

CHEMICAL HERITAGE FOUNDATION

MARK W. GRINSTAFF

The Pew Scholars Program in the Biomedical Sciences

Transcript of an Interview
Conducted by

Karen A. Frenkel

at

Boston University
Boston, Massachusetts

on

19, 20, and 22 September 2005

From the Original Collection of the University of California, Los Angeles

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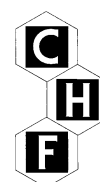
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MARK W. GRINSTAFF

Born in Texas

Education

1987 A.B., with Chemistry Honors, Occidental College
1992 Ph.D., University of Illinois at Urbana-Champaign

Professional Experience

California Institute of Technology
1992-1996 Postdoctoral Training, with Professor Harry B. Gray.
1993-1995 NIH Postdoctoral Fellow
1995-1996 Senior Research Fellow

Duke University
1996-2002 Member of the Biological Chemistry Program
1997-2002 Member of the Pharmacology Training Grant Program
1997-2003 Member of the Center for Cellular & Biosurface Engineering
1999-2003 Assistant Professor of Ophthalmology (Secondary Appointment),
Duke University Medical Center
2001-2003 Assistant Professor of Biomedical Engineering (Secondary
Appointment), School of Engineering
1996-2003 Assistant Professor of Chemistry, College of Arts and Sciences
2003-present Adjunct Associate Professor of Biomedical Engineering, School
of Engineering

Boston University
2003-present Associate Professor of Chemistry, College of Arts and Sciences
2003-present Associate Professor of Ophthalmology (Secondary Appointment),
Boston University Medical School
2003-present Associate Professor of Biomedical Engineering, College of
Engineering
2004-present Member of the Center for Nanoscience and Nanobiotechnology

Honors

1981 Eagle Scout (Boy Scouts of America)
1987 Service Award for Alpha Chi Sigma

1987	Occidental College Chemistry Department Honors
1987	Frank Lambert Chemistry Award
1988	Excellence in Teaching (Fall & Spring)
1989	Membership to Phi Lambda Upsilon (Chemical Honor Society)
1989	University of Illinois Chemistry Department Fellowship
1990	The ACS Fellowship of the Colloid & Surface Division (Sponsored by Procter & Gamble)
1991	T.S. Piper Award for Outstanding Inorganic Research
1991	Biotechnology Center Travel Award
1991	Sigma Xi Research Paper Competition (2nd Prize)
1993	National Institute of Health Postdoctoral Fellowship
1994	ACS Nobel Laureate Signature Award
1998	Whitaker Foundation Grant Recipient
1999	Pew Scholar in the Biomedical Sciences
1999	NSF Career Award
2000	Alfred P. Sloan Research Fellowship
2000	Camille Dreyfus Teacher-Scholar
2001	Johnson and Johnson Focused Giving Grant Recipient
2001	3M Non-Tenured Faculty Award
2002	Selected by National Academy of Engineering to attend the Annual JST International Interdisciplinary Research Exchange Symposium
2003	Selected by NSF/DFG to attend the VII th American German Polymer Symposium

Selected Publications

- “Protein Microencapsulation of Nonaqueous Liquids.” Kenneth S. Suslick and Mark W. Grinstaff *J. Am. Chem. Soc.* 1990, *112*, 7807-7809.
- “Air-filled Proteinaceous Microbubbles: Synthesis of an Echo Contrast Agent.” Mark W. Grinstaff and Kenneth S. Suslick *Proc. Natl. Acad. Sci. USA* 1991, *88*, 7708-7710.
- “Sonochemical Synthesis of Amorphous Iron.” Kenneth S. Suslick, Seok-Burm Choe, Andrzej A. Cichowlas and Mark W. Grinstaff *Nature* 1991, *353*, 414-416.
- “Proteinaceous Microspheres.” Mark W. Grinstaff and Kenneth S. Suslick in *Macromolecular Assemblies* Stroevé P.; Balazs, A. C., eds.; ACS Symposium Series; Washington, D.C.; 1991, Chapter 18, 218-226.
- “Effect of Cavitation Conditions on Amorphous Metal Synthesis.” Mark W. Grinstaff, Andrzej A. Cichowlas, Seok-Burm Choe, and Kenneth S. Suslick *Ultrasonics* 1991, *30*, 168-172.
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- “Sonoluminescence from Metal Carbonyls.” Kenneth S. Suslick, Edward B. Flint, Mark W. Grinstaff, and Kathleen A. Kemper *J. Phys. Chem.* 1993, *97*, 3098-3099.
- “Neutron Diffraction on Amorphous Iron Powder.” R. Bellissent, G. Galli, M. W. Grinstaff, P. Miglirido, and K. S. Suslick *Phys. Rev. B* 1993, *48*, 15797-15800.
- “Characterization of Sonochemically Prepared Proteinaceous Microspheres.” Kenneth S.

- Suslick, Mark W. Grinstaff, Ken J. Kolbeck, and Mike Wong *Ultrasonics Sonochemistry* 1994, 1, S65-S68.
- “In Vivo Measurement of Oxygen Concentration Using Sonochemically Synthesized Microspheres.” KeJain Liu, Mark W. Grinstaff, Harold M. Swartz, Jinjie Jiang, Kenneth S. Suslick, and Wei Wang *Biophysical Journal* 1994, 67, 896-901.
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- “Electron Transfer in Cytochrome c Depends Upon the Structure of the Intervening Medium.” Timothy B. Karpishin, Mark W. Grinstaff, Sonja Komar-Panicucci, George L. McLendon, and Harry B. Gray *Structure* 1994, 2, 414-422.
- “¹⁹F-NMR Spectra and Structures of Halogenated Porphyrins.” Eva R. Birnbaum, Julia A. Hodge, Mark W. Grinstaff, William P. Schaefer, Lawrence Henling, Jay A. Labinger, John E. Bercaw, and Harry B. Gray *Inorg. Chem.* 1995, 34, 3625-3632.
- “Structure, Electronic Properties, and Oxidation-Reduction Reactivity of Halogenated Iron Porphyrins.” Mark W. Grinstaff, Michael G. Hill, Eva R. Birnbaum, William P. Schaefer, Jay A. Labinger, and Harry B. Gray *Inorg. Chem.* 1995, 34, 4896-4902.
- “On the Mechanism of Catalytic Alkene Oxidation by Molecular Oxygen and Halogenated Iron Porphyrins.” Eva R. Birnbaum, Mark W. Grinstaff, Jay A. Labinger, John E. Bercaw, and Harry B. Gray *J. Mol. Catal.* 1995, 104, L119-L122.
- “Biological Temperature Measurements Using EPR Spectroscopy.” Joseph J. Eckburg, John C. Chato, KeJain Liu, Mark W. Grinstaff, Harold M. Swartz, and Kenneth S. Suslick *J. Biomech. Eng.* 1996, 118, 193-200.
- “Aerobic Oxidation of Hydrocarbons Catalyzed by Electronegative Iron Salen Complexes.” Arnd Bottcher, Mark W. Grinstaff, Jay A. Labinger, and Harry B. Gray *J. Mol. Catal.* 1996, 113, 191-200.
- “How Do Electronegative Substituents Make Metal Complexes Better Catalysts for the Oxidation of Hydrocarbons by Dioxygen?” Arnd Bottcher, Eva R. Birnbaum, Jay A. Labinger, Mark W. Grinstaff, and Harry B. Gray *J. Mol. Catal.* 1997, 117, 229-242.
- “Electrophilic Aromatic Substitution 13. Kinetics and Spectroscopy of the Chloromethylation of Benzene and Toluene with Methoxyacetyl Chloride or Chloromethyl Methyl Ether in Nitromethane or Tin Tetrachloride in Dichloromethane. The Methoxymethyl Cation as a Remarkably Selective Common Electrophile.” Franklin P. DeHaan, Mark Djaputra, Mark W. Grinstaff, Craig R. Kaufman, James C. Keithly, Amit Kumar, Mark K. Kuwayama, K. Dale Macknet, Jim Na, Bimal R. Patel, Mike J. Pinkerton, Jeffrey H. Tidwell, and Randy M. Villahermosa *J. Org. Chem.* 1997, 62, 2694-2703.
- “Generation of an Unprecedented Excited State Oxidant in a Coordinately Unsaturated Platinum Complex.” Karl Base and Mark W. Grinstaff *Inorg. Chem.* 1998, 37, 1432-1433.
- “A Facile and Convenient Solid-Phase Procedure for Synthesizing Nucleoside Hydroxamic Acids.” Shoeb I. Khan and Mark W. Grinstaff *Tetrahedron Lett.* 1998, 39, 8031-8034.
- “The Alkylation of Iodouridine by a Heterogeneous Palladium Catalyst.” Shoeb I. Khan and Mark W. Grinstaff *J. Org. Chem.* 1999, 64, 1077-1078.
- “Automated Solid-Phase Synthesis of Site Specifically Labeled Ruthenium- Oligonucleotides.” Shoeb I. Khan, Amy E. Beilstein, and Mark W. Grinstaff *Inorg. Chem.* 1999, 38, 418-419.
- “On the Second-Order Nonlinear Optical Structure-Property Relationships of Metal Chromophores.” Karl Base, Mark A. Tierney, Alain Fort, Jacques Muller, and Mark W.

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- “Palladium(0) Catalyzed Modification of Oligonucleotides during Automated Solid-Phase Synthesis.” Shoeb I. Khan and Mark W. Grinstaff *J. Am. Chem. Soc.* 1999, 121, 4704-4705.
- “Synthesis and Excited-State Properties of a Novel Ruthenium Nucleoside: Ru(bpy)₂(5-bpy-2'-deoxyuridine)²⁺.” Shoeb I. Khan, Amy E. Beilstein, Gregory D. Smith, Milan Sykora, and Mark W. Grinstaff *Inorg. Chem.* 1999, 38, 2411-2415.
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- “How Do Charges Travel in DNA.” Mark W. Grinstaff *Angew Chem. Int. Ed.* 1999, 38, 3629-3635 (invited highlight).
- “Solid-Phase Synthesis and Photophysical Properties of DNA Labeled at the Nucleobase with Ru(bpy)₂(4-m-4'-pa-bpy)²⁺.” Shoeb I. Khan, Amy E. Beilstein, Milan Sykora, Gregory D. Smith, and Mark W. Grinstaff *Inorg. Chem.* 1999, 38, 5999-6002.
- “On-Column Derivatization of Oligodeoxynucleotides with Ferrocene.” Amy E. Beilstein and Mark W. Grinstaff *Chem. Commun.* 2000, 509-510.
- “Site-Specifically Labeled Metallo-Oligonucleotides.” Amy E. Beilstein, Mark T. Tierney, and Mark W. Grinstaff *Comments on Inorganic Chemistry* 2000, 22, 105-127 (invited review).
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- “Biodendrimers: New Polymeric Biomaterials for Tissue Engineering.” Mark W. Grinstaff *Chem. Eur. J.* 2002, 8, 283 8-2846 (invited concepts).
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- “The Convergent Synthesis of Poly(glycerol-succinic acid) Dendritic Macromolecules.” Nathanael R. Luman, Kimberly A. Smeds, and Mark W. Grinstaff *Chem. Eur. J.* 2003, 9, 5618-5626.
- “Unconventional Phospholipid Backbones: Carbohydrate-based and Other Unique Lipid Structures.” Geoffrey S. Hird, Stephen J. Lee, and Mark W. Grinstaff *Self-Assembly*, R.H. Robinson (Ed.), IOS Press, 2003, 121-13 1.
- “Intramolecular Electrocatalysis of 8-oxo-Guanine Oxidation: Secondary Structure Control of Electron Transfer in Osmium-Labeled Oligonucleotides.” Rebecca C. Holmberg, Mark T. Tierney, Eric X. Berg, Mark W. Grinstaff, and H. Holden Thorp *Inorg. Chem.* 2003, 42, 6379-63 87.
- “Dendritic Molecular Capsules for Hydrophobic Compounds.” Meredith T. Morgan, Michael A.

- Carnahan, Chad E. Immoos, Anthony R. Ribeiro, Stella Finkelstein, Stephen J. Lee, and Mark W. Grinstaff *J. Am. Chem. Soc.* 2003, *125*, 15485-15489.
- “Patterning Conductive Polymer Nanostructures.” Shaun F. Filocamo and Mark W. Grinstaff *Encyclopedia of Nanoscience and Nanotechnology*, 2004, 2615-2626 (invited article).
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- “New Dendritic Adhesives for Sutureless Ophthalmic Surgeries: In Vitro Studies of Corneal Laceration Repair.” Andrew J. Velazquez, Michael A. Carnahan, Johannes Kristinsson, Sandra Stinnett, Mark W. Grinstaff, and Terry Kim *Arch. Ophthalmol.* 2004, *122*, 867-870.
- “Conformationally Gated Electrochemical Gene Detection.” Chad E. Immoos, Stephen J. Lee, Mark W. Grinstaff *ChemBioChem.* 2004, *5*, 1100-1103.
- “Dendritic Polymers Composed of Glycerol and Succinic Acid: Synthetic Methodologies and Medical Applications.” Nathanael R. Luman, Terry Kim, and Mark W. Grinstaff *Pure App. Chem.* 2004, *76*, 1375-1385 (invited article).
- “Supramolecular Assemblies of Nucleoside-based Amphiphiles.” Louis Moreau, Philippe Barthélémy, Mohamed El Maataoui, and Mark W. Grinstaff *J. Am. Chem. Soc.* 2004, *126*, 7533-7539.
- “DNA-PEG-DNA Triblock Macromolecules for Reagentless DNA Detection.” Chad E. Immoos, Stephen J. Lee, and Mark W. Grinstaff *J. Am. Chem. Soc.* 2004, *126*, 10814-10815.
- “Charge-Reversal Amphiphiles for Gene Delivery.” Carla A. H. Prata, Yuxing Zhao, Philippe Barthélémy, Yougen Li, Dan Luo, Thomas J. McIntosh, Stephen J. Lee, and Mark W. Grinstaff *J. Am. Chem. Soc.* 2004, *126*, 12196-12197.
- “Dendritic Macromers as In Situ Polymerizing Biomaterials for Securing Cataract Incisions.” Michel Wathier, Pil J. Jung, Michael A. Carnahan, Terry Kim, and Mark W. Grinstaff *J. Am. Chem. Soc.* 2004, *126*, 12744-12745.
- “Supramolecular Assemblies of DNA with Neutral Nucleoside Amphiphiles.” Philippe Barthélémy, Carla A. H. Prata, Shaun F. Filocamo, Chad E. Immoos, Benjamin W. Maynor, S. A. Nadeem Hashmi, Stephen J. Lee, and Mark W. Grinstaff *Chem. Comm.* 2005, 1261-1263.
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- “Amphiphilic Dendritic Supramolecular Assemblies for Drug Delivery.” Meredith T. Morgan, Michael A. Carnahan, Stella Finkelstein, Stephen J. Lee, and Mark W. Grinstaff *Chem. Comm.* 2005, 1261-1263.
- “Novel Tissue Adhesives to Secure Laser in situ Keratomileusis Flaps.” Paul C. Kang, Michael A. Carnahan, Michel Wathier, Mark W. Grinstaff, Terry Kim *J. Cataract Refract. Surg.* 2005, *31*, 1208-1212.
- “Nucleic acid Complexing Glycosyl Nucleoside-Based Amphiphile.” Jerome Arigon, Carla A. H. Prata, Mark W. Grinstaff and Philippe Barthélémy *Bioconjugate Chem.* 2005, in press.
- “Supramolecular Assemblies with DNA” Philippe Barthélémy, Stephen J. Lee, and Mark W. Grinstaff *Pure App. Chem.* 2005, in press (Invited Special Topic Article).
- “Nucleoside Phosphocholine Amphiphile for In Vitro DNA Transfection.” Louis Moreau, Philippe Barthélémy, Yougen Li, Dan Luo, Carla A. H. Prata, and Mark W. Grinstaff

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“Designer Materials for Nucleic Acid Delivery.” Theresa M. Reineke and Mark W. Grinstaff
Mat. Res. Soc. Bull. 2005, 30, 635-639 (Invited Editorial Article/Special Issue on Gene Delivery).

“Cationic Nucleoside Lipids for Gene Delivery.” Pauline Chabaud, Michel Camplo, Dominique Payet, Guillaume Serin, Louis Moreau, Philippe Barthélémy, and Mark W. Grinstaff submitted

“Spontaneous Formation of Hollow Microspheres from f-Block Elements and Nucleoamphiphiles.” Louis Moreau, Fabio Ziarelli, Mark W. Grinstaff, and Philippe Barthélémy submitted

“Biodendrimer-Based Hydrogel Scaffolds for Cartilage Tissue Repair.” Serge H.M. Söntjens, Dana L. Nettles, Michael A. Carnahan, Lori A. Setton, and Mark W. Grinstaff submitted.

“Synthesis of Controlled Layered Polyester Dendrimers Composed of Glycerol and Succinic or Adipic Acid.” Michael A. Carnahan and Mark W. Grinstaff submitted.

ABSTRACT

Mark W. Grinstaff was born in Texas, the elder of two sons. His father was in the United States Air Force, and the family moved a number of times during Grinstaff's childhood. He has lived in Japan and at least six states; his longest time in one place was when he was in college. His father was an administrator who brought troubled hospitals up to standard. His mother stayed at home until her children were in high school, and then she became an accountant. His brother became a hospital administrator and joined the military, just like their father. Grinstaff stayed in Redlands, California, for high school; he liked his chemistry, biology, and physics classes, at which he had to work hard. He also played tennis and was very active in Boy Scouts of America.

Grinstaff attended Occidental College. As a sophomore working in Franklin DeHaan's kinetic chemistry laboratory he fell in love with lab research. He had vacillated between medicine and international relations before this, but now he was sure he wanted to be in science. To help pay the bills, Grinstaff worked in the hummingbird section of a museum for his first year; after that he became a teaching assistant in a chemistry lab class. His experience at the museum convinced him he was less interested in biology than chemistry. By his junior year he had decided that he wanted to do research, not go into medicine, and he declared a chemistry major.

Grinstaff chose graduate school at University of Illinois, Urbana-Champaign because they had a strong inorganic chemistry department and because it was not California. There he worked in Kenneth S. Suslick's laboratory; his doctoral project used sound waves to make amorphous iron and protein-microsphere compounds. Here he talks about wider applications of his doctoral research; his own management style versus Suslick's; what he likes best about being a principal investigator; writing journal articles; and his patents. Rather than working in industry he decided to do a postdoctoral fellowship. For his postdoc, Grinstaff conducted research on electron transfer and catalysis in Harry Gray's laboratory at the California Institute of Technology. While there he met the woman with whom he eloped on the way to his first job. Here he discusses Gray's laboratory management style as compared to his own, and speculates on the source of one's ideas.

Grinstaff accepted a position at Duke University and foraged for equipment to set up his lab; he prefers to spend his money on people. Here he explains his research making diagnostic devices based on DNA electron transfer, designing single molecular-weight polymers, and polymers for ophthalmic wound repair. He continues with more clinical applications of his research; the issue of patents; commercialization of his research (he has founded two companies); his current research projects in biomaterials chemistry and nanotechnology; and the impact of the Pew Scholars Program in the Biomedical Sciences on his work.

Grinstaff felt Duke did not provide an environment conducive to interdisciplinary work. He was very interested in many things, from lasers to biochemistry, and did not want to be "put in a box." He had co-founded two companies by then. He accepted a position at Boston University, with a joint appointment in chemistry and engineering. He talks about his lab makeup and management; his administrative and teaching duties; funding; biomaterials chemistry; grant writing; and his future research plans. He gives his opinions on a variety of common issues in science: the dearth of minorities; the falling-away of women as they attain higher positions; lack of science literacy in the United States; competition and collaboration. He

concludes by describing how he and his wife, also a PhD chemist, balance their home life with their work life.

UCLA INTERVIEW HISTORY

INTERVIEWER:

Karen A. Frenkel, Interviewer, UCLA Oral History Program; B.A., Hampshire College, 1978; M.S., Boston University, 1982

TIME AND SETTING OF INTERVIEW:

Place: Mark Grinstaff's office at Boston University, Boston, Massachusetts.

Total number of recorded hours: 6.0

Persons present during interview: Grinstaff and Frenkel.

CONDUCT OF INTERVIEW:

This interview is one in a series with Pew Scholars in the Biomedical Sciences conducted by the UCLA Oral History Program in conjunction with the Pew Charitable Trusts' Pew Scholars in the Biomedical Sciences Oral History and Archives Project. The project has been designed to document the backgrounds, education, and research of biomedical scientists awarded four-year Pew scholarships since 1988.

To provide an overall framework for project interviews, the director of the UCLA Oral History Program and three UCLA faculty project consultants developed a topic outline. In preparing for this interview, Frenkel held a telephone pre-interview conversation with Grinstaff to obtain written background information (curriculum vitae, website address, copies of published articles, etc.) and agree on an interviewing schedule. She also reviewed the documentation in Grinstaff's file at the Pew Scholars Program office in San Francisco, including his proposal application, letters of recommendation, and reviews by Pew Scholars Program national advisory committee members.

ORIGINAL EDITING:

Carol Squires edited the interview. She checked the verbatim transcript of the interview against the original tape recordings, edited for punctuation, paragraphing, and spelling, and verified proper names. Words and phrases inserted by the editor have been bracketed.

Grinstaff did not review the transcript. Consequently, some proper names and other information remain unverified.

Carol Squires prepared the table of contents. TechniType Transcribing compiled the guide to proper names.

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