (Deepwater, NJ). December 1994.

271. Symposium on Therapeutic Protein Production and Processing (Cambridge, MA). January 1995.

272. International Symposium on Biocatalysts for Flavor Production, BioFlavour '95 (Dijon, France). February 1995.

273. Institut Pasteur (Paris, France). February 1995.

274. Florida State University (Tallahassee, FL). March 1995.

275. Abbott Laboratories (North Chicago, IL). March 1995.

276. University of Maryland, Baltimore County (Baltimore, MD). March 1995.

277. University of California at San Diego (La Jolla, CA). April 1995.

278. Great Lakes Regional Meeting of the American Chemical Society (LaCrosse, W I). June 1995.

279. Gordon Conference on Bioorganic Chemistry (Andover, NH). June 1995.

280. Annual Meeting of Department of Energy's Biochemical and Chemical Technology Research Principal Investigators (Albuquerque, NM). July 1995.

281. International Symposium "Biocatalysis-95" (Suzdal, Russia). August 1995.

282. International Enzyme Engineering Conference (San Diego, CA). October 1995.

283. Symposium on Biomacromolecules: *From 3-D Structure to Applications* (Pasco, W A). October 1995.

284. Enzymol International Inc. (Columbus, OH). December 1995.

285. International Symposium PacifiChem ‘95 (Honolulu, HI). December 1995.

286. 3rd U.S.-Japan Symposium on Drug Delivery (Maui, HI). December 1995.

287. New England Section of the Society for Industrial Microbiology (Cambridge, MA). February 1996.

288. Brown University (Providence, RI). February 1996.

289. University of Pittsburgh (Pittsburgh, PA). February 1996.

290. Food Research Institute (Reading, England). March 1996.

291. International Symposium Chiral USA ‘96 (Boston, MA). May 1996.

292. BP Catalyst Colloquium (Uxbridge, England). June 1996.

293. International Symposium on Homogeneous Catalysis (Princeton, NJ). August 1996.

294. Juan March Foundation’s International Workshop on Novel Biocatalysts (Madrid, Spain). March 1997.

295. University of Kentucky (Lexington, KY). April 1997.

296. Gordon Conference on Organic Reactions and Processes (Henniker, NH). August 1997.

297. Novo Nordisk Symposium on Protein Stability (Klampenborg, Denmark). August 1997.

298. International Enzyme Engineering Conference (Beijing, China). October 1997.

299. Biogen Inc. (Cambridge, MA). December 1997.

300. INBIO Europe’98 Conference on Advances in Industrial Biocatalysis (Amsterdam, The Netherlands). February 1998.

301. International Symposium on Stability and Stabilization of Biocatalysts (Córdoba, Spain). April 1998.

302. International Symposium on Protein Structure, Stability and Folding: *Fundamental and Medical Aspects* (Moscow, Russia). June 1998.

303. International Conference on Protein Stabilization (Leeds, England). June 1998.

304. University of Virginia (Charlottesville, VA). September 1998.

305. Danish Biotechnology Conference (Vejle, Denmark). May 1999.

306. International Conference on Biocatalysis and Biotransformation Biotrans '99 (Giardini Naxos, Italy). September 1999.

307. Annual Meeting of the American Association of Pharmaceutical Scientists (New Orleans, LA). November 1999.

308. Brandeis University (Waltham, MA). November 1999.

309. Rutgers University (Piscataway, NJ). March 2000.

310. Chiral USA 2000 Conference (Boston, MA). May 2000.

311. Land O'Lakes Conference on Solid-State Reactivity in Pharmaceutical Systems (Merrimac, W I). June 2000.

312. Agouron Pharmaceuticals Inc. (San Diego, CA). July 2000.

313. U.S. Patent and Trademark Office Technology Fair (Arlington, VA). July 2000.

314. 23rd Gulf Coast Chemistry Conference (Pensacola, FL). September 2000.

315. Avon Products (Suffern, NY). November 2000.

316. Procter & Gamble Co. (Cincinnati, OH). November 2000.

317. Flamel Technologies (Venissieux, France). December 2000.

318. BioVision 2001 International Conference (Lyon, France). February 2001.

319. 9th Baxter Science and Technology Symposium (Hyland, IL). May 2001.

320. International Symposium on Applications of Enzymes in Chemical and Biological Defense (Orlando, FL). May 2001.

321. International Conference on Applied Biocatalysis (Trondheim, Norway). June 2001.

322. PPG Industries (Allison Park, PA). August 2001.

323. University of Kansas (Lawrence, KS). August 2001.

324. Alkermes Inc. (Cambridge, MA). October 2001.

325. 6th U.S.-Japan Symposium on Drug Delivery Systems (Maui, HI). December 2001.

326. Acambis Inc. (Cambridge, MA). January 2002.

327. Baxter BioScience Co. (Duarte, CA). January 2002.

328. International Symposium on Challenges in Drug Discovery and Development in the 21st Century (Kolkata, India). March 2002.

329. National Institute of Standards and Technology (Gaithersburg, MD). April 2002.

330. Albany Molecular Research, Inc. (Mt. Prospect, IL). April 2002.

331. Institute for International Research Conference on Protein and Peptide Formulation Strategies for Drug Development and Delivery (San Francisco, CA). August 2002.

332. R&D Management Council Meeting of the Technical Association of the Pulp and Paper Industry (Cambridge, MA). November 2002.

333. DuPont Central R&D Center (Wilmington, DE). December 2002.

334. *ACTIVE*Pack 2003 Conference (Ponte Verde Beach, FL). February 2003.

335. International Symposium on Industrial Applications of Biocatalysis: *Chemical Development Issues* (Boston, MA). September 2003.

336. U.S. Army Workshop on Self-Decontaminating Materials and Multifunctional Coatings (Arlington, VA). October 2003.

337. British Royal Society Meeting on Biocatalysis in Alternative Media (London, England). December 2003.

338. National Autonomous University of Mexico (Mexico City, Mexico). March 2004.

339. Healthcare Research Initiative Workshop on the Effect of Radiofrequency Radiation on Pharmaceutical Product Quality (Cambridge, MA). June 2004.

340. Rensselaer Biotechnology Symposium on Biological Discoveries That Will Change the World (Troy, NY). September 2004.

341. Barnett International Conference: *The Consequences of Aggregation in Drug Development, Immunology, Quality Control, and Disease Genesis* (Philadelphia, PA). September 2004.

342. 4th Annual IBC Conference on Formulation Strategies for Protein Therapeutics (Boston, MA). October 2004.

343. U.S. Army Edgewood Chemical Biological Center (Aberdeen Proving Ground, MD). August 2005.

344. World Congress on Synthetic Receptors (Salzburg, Austria). September 2005.

345. International Conference "Celebrating 30 Years of Robert Langer's Science" (Cambridge, MA). July 2006.

346. University of Montreal (Montréal, Québec, Canada). October 2006.

347. The Boeing Company Research Center (Everett, W A). December 2006.

348. Instrumentation Laboratory (Lexington, MA). December 2006.

349. Acambis Inc. (Cambridge, MA). January 2007.

350. 6th International Symposium on Industrial Microbiology and Biotechnology (Cambridge, MA). August 2007.

351. Scientific Conference on Chemical & Biological Defense Research (Timonium, MD). November 2007.

352. MIT Research and Development Conference (Cambridge, MA). November 2007.

353. Nanotech '2008 International Conference (Boston, MA). June 2008.

354. Materials Research Society Symposium (Boston, MA). December 2008.

355. Johnson & Johnson Research Briefing at MIT (Cambridge, MA). January 2009.

356. 3rd Annual Lyophilization Conference: *Ensuring Optimum Formulations for Pharmaceuticals and Biologics* (Boston, MA). February 2010.

357. DSM Corporate Research Center (Geleen, The Netherlands). June 2010.

358. Merck Serono Pharmaceutical Co. (Darmstadt, Germany). June 2010.

359. NanoFormulations '2010 International Conference (Stockholm, Sweden). June 2010.

360. Covidien Surgical Devices and Vascular Therapies Divisions (Cambridge, MA). October 2010.

361. World Lyophilization Summit (Cambridge, MA). May 2011.

362. Alvogen (Cambridge, MA). March 2012.

363. Colgate-Palmolive Co. (Cambridge, MA). April 2012.

364. FDA Parenteral Drug Association Glass Quality Conference (Washington, DC). June 2012.

365. University of Puerto Rico (Humacao, Puerto Rico). January 2013.

366. International Conference on Creating and Leveraging Intellectual Property in Developing Countries (Durban, South Africa – *via teleconference*). November 2013.

367. Northwestern University (Evanston, IL). April 2015.

368. FDA and Parenteral Drug Association Joint Regulatory Conference (Washington, DC). September 2016.

369. Annual Partnership Opportunities in Drug Delivery (PODD) Conference (Boston, MA). October 2017.