

Curriculum Vitae  
**Ming-Daw Tsai, Ph.D.**  
Department of Chemistry and Department of Biochemistry  
The Ohio State University

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### Personal

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### Education

1968-1972, B.S. in Chemistry, National Taiwan University, Taipei  
(1972-1974 in compulsory military service)  
1974-1978, Ph.D. in Biochemistry & Medicinal Chemistry, Purdue Univ.  
(Heinz Floss)

### Positions Held

Oct 2003 – Present	Kimberly Professor of Chemistry
Sept. 1995 - Present	Director, Chemistry/Biology Interface Training Program
Oct. 1993 - Present	Director, Office of Research Campus Chemical Instrument Center (overseeing NMR and MS facilities)
Jan. 1992 - Present	Professor, Department of Biochemistry
Oct. 1990 - Present	Professor, Department of Chemistry
Oct. 1986 - Sept. 1990	Associate Professor of Chemistry, Ohio State University
Aug. 1989 - June 1990	Visiting Professor, Dept. of Biochemistry, University of Wisconsin at Madison (with John Markley)
Mar. 1986 - Sept. 1986	Visiting Professor, University of Lund, Sweden (with Sture Forsen)
July 1981 - Sept. 1986	Assistant Professor of Chemistry, Ohio State University
July 1980 - July 1981	Assistant Prof of Chemistry, Rutgers Univ. (Newark)
July 1980 - Dec. 1980	Research Associate, University of Illinois (with Eric Oldfield)
July 1979 - Dec. 1980	Visiting Assistant Professor, Purdue University
Jan. 1978 - June 1979	Postdoctoral Associate, Purdue University (with H. G. Floss)

### Graduate Programs

Department of Chemistry  
Department of Biochemistry  
Ohio State Biochemistry Program  
Biophysics Program  
M. D./Ph. D. Program

### Research Interest

Structure-Function Relationship of Enzymes and Signal-Transduction Proteins  
Biological NMR, Chemical biology, DNA repair mechanisms.

## Honors/Awards

1. Glenn L. Jenkins Award for Excellence in Research, Purdue Univ., 1977.
2. Alfred P. Sloan Fellow, 1983-1985
3. Faculty Research Award, Ohio State Chapter of Sigma Xi, 1985.
4. Camille and Henry Dreyfus Teacher-Scholar, 1985-1990.
5. Distinguished Scholar Award, Ohio State University, 1992.
6. Elected Fellow, American Association for the Advancement of Science, 1992.
7. Committee on Institutional Cooperation (CIC) Academic Leadership Program Fellow, 2002-2003.
8. Guest Professor, Tsinghua University, PRC
9. Distinguished Research Fellow, Academia Sinica, Taiwan

## Special Professional Services

1. Symposium Organizer, "Quadrupolar NMR in Biophysical Chemistry", ACS 18th Central Regional Meeting, Bowling Green, June 4, 1986.
2. Co-Chairperson, 8th Midwest Enzyme Chemistry Conference, October, 1988.
3. NIH Physical Biochemistry Study Section Member, 1988-92.
4. Co-chair, Gordon Conference on Enzymes, July 1993.
5. Board Member, Chinese American Chemical Society, 1993-96.
6. Co-founder, Ohio NMR Consortium, 1995.
7. Nominating Committee, American Chemical Society Division of Biological Chemistry, 1997.
8. NIH Training Grant Study Section, 1997-01.
9. Symposium Organizer, "NMR of Biological Macromolecules". 31<sup>st</sup> Central Regional Meeting of the American Chemical Society, June 21-23, 1999.
10. Advisory Board, Institute of Chemistry, Academia Sinica, Taiwan, 1991-present.
11. President, Chinese American Chemical Society, 2003.

## Professional Membership

American Chemical Society  
American Society of Biochemistry and Molecular Biology  
American Association for the Advancement of Science (Elected Fellow)  
Protein Society

## Active Research Grants

1. "Mechanism of DNA Polymerases". NIH GM43268, PI. This is continuation of "Mechanism of Adenylate Kinase"; title changed at competing renewal.
2. "Structure-Function Relationship of Tumor Suppressors". NIH, CA69472, PI
3. "Conformational Changes in Phospholipase C", NIH, GM57568, co-PI.  
This is continuation of GM30327. K. Bruzik became the PI of this grant. The budget below reflects the portion of my share. Renewal is pending.

4. "Structure Function of FHA Domain in Signaling and Cancer". NIH, CA87031, PI

#### **Training Grants (as Principal Investigator/Program Director)**

1. "Chemistry/Biology Interface Training Grant", NIH, T32 GM 08512,

#### **Equipment Grants (as Principal Investigator only; co-PI of many other proposals.)**

1. "Purchase of a 600 MHz NMR Spectrometer", NIH, RR 08299.
2. "Purchase of a 600 MHz NMR Spectrometer", NSF, BIR-9221639,
3. "500 MHz Console Upgrade", NSF.
4. "800 MHz NMR", Ohio Board of Regents.
5. "Ohio NMR Consortium", Ohio Board of Regents (the funding is distributed among several universities in Ohio; Tsai serve as PI of the Consortium proposal).

#### **Journal Editing**

1. Board of Consulting Editors, Bioorganic & Medicinal Chemistry, 1998-present.
2. Board of Consulting Editors, Bioorganic & Medicinal Chemistry Letters, 1998-present.
3. Theme Editor, Current Opinions in Chemical Biology, Volume 7, April 2003.

## Publications

1. "Terpenes and Sterols of *Cunninghamia Konishii*," Y. S. Cheng and M.-D. Tsai, *Phytochemistry*, *11*, 2108-2109 (1972).
2. "Air Oxidation of  $\alpha$ -Terpineol," M.-D. Tsai and Y. S. Cheng, *J. Chinese Chem. Soc.*, *22*, 149-155 (1974).  
  
"Dye-sensitized Photooxidation of  $\alpha$ -Terpineol," Y. S. Cheng, M.-D. Tsai, J. M. Fang and S. S. Hsu, *Chemistry* (The Chinese Chem. Soc., Taiwan, China), 8-11 (1975).  
  
"Conformational Analysis of Pyridoxal Amino Acid Schiff's Bases," H. J. R. Weintraub, M.-D. Tsai, S. R. Byrn, C.-j. Chang and H. G. Floss, *Int. J. Quantum Chem.*, QBS *3*, 99-105 (1976).
3. "Conformational Analysis of Pyridoxal Schiff's Bases," M.-D. Tsai, S. R. Byrn, C.-j. Chang, H. G. Floss and H. J. R. Weintraub, *Biochemistry* *17*, 3177-3182 (1978).
4. "Conformation-Reactivity Relationship for Pyridoxal Schiff's Bases," M.-D. Tsai, H. J. R. Weintraub, S. R. Byrn, C.-j. Chang and H. G. Floss, *Biochemistry*, *17*, 3183-3188 (1978).
5. "Stereochemistry and Mechanism of Reactions Catalyzed by Tryptophan Synthetase and its  $\beta_2$  Subunit," M.-D. Tsai, E. Schleicher, R. Potts, G. E. Skye and H. G. Floss, *J. Biol. Chem.*, *253*, 5344-5349 (1978).
6. "Stereochemistry and Mechanism of Reactions Catalyzed by Tryptophanase from *Escherichia coli*," J. C. Vederas, E. Schleicher, M.-D. Tsai and H. G. Floss, *J. Biol. Chem.*, *253*, 5350-5354 (1978).
7. "Stereochemistry of the  $\beta$ -Cyanoalanine Synthetase and S-Alkylcysteine Lyase Reactions," M.-D. Tsai, J. Weaver, H. G. Floss, E. E. Conn, R. K. Creveling and M. Mazelis, *Arch. Biochem. Biophys.*, *190*, 553-559 (1978).
8. "Stereochemistry of Enzymatic Transmethylation," H. G. Floss, L. Mascaro, M.-D. Tsai and R. W. Woodard, in *Transmethylation* (E. Usin, R. T. Borchardt and C. R. Creveling, Eds.), Elsevier North-Holland, New York (1979), pp. 135-141.
9. "Chiral Methyl Groups," H. G. Floss and M.-D. Tsai, *Adv. Enzymol.* *50*, 243-302 (1979).
10. "Stereochemistry and Mechanism of Reactions Catalyzed by Indolyl 3-alkane- $\alpha$ -Hydroxylase," M.-D. Tsai, H. G. Floss, H. J. Rosenfeld and J. Roberts, *J. Biol. Chem.*, *254*, 6437-6443 (1979).
11. "Stereochemical Course of the Transmethylation Catalyzed by Catechol O-Methyltransferase," R. W. Woodard, M.-D. Tsai, H. G. Floss, P. A. Cook and J. K. Coward, *J. Biol. Chem.*, *255*, 9124-9127 (1980).
12. "First Observation of Amino Acid Side Chain Dynamics in Membrane Proteins Using High Field Deuterium NMR Spectroscopy," R. A. Kinsey, A. Kintanar, M.-D. Tsai, R. L. Smith, N. Janes and E. Oldfield, *J. Biol. Chem.*, *256*, 4146-4149 (1981).

13. "Protein Crystals, Membrane Proteins and Membrane Lipids." E. Oldfield, N. James, R. Kinsey, A. Kintanar, R. W. K. Lee, T. M. Rotngeb, S. Schramm, R. Skarjune, R. Smith and M.-D. Tsai, *Biochem. Soc. Trans.*, *45*, 155-181 (1981).
14. "Use of  $^{31}\text{P}$  Nuclear Magnetic Resonance to Distinguish Bridge and Non-bridge Oxygens of  $^{17}\text{O}$ -enriched Nucleoside Triphosphates. Stereochemistry of Acetate Activation by Acetyl CoA Synthetase," M.-D. Tsai, *Biochemistry* *18*, 1468-1472 (1979).
15. "Applicability of the  $^{31}\text{P}(^{17}\text{O})$  NMR Method in the Study of Enzyme Mechanism Involving Phosphorus," M.-D. Tsai, S. L. Huang, J. F. Kozlowski and C. C. Chang, *Biochemistry* *19*, 3531-3536 (1980).
16. "Chirality at a Pro-pro-prochiral Phosphorus Center, Stereochemical Course of the 5'-Nucleotidase-Catalyzed Reaction," M.-D. Tsai and T. T. Chang, *J. Am. Chem. Soc.*, *102*, 5416-5418 (1980).
17. "Stereochemistry of the Hydrolysis of Adenosine 5'-Thiophosphate Catalyzed by Venom 5'-Nucleotidase," M.-D. Tsai, *Biochemistry* *19*, 5310-5316 (1980).
18. "Does  $\text{Mg}^{2+}$  Interact with the  $\alpha$ -Phosphate of ATP? An Investigation by  $^{17}\text{O}$  NMR," S.-L. Huang and M.-D. Tsai, *Biochemistry* *21*, 951-959 (1982).
19. "Use of  $^{31}\text{P}(^{18}\text{O})$ ,  $^{31}\text{P}(^{17}\text{O})$ , and  $^{17}\text{O}$  NMR Methods to Study Enzyme Mechanism Involving Phosphorus," M.-D. Tsai, *Methods Enzymol.* *87*, 235-279 (1982).
20. "Phospholipids Chiral at Phosphorus. 1. Stereochemistry of Transphosphatidylation Catalyzed by Phospholipase D," K. Bruzik and M.-D. Tsai, *J. Am. Chem. Soc.* *104*, 863-865 (1982).
21. "Phospholipids Chiral at Phosphorus. 2. Preparation, Property and Application of Chiral Thiophospholipids" K. Bruzik, S. M. Gupte and M.-D. Tsai, *J. Am. Chem. Soc.* *104*, 4682-4684 (1982).
22. "Phospholipids Chiral at Phosphorus. 3. Preparation and Spectral Properties of Chiral Thiophospholipids," K. Bruzik, R.-T. Jiang and M.-D. Tsai, *Biochemistry* *22*, 2478-2486 (1983).
23. "Phospholipids Chiral at Phosphorus. 4. Could Membranes be Chiral at Phosphorus?" M.-D. Tsai, R.-T. Jiang and K. Bruzik, *J. Am. Chem. Soc.* *105*, 2478-2480 (1983).
24. "Phospholipids Chiral at Phosphorus. Synthesis, Absolute Configurations and Applications." K. Bruzik, R.-T. Jiang and M.-D. Tsai, *Phosphorus and Sulfur* *18*, 369-372 (1983).
25. "Effects of  $^{17}\text{O}$  and  $^{18}\text{O}$  on  $^{31}\text{P}$  NMR: Further Investigation and Applications," R. D. Sammons, P. A. Frey, K. Bruzik and M.-D. Tsai, *J. Am. Chem. Soc.* *105*, 5455-5461 (1983).
26. "NMR Methods Involving Oxygen Isotopes in Biophosphates," M.-D. Tsai and K. Bruzik, in *Biological Magnetic Resonance*, Vol. 5, L. J. Berliner and J. Reuben, Eds., Plenum Press, New York, pp. 129-181 (1983).

27. "Phospholipids Chiral at Phosphorus. 5. Synthesis and Configurational Analysis of Chiral [ $^{17}\text{O}$ ,  $^{18}\text{O}$ ]-Phosphatidylethanolamine." K. Bruzik and M.-D. Tsai, *J. Am. Chem. Soc.* 106, 747-754 (1984).
28. "Phospholipids Chiral at Phosphorus. 6. Synthesis of Chiral Phosphatidylcholine and Stereochemistry of Phospholipase D." K. Bruzik and M.-D. Tsai, *Biochemistry* 23, 1656-1661 (1984).
29. "Phospholipids Chiral at Phosphorus. 7. Absolute Configuration of Chiral Thiophospholipids and Stereochemistry of Phospholipase D." R.-T. Jiang, Y.-J. Shyy, and M.-D. Tsai, *Biochemistry* 23, 1661-1667 (1984).
30. "Phospholipids Chiral at Phosphorus. 8. Properties of Small Unilamellar Vesicles of Chiral Thiophosphatidylcholine." T.-C. Tsai, R.-T. Jiang and M.-D. Tsai, *Biochemistry* 23, 5564-5570 (1984).
31. "Stereochemistry of Biological Reactions at Pro-prochiral Centers." H. G. Floss, M.-D. Tsai, and R. W. Woodard, *Topics in Stereochemistry*, E. L. Eliel, N. L. Allinger and S. H. Wilen, Eds., John Wiley & Sons, pp. 253-321 (1984).
32. "Use of Chiral thiophosphates and the Stereochemistry of Enzymatic Phosphoryl Transfer." M.-D. Tsai, in  $^{31}\text{P}$  NMR: *Principles and Applications*, D. Gorenstein, Ed., Academic Press, pp. 175-197 (1984).
33. "Phospholipids Chiral at Phosphorus. 9. Use of Chiral Thiophosphatidylcholine to Study the Metal-Binding Properties of Bee Venom Phospholipase A<sub>2</sub>," T.-C. Tsai, J. Hart, R.-T. Jiang, K. Bruzik and M.-D. Tsai, *Biochemistry* 24, 3180-3188 (1985).
34. "Metal-Nucleotide Interactions. 3.  $^{17}\text{O}$ ,  $^{31}\text{P}$  and  $^1\text{H}$  NMR Studies on the Interactions of Sc(III) and La(III) with ATP," Y.-J. Shyy, T.-C. Tsai and M.-D. Tsai, *J. Am. Chem. Soc.* 107, 3478-3484 (1985).
35. "Mechanism of Adenylate Kinase. 1. Use of  $^{17}\text{O}$  NMR to Study the Binding Properties of Substrates," D. A. Wisner, C. Steginsky, Y.-J. Shyy and M.-D. Tsai, *J. Am. Chem. Soc.* 107, 2814-2815 (1985).
36. "Phospholipids Chiral at Phosphorus. 10. Use of Chiral Thiophospholipids to Study the Mechanism of Phospholipase A<sub>2</sub>," M.-D. Tsai, K. Bruzik, J. Hart, R.-T. Jiang, T. Rosario-Jansen, T.-C. Tsai and D. A. Wisner, in *Mechanisms of Enzymatic Reactions: Stereochemistry*, P. A. Frey, ed., Elsevier, 115-126 (1986).
37. "Phospholipids Chiral at Phosphorus. 11. FT-IR Study on the Gel-Liquid Crystalline Transition of Chiral Thiophosphatidylcholine," S.-B. Chang, J. O. Alben, D. A. Wisner and M.-D. Tsai, *Biochemistry* 25, 3435-3440 (1986).
38. "Phospholipids Chiral at Phosphorus. 12. Configurational Effect on the Thermotropic Properties of Chiral Dipalmitoylthiophosphatidylcholine," D. A. Wisner, T. Rosario-Jansen and M.-D. Tsai, *J. Am. Chem. Soc.*, 108, 8064-8068 (1986).
39. "Phospholipids Chiral at Phosphorus. 13. Stereochemical Comparison of Phospholipase A<sub>2</sub>, Lecithin-Cholesterol Acyl Transferase, and Platelet-Activating Factor," T. Rosario-Jansen, H. J. Pownall, J. P. Noel and M.-D. Tsai, *Phosphorus and Sulfur* 30, 601-604 (1987).

40. Phospholipids Chiral at Phosphorus. 14. Stereochemical Effects on the Thermotropic Properties of Thiophosphatidylcholines and Thiosphingomyelins," M.-D. Tsai, K. S. Bruzik, D. Wisner and S.-H. Liu, in "*Biophosphates and Their Analogues, Synthesis, Structure, Metabolism and Activity*", K.S. Bruzik and W.J. Stec, Eds., Elsevier, pp. 561-570 (1987).
41. "Is the Binding of  $Mg^{2+}$  to Calmodulin Significant? An Investigation by  $^{25}Mg$  NMR," M.-D. Tsai, T. Drakenberg, E. Thulin and S. Forsen, *Biochemistry*, 26, 3635-3643 (1987).
42. "Magnesium Binding to Calcium-Binding Proteins: A Regulatory Function?" T. Drakenberg, S. Forsen, E. Thulin, and M.-D. Tsai, in *Calcium-Binding Proteins in Health and Disease*, Norman, A. W., Vanaman, T. C., and Means, A. R., Eds., Academic Press, pp. 430-432 (1987).
43. "Phospholipids Chiral at Phosphorus. 15. Steric Course of Phosphatidylserine Synthases from *E. coli* and Yeast," C. R. H. Raetz, G. M. Carman, W. Dowhan, R.-T. Jiang, W. Waszkuc, W. Loffredo and M.-D. Tsai, *Biochemistry*, 26 4022-4027 (1987).
44. "A Calorimetric Study of the Thermotropic Behavior of Pure Sphingomyelin Diastereomers," K. S. Bruzik and M.-D. Tsai, *Biochemistry* 26, 5364-5368 (1987).
45. "Mechanism of Adenylate Kinase. 2. Does ATP bind to the AMP Site?" Y. J. Shyy, G. Tian, and M.-D. Tsai, *Biochemistry*, 26, 6411-6415 (1987).
46. "Mechanism of Adenylate Kinase. 3. Use of Deuterium NMR to Show Lack of Correlation Between Local Substrate Dynamics and Local Binding Energy." C. R. Sanders II and M.-D. Tsai, *J. Am. Chem. Soc.* 110, 3323-3324 (1988).
47. "Steric Course of the Reaction Catalyzed by Phosphatidylserine Decarboxylase from *E. coli*". Z. No, C. R. Sanders II, W. Dowhan, and M.-D. Tsai, *Bioorg. Chem.*, 16, 184-188 (1988).
48. "Phospholipids Chiral at Phosphorus. 16. Synthesis and Stereospecificity of Phosphorothioate Analogues of Platelet Activating Factor." T. Rosario-Jansen, R.-T. Jiang, D. J. Hanahan, and M.-D. Tsai, *Biochemistry*, 27, 4619-4624 (1988).
49. "Phospholipids Chiral at Phosphorus. 17. Characterization of the Subgel Phase of Thiophosphatidylcholines by Use of X-Ray Diffraction, P-31 NMR, and FT-IR". H. E. Sarvis, W. Loffredo, R. A. Dluhy, L. Hernqvist, D. A. Wisner, and M.-D. Tsai, *Biochemistry*, 27, 4625-4631 (1988).
50. "Mechanism of Adenylate Kinase. 4. Histidine-36 Is Not Directly Involved in Catalysis, But Protects Cysteine-25 and Stabilizes the Tertiary Structure." G. Tian, C. R. Sanders II, F. Kishi, A. Nakazawa, and M.-D. Tsai, *Biochemistry*, 27, 5544-5552 (1988).
51. "Use of Short-Chain *Cyclopentano*-phosphatidylcholines to Probe the Mode of Activation of Phospholipase A<sub>2</sub> from Bovine Pancreas and Bee Venom". G. L. Lin, J. Noel, W. Loffredo, H. Sable, and M.-D. Tsai, *J. Biol. Chem.*, 263, 13208-13214 (1988).

52. "Phospholipase A<sub>2</sub> Engineering: Design, Synthesis, and Expression of a Gene for Bovine Pancreatic Phospholipase A<sub>2</sub>". J. P. Noel and M.-D. Tsai, *J. Cellular Biochem.* 40 (UCLA Symposium Series), 309-320 (1989).
53. "Phospholipids Chiral at Phosphorus. 18. Stereochemistry of Phosphatidylinositide-specific Phospholipase C". G. Lin and M.-D. Tsai, *J. Am. Chem. Soc.*, 111, 3099-3101 (1989).
54. "Ligand-Protein Interactions Via NMR of Quadrupolar Nuclei". C. R. Sanders II and M.-D. Tsai, *Methods. Enzymol.* 177, 317-333 (1989).
55. "Mechanism of Adenylate Kinase. 5. Is There a Relationship Between Local Substrate Dynamics, Local Binding Energy, and the Catalytic Mechanism?" C. R. Sanders II, G. Tian and M.-D. Tsai, *Biochemistry* 28, 9028-9043 (1989).
56. "Phospholipids Chiral at Phosphorus. 19. Synthesis and Configurational Assignment of Phosphorothioate Analogues of Phosphatidylserine". W. M. Loffredo and M.-D. Tsai, *Bioorg. Chem.* 18, 78-84 (1990).
57. "Phospholipids Chiral at Phosphorus. 20. Stereochemical Mechanism of the Reactions Catalyzed by Phosphatidylinositide-Specific Phospholipase C From *Bacillus Cereus* and Guinea Pig Uterus". G. H. Lin, C. F. Bennett, and M.-D. Tsai, *Biochemistry* 29, 2747-2757 (1990).
58. "Mechanism of Adenylate Kinase. 6. Are the Essential Lysines Essential?" G. Tian, H. Yan, R.-T. Jiang, F. Kishi, A. Nakazawa, and M.-D. Tsai, *Biochemistry* 29, 4296-4304 (1990).
59. "Phospholipids Chiral at Phosphorus. 22. Synthesis of Chiral Dioleoylthiophosphatidylcholine and Stereospecificity of Lecithin-Cholesterol Acyltransferase". T. Rosario-Jansen, H. Pownall, R.-T. Jiang, and M.-D. Tsai, *Bioorg. Chem.* 18, 179-184 (1990).
60. "A Novel Expression Vector for High-Level Synthesis and Secretion of Foreign Proteins in *E. coli*: Overproduction of Bovine Pancreatic Phospholipase A<sub>2</sub>." T. Deng, J. P. Noel, and M.-D. Tsai, *Gene* 93, 229-234 (1990).
61. "Phospholipase A<sub>2</sub> Engineering. 3. Replacement of Lysine-56 by Neutral Residues Improves Catalytic Efficiency Significantly, Alters Substrate Specificity, and Clarifies the Mechanism of Interfacial Recognition". J. P. Noel, T. Deng, K. J. Kelly, and M.-D. Tsai, *J. Am. Chem. Soc.* 112, 3704-3706 (1990).
62. "Mechanism of Adenylate Kinase. 7. Structural and Functional Demonstration of Arginine-138 as a Key Catalytic Residue Which Cannot be Replaced by Lysine". H. Yan, Z. Shi, and M.-D. Tsai, *Biochemistry* 29, 6385-6392 (1990).
63. "Phospholipase A<sub>2</sub> Engineering. 4. Can the Active Site Aspartate Function Alone?" C. M. Dupureur, T. Deng, J.-G. Kwak, J. Noel, and M.-D. Tsai, *J. Am. Chem. Soc.* 112, 7074-7076 (1990).
64. "Phospholipids Chiral at Phosphorus. 23. Dramatic Effect of P-Chirality on the Deuterium NMR Properties of the Choline Head Group of Phospholipids in the Liquid Crystalline Phase". W. M. Loffredo, R.-T. Jiang, and M.-D. Tsai, *Biochemistry* 29, 10912-10918 (1990).



65. "Mechanism of Adenylate Kinase. 8. Critical Evaluation of the X-Ray Model and Assignment of the AMP Site." H. Yan, T. Dahnke, B. Zhou, A. Nakazawa, and M.-D. Tsai, *Biochemistry* 29, 10956-10964 (1990).
66. "Phospholipids Chiral at Phosphorus. 21. Phospholipase Stereospecificity at Phosphorus." K. Bruzik and M.-D. Tsai, *Methods Enzymol.* 197, 258-269 (1991).
67. "Phospholipids Chiral at Phosphorus. 24. Phosphorothioate Analogs of Phosphatidylinositol and Inositol 1,2-Cyclic Phosphate: Applications to the Mechanism of Phospholipase C." K. Bruzik, G. Lin, and M.-D. Tsai, *ACS Symp. Series* 463, 172-185 (1991).
68. "Mechanism of Adenylate Kinase. 9. Demonstration of Functional Relationship Between Aspartate-93 and  $Mg^{2+}$  by Site-Directed Mutagenesis and  $^1H$ ,  $^{31}P$ , and  $^{25}Mg$  NMR." H. Yan and M.-D. Tsai, *Biochemistry* 30, 5539-5546 (1991).
69. "Mechanism of Adenylate Kinase. 10. Reversing Phosphorus Stereospecificity of an Enzyme by Site-Directed Mutagenesis". R.-T. Jiang, T. Dahnke, and M.-D. Tsai, *J. Am. Chem. Soc.* 113, 5485-5486 (1991).
70. "Mechanism of Adenylate Kinase. 11. Site-Directed Mutagenesis Versus X-Ray and NMR." M.-D. Tsai and H. Yan, *Biochemistry* 30, 6806-6818 (1991). [This is a *Perspectives in Biochemistry* article.]
71. "Phospholipase A<sub>2</sub> Engineering. 5. X-Ray Structural and Functional Evidence for the Interaction of Lysine-56 with Substrates." J. P. Noel, C. A. Bingman, T. Deng, C. M. Dupureur, K. J. Hamilton, R.-T. Jiang, J.-G. Kwak, C. Sekharudu, M. Sundaralingam, and M.-D. Tsai, *Biochemistry* 30, 11801-11811 (1991).
72. "Mechanism of Adenylate Kinase. 12. Prediction and Demonstration of Enhancement of Phosphorus Stereospecificity by Site-Directed Mutagenesis". T. Dahnke, R.-T. Jiang, and M.-D. Tsai, *J. Am. Chem. Soc.* 113, 9388-9389 (1991).
73. "Practical Synthesis of Enantiomerically Pure myo-Inositol Derivatives." K. S. Bruzik, J. Myers, and M.-D. Tsai, *Tetrahedron Lett.*, 1009-1012 (1992).
74. "Phospholipase A<sub>2</sub> Engineering. 6. Single Amino Acid Substitutions of Active Site Residues Convert the Rigid Enzyme to Highly Flexible Conformational States." C. M. Dupureur, Y. Li, and M.-D. Tsai, *J. Am. Chem. Soc.* 114, 2748-2749 (1992).
75. "Phospholipids Chiral at Phosphorus. 25. Stereochemical Mechanism for the Formation of Inositol 1-Phosphate Catalyzed by Phosphatidylinositide-Specific Phospholipase C." K. S. Bruzik, A. M. Morocho, D.-Y. Jhon, S. G. Rhee, and M.-D. Tsai, *Biochemistry* 31, 5183-5193 (1992).
76. "Mechanism of Adenylate Kinase. 13. Structural and Functional Roles of Arginine-97 and Arginine-132." T. Dahnke, Z. Shi, H. Yan, R.-T. Jiang, and M.-D. Tsai, *Biochemistry* 31, 6318-6328 (1992).
77. "Phospholipase A<sub>2</sub> Engineering. 7. Structural and Functional Roles of Highly Conserved Tyrosine-52 and Tyrosine-73." C. M. Dupureur, B.-Z.

- Yu, M. Jain, J. P. Noel, T. Deng, Y. Li, I.-J. Byeon, and M.-D. Tsai, *Biochemistry* 31, 6402-6413 (1992).
78. "Efficient and Systematic Syntheses of Enantiomerically Pure and Regiospecifically Protected *Myo*-Inositols." K. S. Bruzik and M.-D. Tsai, *J. Am. Chem. Soc.* 114, 6361-6374 (1992).
79. "Interfacial Catalysis by Phospholipase A<sub>2</sub>: The Rate-Limiting Step for Maximal Turnover". M. K. Jain, B.-Z. Yu, J. Rogers, M. H. Gelb, M.-D. Tsai, E. K. Hendrickson, and H. S. Hendrickson, *Biochemistry* 31, 7841-7847 (1992).
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