

Curriculum Vitae

CRAIG TIMOTHY MARTIN

PERSONAL

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Date of Birth: December 5, 1956
Place of Birth: Whittier, California

EDUCATION

1984 Ph.D. Chemistry Thesis Advisor: Dr. Sunney I. Chan
"The Structures of Cu_A and Cytochrome *a* in Cytochrome *c* Oxidase"
California Institute of Technology, Pasadena, California

1979 B.A. Chemistry, with emphasis in Biochemistry, magna cum laude
University of California at San Diego, La Jolla, California

HONORS AND ACTIVITIES

Ad hoc member, Special Emphasis Panel, National Institutes of Health, June 2004
Member NSF Panel: Biochemistry of Gene Expression, 1997-2002
Executive Committee: Chemistry-Biology Interface Training Program, Univ. of Mass.
Past invited seminars: Paris, Madrid, Univ of Penn, Univ of Indiana, Caltech
Special Review Committee (SRC) to Review NIH Predoctoral Research Training Grant
Applications in Molecular Biophysics, 1994.
Co-convenor: session on "Phage RNA Polymerases," Annual Meeting of the American
Society of Microbiology, Atlanta, GA, May 1993.
National Research Service Award, National Institutes of General Medical Sciences
(1986-88)
Elected to Sigma Xi (1984)
National Institutes of Health Predoctoral Trainee (1980-1984)
William Barton Jones Fellowship
Honorable Mention, National Science Foundation Predoctoral Fellowship (1980)
Urey Prize for Outstanding Senior Chemistry Major (1979)
University of California Regent's Scholarship (1975-1979)

PROFESSIONAL SOCIETIES

American Chemical Society
Biophysical Society / FASEB
American Society for Biochemistry and Molecular Biology
Sigma Xi

PROFESSIONAL EXPERIENCE

Craig T. Martin

University of Massachusetts at Amherst:

- 2003- Graduate Program Director, Dept of Chemistry
- 2002- Professor of Chemistry
- 2002- Adjunct Professor of Biochemistry & Molecular Biology
- 1988- Faculty in the Graduate Program in Molecular & Cellular Biology
- 1994-2002 Associate Professor of Chemistry
- 2001-2002 Adjunct Associate Professor of Biochemistry & Molecular Biology
- 1988-1994 Assistant Professor of Chemistry

California Institute of Technology:

- 2005 Visiting Associate in Chemistry

Yale University:

(Research advisor: Dr. Joseph E. Coleman)

- 1988 Associate Research Scientist
- 1986-1988 Postdoctoral fellow, National Research Service Award, NIGMS
- 1984-1986 Postdoctoral associate

California Institute of Technology:

(Thesis advisor: Dr. Sunney I. Chan)

- 1980-1984 National Institutes of Health Trainee, Chemistry Department
- 1980-1984 Graduate Laboratory Assistant, Departmental EPR Facility
- 1979-1980 Graduate Teaching Assistant, General Chemistry

University of California at San Diego:

- 1978-1979 Research Assistant.

CURRENT RESEARCH FUNDING

“Initiation of Transcription by T7 RNA Polymerase,” National Institutes of Health, 1R01GM55002, 12/01/01-11/30/05, \$150,000/year direct costs.

RESEARCH INTERESTS

The overall goal of my research is to understand the chemical and enzymological basis of complex and fundamental processes in biology. The powerful quantitative tools of biophysical chemistry can be combined with equally powerful techniques found in modern molecular biology to provide detailed information on specific chemical interactions in enzymology.

A major portion of my current research is aimed at understanding the fundamental processes in protein-nucleic acid interactions, specifically in transcription. Towards this end, the family of single subunit RNA polymerases from the bacteriophages T7, T3, and SP6 has proven to be an ideal model system in which to probe the various stages of transcription. In this work, we combine the chemical synthesis of specifically modified DNA templates with kinetic and thermodynamic assays of binding and transcription. This approach has allowed the determination of contributions to binding and function of specific chemical groups in the DNA and in the enzyme. A mapping of specific functional group contacts along the DNA has led to a detailed model for promoter function, while the use of base analogs and the incorporation of non-nucleosidic functions into the DNA has provided key insight into the mechanism of start site selection. Site specifically placed fluorescent base analogs are now providing a detailed picture of the initially transcribing complex as it steps away from the promoter and becomes a stable elongation complex, testing specific models and providing key insight into this critical step in transcription.

The overall goal of these studies is to tie specific structural interactions to individual mechanistic steps in the complex process which is transcription.

PUBLICATIONS

1. "Reactions of Nitric Oxide with Tree and Fungal Laccase," Craig T. Martin, Randall H. Morse, Robert M. Kanne, Harry B. Gray, Bo G. Malmström, and Sunney I. Chan, *Biochemistry* 20, 5147-5155, 1981.
2. "The Nature of Cu_A in Cytochrome c Oxidase," Tom H. Stevens, Craig T. Martin, Hsin Wang, Gary W. Brudvig, Charles P. Scholes, and Sunney I. Chan, *J. Biol. Chem.* 257, 12106-12113, 1982.
3. "The Nature and Distribution of the Metal Centers in Cytochrome c Oxidase," Sunney I. Chan, Gary W. Brudvig, Craig T. Martin, and Tom H. Stevens, in *Electron Transport and Oxygen Utilization*, Chien Ho, ed., Elsevier, Amsterdam, 171-177, 1982.
4. "The Metal Centers of Cytochrome c Oxidase: Structures and Interactions," David F. Blair, Craig T. Martin, Jeff Gelles, Hsin Wang, Gary W. Brudvig, Tom H. Stevens, and Sunney I. Chan, *Chemica Scripta* 21, 43-53, 1983.
5. "A Resonance Raman Investigation of Perturbed States of Tree and Fungal Laccase," D. F. Blair, G. W. Campbell, V. Lum, C. T. Martin, H. B. Gray, B. G. Malmström, and Sunney I. Chan, *J. Inorg. Biochem.* 19, 65-73, 1983.
6. "The Structure of the Metal Centers in Cytochrome c Oxidase," Sunney I. Chan, Craig T. Martin, Hsin Wang, Gary W. Brudvig, and Tom H. Stevens, in *The Coordination Chemistry of Metalloenzymes*, I. Bertini, R. S. Drago, and C. Luchinat, eds., D. Reidel Pub. Co., Boston, 313-328, 1983.
7. "Structural Studies on the Metal Centers of Cytochrome c Oxidase," Jeff Gelles, David F. Blair, Craig T. Martin, Hsin Wang, and Sunney I. Chan, in *Frontiers in Biochemical and Biophysical Studies of Proteins and Membranes*, Teh-Yung Liu, Shunpei Sakakibara, Alan N. Schechter, Kunio Yagi, Haruaki Yajima, and Kerry T. Yasunobu, eds., Elsevier, New York, 259-277, 1983.
8. "Energetics and Molecular Dynamics of the Proton Pumping Photocycle in Bacteriorhodopsin," Robert R. Birge, Albert F. Lawrence, Thomas M. Cooper, Craig T. Martin, David F. Blair, and Sunney I. Chan, in *Nonlinear Electrodynamics in Biological Systems*, W. Ross Adey and Albert F. Lawrence, eds., Plenum, New York, 107-120, 1984.
9. "The Metal Centers of Cytochrome c Oxidase: Structure and Function," Sunney I. Chan, Craig T. Martin, Hsin Wang, David F. Blair, Jeff Gelles, Gary W. Brudvig, and Tom H. Stevens, in *Biochemical and Biophysical Studies of Proteins and Nucleic Acids*, Tung-Bin Lo, Teh-Yung Liu, and Choh-Hao Li, eds., Elsevier, New York, 219-239, 1984.
10. "The Identification of Histidine Ligand(s) to Cytochrome a in Cytochrome c Oxidase," Craig T. Martin, Charles P. Scholes, and Sunney I. Chan, *J. Biol. Chem.* 260, 2857-2861, 1985.
11. "Transcription by T7 RNA Polymerase Is Not Zinc-Dependent and Is Abolished on Amidomethylation of Cysteine-347," Garry C. King, Craig T. Martin, Thang T. Pham, and Joseph E. Coleman, *Biochemistry* 25, 36-40, 1986.
12. "Zinc Metalloproteins Involved in Replication and Transcription," David P. Giedroc, Kathleen M. Keating, Craig T. Martin, Kenneth R. Williams, and Joseph E. Coleman, *J. Inorg. Biochem.* 28, 155-169, 1986.
13. "Kinetic Analysis of T7 RNA Polymerase-Promoter Interactions with Small Synthetic Promoters," Craig T. Martin and Joseph E. Coleman, *Biochemistry* 26, 2690-2696, 1987.

14. "A Proposal for the Site and Mechanism of Redox-Linked Proton Translocation in Cytochrome *c* Oxidase," Sunney I. Chan, Peter Mark Li, Thomas Nilsson, Jeff Gelles, David F. Blair, and Craig T. Martin, *Prog. Clin. Biol. Res.* 274, 731-747, 1988.
15. "On the Nature of Cysteine Coordination to Cu_A in Cytochrome *c* Oxidase," Craig T. Martin, Charles P. Scholes, and Sunney I. Chan, *J. Biol. Chem.* 263, 8420-8429, 1988.
16. "Processivity in Early Stages of Transcription by T7 RNA Polymerase," Craig T. Martin, Daniel K. Muller, and Joseph E. Coleman, *Biochemistry* 27, 3966-3974, 1988.
17. "Processivity of Proteolytically Modified Forms of T7 RNA Polymerase," Daniel K. Muller, Craig T. Martin, and Joseph E. Coleman, *Biochemistry* 27, 5763-5771, 1988.
18. "T7 RNA Polymerase Does Not Interact with the 5'-Phosphate of the Initiating Nucleotide," Craig T. Martin and Joseph E. Coleman, *Biochemistry* 28, 2760-2762, 1989.
19. "T7 RNA Polymerase Interacts with Its Promoter from One Side of the DNA Helix," Daniel K. Muller, Craig T. Martin, and Joseph E. Coleman, *Biochemistry* 28, 3306-3313, 1989.
20. "Reaction of Single-Stranded DNA with Hydroxyl Radical Generated by Iron(II)-Ethylenediaminetetraacetic Acid," Richard V. Prigodich & Craig T. Martin, *Biochemistry* 29, 8017-8019, 1990.
21. "Tests of a Model for Promoter Recognition by T7 RNA Polymerase: Thymine Methyl Group Contacts," Maribeth Maslak, Martha D. Jaworski, and Craig T. Martin, *Biochemistry* 32, 4270-4274, 1993.
22. "Identification of Specific Contacts in T3 RNA Polymerase-Promoter Interactions: Kinetic Analysis using Small Synthetic Promoters," Charlie Schick and Craig T. Martin, *Biochemistry* 32, 4275-4280, 1993.
23. "Kinetic Analysis of T7 RNA Polymerase Transcription Initiation From Promoters Containing Single Stranded Regions," Maribeth Maslak and Craig T. Martin, *Biochemistry* 32, 4281-4285, 1993.
24. "Effects of Solution Conditions on the Steady State Kinetics of Initiation of Transcription by T7 RNA Polymerase," Maribeth Maslak and Craig T. Martin, *Biochemistry* 33, 6918-6924, 1994.
25. "Tests of a Model of Specific Contacts in T7 RNA Polymerase-Promoter Interactions," Charlie Schick and Craig T. Martin, *Biochemistry* 34, 666-672, 1995.
26. "Identification of Essential Amino Acids Within the Proposed Cu_A Binding Site in Subunit II of Cytochrome *c* Oxidase," Henry Speno, M. Reza Taheri, Derek Sieburth, and Craig T. Martin, *J. Biol. Chem.* 270, 25363-25369, 1995.
27. "Major Groove Recognition Elements in the Middle of the T7 RNA Polymerase Promoter," Tong Li, Hoi Hung Ho, Maribeth Maslak, Charlie Schick & Craig T. Martin, *Biochemistry* 35, 3722-3727, 1996.
28. "Thermodynamic and Kinetic Measurements of Promoter Binding by T7 RNA Polymerase, Andrea Ujvári & Craig T. Martin, *Biochemistry* 35, 14574-14582, 1996.
29. "Positioning of the Start Site in the Initiation of Transcription by T7 RNA Polymerase," Benjamin F. Weston, Iaroslav Kuzmine, & Craig T. Martin, *J. Mol. Biol.* 272, 21-30, 1997.
30. "Identification of a Minimal Binding Element within the T7 RNA Polymerase Promoter," Andrea Ujvári & Craig T. Martin, *J. Mol. Biol.* 273, 775-781, 1997.

31. "Evidence for DNA Bending at the T7 RNA Polymerase Promoter," Andrea Ujvári & Craig T. Martin, *J. Mol. Biol.* 295, 1173-1184, 2000.
32. "Pre-steady State Kinetics of Initiation of Transcription by T7 RNA Polymerase - A New Kinetic Model," Iaroslav Kuzmine & Craig T. Martin, *J. Mol. Biol.* 305, 559-566, 2001.
33. "Fluorescence Characterization of the Transcription Bubble in Elongation Complexes of T7 RNA Polymerase," Cuihua Liu & Craig T. Martin, *J. Mol. Biol.* 308, 465-475, 2001.
34. "Structure in Nascent RNA Leads to Termination of Slippage Transcription by T7 RNA Polymerase," Iaroslav Kuzmine, Philip A. Gottlieb, & Craig T. Martin, *Nucl. Acids Res.*, 29, 2601-2606, 2001.
35. "Interrupting the Template Strand of the T7 Promoter Facilitates Translocation of the DNA During Initiation, Reducing Transcript Slippage and the Release of Abortive Products," Manli Jiang, Mingqing Rong, Craig Martin, and William T. McAllister, *J. Mol. Biol.* 310, 509-522, 2001.
36. "Gold Nanoparticles with Biological Activity: Disruption of Transcription via Electrostatic Attraction," Catherine M. McIntosh, Edward A. Esposito, III, Andrew K. Boal, Joseph M. Simard, Craig T. Martin, & Vincent M. Rotello, *J. Am. Chem. Soc.*, 123, 7626-7629, 2001
37. "Promoter Clearance by T7 RNA Polymerase: Initial Bubble Collapse and Transcript Dissociation Monitored by Base Analog Fluorescence," Cuihua Liu & Craig T. Martin, *J. Biol. Chem.*, 277, 2725-2731, 2002.
38. "Binding of the Priming Nucleotide in the Initiation of Transcription by T7 RNA Polymerase," Iaroslav Kuzmine, Philip A. Gottlieb, & Craig T. Martin, *J. Biol. Chem.* 278, 2819-2823, 2003.
39. "Evaluation of fluorescence spectroscopy methods for mapping melted regions of DNA along the transcription pathway," Craig T. Martin, Andrea Ujvári, & Cuihua Liu, *Methods in Enzymology*, S. Adhya & S. Garges, eds., (invited), 371, 13-33, 2003.
40. "Crosslinking of Promoter DNA to T7 RNA Polymerase Does Not Prevent Formation of a Stable Elongation Complex," Edward A. Esposito and Craig T. Martin, *J. Biol. Chem.* 279, 44270-44276, 2004.
41. "Initial DNA bubble collapse plays a key role in the transition to elongation in T7 RNA polymerase," Peng Gong, Edward A. Esposito, & Craig T. Martin, *J. Biol. Chem.* 279, 44277-44285, 2004.
42. "Topological and conformational analysis of the initiation and elongation complex of T7 RNA polymerase suggests a new twist," Karsten Theis, Peng Gong and Craig T. Martin, *Biochemistry* 43, 12709-12715, 2004.
43. "Structure and Function in Promoter Escape by T7 RNA," Craig T. Martin, Edward A. Esposito, Karsten Theis, & Peng Gong, *Progress in Nucleic Acid Research and Molecular Biology* 80, 323-347, 2005.
44. "Controlled Recovery of the Transcription of Nanoparticle-Bound DNA by Intracellular Concentrations of Glutathione," Gang Han, Nandini S. Chari, Ayush Verma, Rui Hong, Craig T. Martin, & Vincent Rotello, *Bioconjugate Chemistry*, 16, 1356-1359, 2005.
45. "Stability of Gold Nanoparticle-Bound DNA toward Biological, Physical, and Chemical Agents," Gang Han, Craig T. Martin, & Vincent M. Rotello, *Chem Biol Drug Des* 1, 1-5, 2005.
46. "Light-Regulated Release of DNA and Its Delivery to Nuclei by Means of Photolabile Gold Nanoparticles," Gang Han, Chang-Cheng You, Byoung-jin Kim, Rosemary S. Turingan, Neil S. Forbes, Craig T. Martin, & Vincent M. Rotello, *Angew. Chem. Int. Ed.* 45, 3165-3169, 2006.

47. "Mechanism of instability in abortive cycling by T7 RNA polymerase," Peng Gong & Craig T. Martin, *J. Biol. Chem.* **281**, 23533-23544, 2006.
48. "Observed instability of T7 RNA polymerase elongation complexes can be dominated by collision-induced 'bumping'," Yi Zhou & Craig T. Martin, *J. Biol. Chem.* **281**, 24441-24448, 2006.
49. "Forward Translocation as a Primary Mechanism in the Instability of Stalled Elongation Complexes of T7 RNA Polymerase," Yi Zhou & Craig T. Martin, *submitted, in review*, 2006.
50. "Structural Confirmation of a Bent and Open Model for the Initiation Complex of T7 RNA Polymerase," submitted, Rosemary S. Turingan, Cuihua Liu, Mary E. Hawkins, & Craig T. Martin, 2006.

Other:

Review of (curve fitting software) "pro Fit 5.01 for the Mac" *J. Am. Chem. Soc.* **119**(30), 7171-7172, 1997.

Book Review: "DNA-Protein Interactions: Principles and Protocols, 2nd. Edition Edited by Tom Moss," Craig T. Martin, *ChemBioChem* **4**(6), 546, 2003.