Biographical Summary: Charles Patrick Collier

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PROFESSIONAL HISTORY

Education:

School	Location	Major	Dates	Degrees
U. California, Berkeley	Berkeley, CA	Phys. Chem.	1991-1998	Ph.D.

Advisor: Prof. R. J. Saykally
Coadvisor: Prof. J.R. Heath, UCLA
Thesis: "Design and Characterization of a Reversible Metal- Insulator Transition in Silver Quantum Dot Monolayers"

Oberlin College	Oberlin, OH	Chem, Music	1986-1991	B.A., with honors B.Mus.

Professional Positions:

2001-	Assistant Professor, Division of Chemistry and Chemical Engineering California Institute of Technology
1999- 2001	Joint Hewlett Packard - UCLA Postdoctoral Researcher
1998- 1999	Postdoctoral Researcher, Dept. of Chem. and Biochem., UCLA
1991-1998	Graduate Student, Dept. of Chem., UC Berkeley
1990-1991	Undergrad. Research Assoc., Dept. of Chem., Oberlin College, Oberlin, OH
Summer,1990	NSF Undergraduate Research Fellow, Dept. of Chem., Univ. of Utah, Salt Lake City, UT
Summer, 1989	NSF Undergraduate Research Fellow, Dept. of Chem., Washington University, St. Louis, MO

Current Research Activities:

Nonlinear chemical reaction dynamics. Chemical and biochemical reaction networks. Mesoscopic organization. Single molecule spectroscopy. Scanning probe microscopy. Nanolithography.

Awards and Honors:

2004	Young Faculty Research Initiation Award, Center for Science and Engineering of Materials (NSF MRSEC)
2002	Research Innovation Award, Research Corp.
2002	Caltech President's Fund Award
2001	UCLA Chancellor's Award for Excellence in Postdoctoral Research
1998	Graduate Student Travel Award, American Physical Society, Los Angeles Meeting
1991	Elected into Phi Beta Kappa
1991	Elected into Sigma Xi Research Society, Oberlin College

Professional Activities:

1995- member, American Chemical Society

1998- member, American Physical Society

Served as reviewer for *Journal of Physical Chemistry, A* and *B, Journal of Chemical Physics, Journal of the American Chemical Society, Applied Physics Letters, Chemical Physics Letters, Angewandte Chemie, Analytical Chemistry, Chemistry of Materials, Nano Letters, Nanotechnology*.

Served as reviewer for proposals submitted for the Research Innovation Award (Research Corporation), Caltech President's Fund Award (NASA), Air Force Office of Sponsored Research, Petroleum Research Fund (American Chemical Society) and for the National Science Foundation

2002- mentor, Summer Apprenticeship Program, Institute for Educational Advancement

2004- member, Biophysical Society

2005 co-chair for "Molecular Electronic Circuit Assembly" track, 2nd Conference on Foundations of Nanoscience (DARPA). Discussion leader for "Biomolecular and Supramolecular Electronics", Gordon Research Conference on the Chemistry of Electronic Materials

Presentations:

June 2006 Physical Chemistry Seminar, University of California, Santa Barbara, CA
Biochemical Reaction Dynamics in Restricted Environments, invited talk

May 2006 Rowland Institute, Harvard University, Cambridge, MA
Biochemical Reaction Dynamics in Restricted Environments, invited talk

May 2006 Stanford/IBM Center for Probing the Nanoscale, Stanford, CA
Functionalized Scanning Probes Using Carbon Nanotubes, invited talk

April 2006 Foundations of Nanoscience, Snowbird, UT
Biochemical Reaction Dynamics in Restricted Environments, invited talk

October 2005 Kavli Inaugural Symposium, Caltech
Molecular Circuitry: Construction and Characterization of Coupled Biomolecular Dynamics, invited talk

June 2005 Developmental Biology Seminar, Children's Hospital Los Angeles, CA
Molecular Circuitry: Construction and Characterization of Coupled Enzyme Dynamics, invited talk

June 2005 Physics Seminar, Sungkyunkwan University, Korea
Single-Walled Carbon Nanotube Tips for Scanning Probe Microscopy, invited talk

June 2005 Nano-Biomedical Symposium, Yonsei University, Korea
Molecular Circuitry: Construction and Characterization of Coupled Enzyme Dynamics, invited talk

April 2005 Foundations of Nanoscience, Snowbird, UT
Functionalized Nanoelectrode Scanning Probes Using Carbon Nanotubes, invited talk

March 2005 American Physical Society, Los Angeles, CA
Surfactant Activated Dip-Pen Nanolithography

March 2005 American Chemical Society, San Diego, CA
Functionalized Nanoelectrode Scanning Probes Using Carbon Nanotubes

February 2005 Biophysical Society Meeting, Long Beach, CA
Nanoelectrode Scanning Probes from Fluorocarbon-Coated Single-Walled Carbon Nanotubes

May 2004 Physical Chemistry Seminar, University of California, San Diego, CA
Building Artificial Biochemical Reaction Networks, One Molecule at a Time, invited talk

April 2004 Materials Research Society Meeting, San Francisco, CA
Nanowiring Enzymes to Carbon Nanotube Probes

March 2004 American Chemical Society Annual Meeting, Anaheim, CA
Nanowiring Enzymes to Carbon Nanotube Probes

March 2004 American Physical Society Annual Meeting, Montreal, Canada
Quantitative Study of Single Wall Carbon Nanotube Probe-Sample Interactions

Feb 2004 Biophysical Society Meeting, Baltimore, MD
Nanowiring Biomolecules to Carbon Nanotube Probes

Jan 2004 Dip-Pen Nanolithography Workshop, Air Force Office of Sponsored Research, Duck Key, FL
Enzyme Kinetics Measured from Nanoscale Arrays Formed by Dip-Pen Nanolithography, invited talk.

Oct 2003 Physical Chemistry Seminar, California State University, Los Angeles, CA
Building Artificial Biochemical Reaction Networks, One Molecule at a Time, invited talk.

July 2002 California NanoSystems Institute Nanotriangle Meeting, Marina del Rey, CA
Single-Molecule, Real-Time Characterization of Facilitated Diffusion of a Restriction Enzyme on DNA, invited talk

Nov 2001 Physics Seminar, California State University, Sacramento, CA
Developing Molecular Switches for a Chemically Assembled Computer, invited talk

May 2001 Materials Research Society Meeting, San Francisco, CA
Molecular Electronics for Computing and Memory, invited talk

April 2001 American Chemical Society Annual Meeting, San Diego, CA
Design Considerations in Chemical Assembly of Electronically Reconfigurable Molecular Switching Arrays for Memory and Logic, invited talk

Dec 2000 'Molecular Electronics 2000' United Engineering Foundation Conference, Kailua-Kona, HI
MOL-RAM: Molecular-Based Cross-Point Switching and Memory, invited talk

March 2000	American Physical Society Annual Meeting, Minneapolis, MN *'Mol-RAM': Electrically Reconfigurable, Molecular-Based Cross-Point Switching and Memory Arrays*, invited talk
Feb 2000	Physical Chemistry Seminar, California State University, Fullerton, CA *A Chemical Computer Using Configurable Molecular Switches*, invited talk
Nov 1999	Physics Seminar, California State University, Long Beach, CA *A Chemical Computer Using Configurable Molecular Switches*, invited talk
August 1999	Gordon Research Conference on Clusters, Nanocrystals, and Nanostructures, New London, CT *The Complex Dielectric Function of Ag Quantum Dot Solids*, invited talk
March 1998	American Physical Society Annual Meeting, Los Angeles, CA *Design and Characterization of a Reversible Metal-Insulator Transition in Silver Quantum Dot Monolayers*
April 1997	American Chemical Society Annual Meeting, San Francisco, CA *Reversible Tuning of Silver Quantum Dot Monolayers through the Metal-Insulator Transition*, invited talk
June 1995	International Symposium on Molecular Spectroscopy, Ohio State University, OH *Cavity Ringdown Laser Absorption Spectroscopy and Time-of-Flight Mass Spectroscopy of Jet-Cooled Transition Metal Silicides*
June 1993	International Symposium on Molecular Spectroscopy, Ohio State University, OH *Vibration-Rotation Tunneling Spectroscopy of $H_5O_2^+$ Using Direct Laser Absorption Spectroscopy in Fast Ion Beams*

Publications of Charles Patrick Collier

(* publications from research since appointment to faculty position)

1. *A. Kutana, K.P. Giapis, J.Y. Chen, and C.P. Collier, "Amplitude Response of Single-Wall Carbon Nanotube Probes during Tapping Mode Atomic Force Microscopy: Modeling and Experiment", *Nano Lett.* **6**, 1669-1673 (2006).
2. *C. P. Collier, "Carbon Nanotube Tips for Scanning Probe Microscopy", *Carbon Nanotubes: Properties and Applications*, M.J. O'Connell, Ed.; CRC Press: Boca Raton, 2006.
3. * J.Y. Chen, A. Kutana, C.P. Collier, and K.P. Giapis, "Electrowetting in Carbon Nanotubes", *Science* **310**, 1480-1483 (2005).
4. *S.D. Solares, M.J. Esplandiu, W.A. Goddard III, and C.P. Collier, "Mechanisms of Single-Walled Carbon Nanotube Probe-Sample Multistability in Tapping Mode AFM Imaging", *J. Phys. Chem. B* **109**, 11493-11500 (2005).
5. *J. Chen and C.P. Collier, "Noncovalent Functionalization of Single-Walled Carbon Nanotubes with Water-Soluble Porphyrins", *J. Phys. Chem. B* **109**, 7605-7609 (2005).
6. *S.-Y. Jung, M.A. Holden, P.S. Cremer and C.P. Collier, "Two-Component Membrane Lithography via Lipid Backfilling", *ChemPhysChem*, **6**, 423-426 (2005).
7. *H. Jung, C.K. Dalal, S. Kuntz, R. Shah, and C.P. Collier, "Surfactant Activated Dip-Pen Nanolithography", *Nano Lett.* **4**, 2171-2177 (2004).
8. *M.J. Esplandiu, V.G. Bittner, K.P. Giapis, and C.P. Collier, "Nanoelectrode Scanning Probes from Fluorocarbon-Coated Single-Wall Carbon Nanotubes", *Nano Lett.* **4**, 1873-1879 (2004).
9. *I.R. Shapiro, S. Solares, M.J. Esplandiu, L.A. Wade, W.A. Goddard, and C.P. Collier, "Influence of Elastic Deformation on Single-Wall Carbon Nanotube Atomic Force Microscopy Probe Resolution", *J. Phys. Chem. B.* **108**, 13613-13618 (2004).
10. J.O. Jeppesen, C. P. Collier, J.R. Heath, Y. Luo, K.A. Nielsen, J. Perkins, J. Fraser Stoddart, and E. Wong, "Artificial Molecular Devices Based on Tetrathiafulvalene", *J. Phys. IV France* **114**, 511-513 (2004).
11. *L.A. Wade, I.R. Shapiro, Z. Ma, S.R. Quake, and C.P. Collier, "Correlating AFM Probe Morphology to Image Resolution for Single-Wall Carbon Nanotube Tips", *Nano Lett.* **4**, 725-731 (2004).
12. *H. Jung, R. Kulkarni, and C.P. Collier, "Dip-Pen Nanolithography of Reactive Alkoxysilanes on Glass", *J. Am. Chem. Soc.* **125**, 12096-12097 (2003).
13. Y. Luo, C. P. Collier, J. O. Jeppesen, K. A. Nielsen, E. DeIonno, G. Ho, J. Perkins, H.-R. Tseng, T. Yamamoto, J. F. Stoddart, and J. R. Heath, "Two-Dimensional Molecular Electronics Circuits", *ChemPhysChem* (cover article) **3**, 519-525 (2002).
14. C.P. Collier, B. Ma, E.W. Wong, J.R. Heath, and F. Wudl, "Photochemical Response of Electronically Reconfigurable Molecule-Based Switching Tunnel Junctions", *ChemPhysChem* **3**, 458-461 (2002).
15. H. Choi, X. Yang, G.W. Mitchell, C.P. Collier, F. Wudl, and J.R. Heath, "The Structure of a Tetraazapentacene Molecular Monolayer", *J. Phys. Chem. B* **106**, 1833-1839 (2002).

16. C.P. Collier, J.O. Jeppesen, Y. Luo, J. Perkins, E.W. Wong, J.R. Heath, and J.F. Stoddart, "Molecular-Based Electronically Switchable Tunnel Junction Devices", *J. Am. Chem. Soc.* **123**, 12632-12641 (2001).

17. A.R. Pease, J.O. Jeppesen, J.F. Stoddart, Y. Luo, C.P. Collier, and J.R. Heath, "Switching Devices Based on Interlocked Molecules", *Acc. Chem. Res.* **34**, 433-444 (2001).

18. J. Perkins, C.P. Collier, J.R. Heath, J.O. Jeppesen, Y. Luo, K.A. Nielsen, A.R. Pease, J.F. Stoddart, and E.W.Wong, "Toward Artificial Molecular Devices", *Mol. Electron. Bioelectron.* **12**, 69-74 (2001).

19. C.P. Collier, G. Mattersteig, E.W. Wong, Y. Luo, K. Beverly, J. Sampaio, F.M. Raymo, J.F. Stoddart, and J.R. Heath, "A [2]Catenane-Based Solid State Reconfigurable Switch", *Science* **289**, 1172-1175 (2000).

20. S. Henrichs, C. P. Collier, R. J. Saykally, Y. R. Shen and J. R. Heath, "The Dielectric Function of Ag Quantum Dot Monolayers Compressed through the Metal/Insulator Transition", *J. Am. Chem. Soc.* **122**, 4077-4083 (2000).

21. E.W. Wong, C.P. Collier, M.Belohradský, F.M. Raymo, J.F. Stoddart, and J.R. Heath, "Fabrication and Transport Properties of Single-Molecule Thick Electrochemical Junctions", *J. Am. Chem. Soc.* **122**, 5831-5840 (2000).

22. C.P. Collier, E.W. Wong, M. Belohradský, F.M. Raymo, J.F. Stoddart, P.J. Kuekes, R.S. Williams, and J.R. Heath, "Electronically Configurable Molecular-Based Logic Gates", *Science* **285**, 391-394 (1999).

23. C.P. Collier, S. Henrichs, J. R. Heath, "Direct Measurement of Local Field Factors for Second Harmonic Generation from Quantum Dot Langmuir Monolayers Compressed through the Metal-Insulator Transition", *Phil. Mag. B* **79**, 1299-1305 (1999).

24. S. Henrichs, J. Sample, J. Shiang, C.P. Collier, R.J. Saykally, and J.R. Heath, "Positive and Negative Contrast Lithography on Silver Quantum Dot Monolayers", *J. Phys. Chem. B* (cover article) **103**, 3524-3528 (1999).

25. G. Markovich, C.P. Collier, S.E. Henrichs F. Remacle, R.D. Levine, and J.R. Heath, "Architectonic Quantum Dot Solids", *Acc. Chem. Res*. *Special Issue on Nanochemistry*, **32**, 415-423 (1999).

26. C.P. Collier, T. Vossmeyer, and J.R. Heath, "Nanocrystal Superlattices", *Annu. Rev. Phys. Chem.* **49**, 371-404 (1998).

27. F. Remacle, C.P. Collier, G. Markovich, J.R. Heath, U. Banin, and R.D. Levine, "Networks of Quantum Nanodots: The Role of Disorder in Modifying Electronic and Optical Properties", *J. Phys. Chem. B* **102**, 7727-7734 (1998).

28. F. Remacle, C.P. Collier, J.R. Heath, and R.D. Levine, "The Transition from Localized to Collective Electronic States in a Silver Quantum Dots Monolayer Examined by Nonlinear Optical Response", *Chem. Phys. Lett.* **291**, 453-458 (1998).

29. J.J. Shiang, J.R. Heath, C.P. Collier, and R.J. Saykally, "Cooperative Phenomena in Artificial Solids Made from Silver Quantum Dots: The Importance of Classical Coupling", *J. Phys. Chem. B* **102**, 3425-3430 (1998).

30. G. Markovich, C.P. Collier, and J.R. Heath, "Reversible Metal-Insulator Transition in Ordered Metal Nanocrystal Monolayers Observed by Impedance Spectroscopy", *Phys. Rev. Lett.* **80**, 3807-3810 (1998).

31. A.I. Boldyrev, J. Simons, J.J. Scherer, J.B. Paul, C.P. Collier, and R.J. Saykally, "On the Ground Electronic States of Copper Silicide and Its Ions", *J. Chem. Phys.* **108**, 5728-5732 (1998).

32. C.P. Collier, R.J. Saykally, J.J. Shiang, S.E. Henrichs, and J.R. Heath, "Reversible Tuning of Silver Quantum Dot Monolayers through the Metal-Insulator Transition", *Science* **277**, 1978-1981 (1997).

33. J.B. Paul, C.P. Collier, R.J. Saykally, J.J. Scherer, and A.O'Keefe, "Direct Measurement of Water Cluster Concentrations by Infrared Cavity Ringdown Laser Absorption Spectroscopy", *J. Phys. Chem. A* **101**, 5211-5214 (1997).

34. J.J. Scherer, J.B. Paul, C.P. Collier, A. O'Keefe, D.J. Rakestraw, R.J. Saykally "Cavity Ringdown Laser Spectroscopy: A New Ultrasensitive Absorption Technique", *Spectroscopy* **11**, 46-50 (1996).

35. J.B. Paul, J.J. Scherer, C.P. Collier, and R.J. Saykally, "Cavity Ringdown Laser Absorption Spectroscopy and Time-of-Flight Mass Spectroscopy of Jet-Cooled Platinum Silicides", *J. Chem. Phys.* **104**, 2782-2788 (1996).

36. J.J. Scherer, J.B. Paul, C.P. Collier, A. O'Keefe, and R.J. Saykally, "Cavity Ringdown Laser Absorption Spectroscopy and Time-of-Flight Mass Spectroscopy of Jet-Cooled Gold Silicides", *J. Chem. Phys.* **103**, 9187-9192 (1995).

37. J.J. Scherer, D. Voelkel, D.J. Rakestraw, J.B. Paul, C.P. Collier, and R.J. Saykally, "Infrared Cavity Ringdown Laser Absorption Spectroscopy (IR-CRLAS)", *Chem. Phys. Lett.* **245**, 273-280 (1995).

38. J.J. Scherer, J.B. Paul, C.P. Collier, and R.J. Saykally, "Cavity Ringdown Laser Absorption Spectroscopy and Time-of-Flight Mass Spectroscopy of Jet-Cooled Silver Silicides", *J. Chem. Phys.* **103**, 113-120 (1995).

39. J.J. Scherer, J.B. Paul, C.P. Collier, and R.J. Saykally, "Cavity Ringdown Laser Absorption Spectroscopy and Time-of-Flight Mass Spectroscopy of Jet-Cooled Copper Silicides", *J. Chem. Phys.* **102**, 5190-5199 (1995).

40. N.C. Craig, S.S. Borick, C.P. Collier, J.S. Humm, H. Kim, and L.V. Lee, "Vibrational Spectra and Assignments for 3,3,4,4-tetrafluorocyclobutene-d_0, 3,3,4,4-tetrafluorocyclobutene-d_1, and 3,3,4,4-tetrafluorocyclobutene-d_2", *Spectrochim. Acta A* **51**, 45-63 (1995).

41. T.J. Tague, P.M. Kligmann, C.P. Collier, M.A. Ovchinnikov, and C.A. Wight, "Laser-initiated Chain Reactions and Microexplosions in Solid Solutions of Simple Alkenes and Chlorine", *J. Phys. Chem.* **96**, 1288-1293 (1992).

Patents:

U.S. Patent No. 6,198,655 B1, Issued: March 6, 2001
"Electrically Addressable Volatile Non-Volatile Molecular-Based Switching Devices"

U.S. Patent No. 6,756,296 B2, Issued: June 29, 2004
U.S. Patent No. 6,979,639 B2, Issued: December 27, 2005
"Method for Lithographic Processing on Molecular Monolayer and Multilayer Thin Films"