

SAMUEL JOSEPH LORD

Curriculum Vitae

CONTACT

Department of Chemistry
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Citizenship: USA

EDUCATION

Ph. D. in Chemistry (expected March 2010) **2004–present**

Stanford University, Stanford CA
Advisor: Professor W. E. Moerner
Sub-discipline: Chemical Physics
Research: fluorophore design and single-molecule spectroscopy

B. S. in Chemistry with Honors and with Distinction **2001–2004**

University of North Carolina, Chapel Hill NC
Advisor: Professor Sergei S. Sheiko
Thesis Title: "Gradient Bottle Brushes"
Research: AFM and polymer physics

Human Ecology **1999–2001**

College of the Atlantic, Bar Harbor ME
Completed two years toward B. A.
Research: genetics and molecular cell biology

SKILLS AND TECHNIQUES

single-molecule spectroscopy; optical microscopy; photophysics; fluorophore design; UV-vis and fluorescence spectroscopy; optics; biosensors; bioconjugation and cellular targeting; cell imaging; quantum-chemistry calculations and simulations (Gaussian); HPLC-MS; analytical chemistry; physical chemistry; rheology; atomic-force microscopy (AFM); Langmuir-Blodgett troughs; polymer physics; gel electrophoresis

ACADEMIC HONORS

First Biennial Sessler Graduate Student Leadership Award, Stanford	2008
Bio-X Travel Award Subsidy, Stanford	2008
Undergraduate Award for Excellence in Physical Chemistry, UNC	2004
Hypercube Scholar, UNC	2004
CPIMA Research Fellow, Stanford	2003
Thompson Undergraduate Research Award, UNC	2003
National Starch and Chemical Company Award, UNC	2002

RESEARCH EXPERIENCE

Ph. D. Research, Stanford University, Stanford CA

2004–present

Advisor: Professor W. E. Moerner, Chemistry

Designing Photoactivatable Fluorophores: New classes of photoactivatable single-molecule fluorophores are needed for far-field super-resolution microscopies. Reengineered red-emitting push–pull fluorophores so that they are dark until photoactivated with a short burst of low-intensity violet light. Photoactivating dark fluorogens converts an azide to an amine, which shifts the absorption to long wavelengths. After photoactivation, the fluorophores are bright and photostable enough to be imaged on the single-molecule level in living cells.

Designing and Characterizing Fluorophores for Single-Molecule Imaging in Living Cells: Single-molecule labels for living cells face strict requirements. Designed and characterized several fluorophores (in close collaboration with a synthetic lab), termed DCDHF fluorophores, based on the push-pull design: an amine donor group and a 2-dicyanomethylene-3-cyano-2,5-dihydrofuran acceptor group, separated by a π -rich conjugated network. DCDHF fluorophores are photostable, sensitive to local environment, and their chemistries and photophysics are tunable to optimize absorption wavelength, membrane affinity, and solubility.

Summer Undergraduate Fellowship, Stanford University, Stanford CA

2003

Advisors: Professors Eric Shaqfeh & Steven Chu, Chemical Engineering & Physics

Polymer Dynamics—Microscopy of Single DNA Strands: Experimentally investigated the non-equilibrium dynamics of entangled polymer chains using single-molecule techniques and compared these results to theoretical models. Observed individual lambda-phage DNA molecules in entangled solutions in extensional flow. Explored multiple methods to concentrate DNA solutions without inducing phase separation or clumping. Fluorescently labeled DNA and used flow cells and microscopy in order to visualize the motions and dynamics of single strands among many unlabeled strands.

Polymer Dynamics—Rheology of Complex Fluids: Measured relevant parameters, such as reptation time and number of entanglements per chain, using rheology.

B. S. Research, University of North Carolina, Chapel Hill NC

2002–2004

Advisor: Professor Sergei S. Sheiko, Chemistry

Polymer Physics—Conformations of Single Polymers using AFM: Demonstrated that cylindrical molecular brushes, each with a gradient of grafting density along the backbone, transition from rodlike to tadpole conformations. Used atomic force microscopy (AFM) to observe coexistence of two conformational phases within individual molecules adsorbed on a mica substrate. Studied other conformational effects on single polymer brushes, including the effect of humidity and super-critical CO₂ pressure. Worked independently with guidance from professor.

Undergraduate Research, Jackson Laboratory, Bar Harbor ME

2000

Advisor: Dr. Antonio Planchart

Genetics and Molecular Cell Biology: Exposed to basic skills of genetics laboratory, including PCR and gel electrophoresis.

TEACHING EXPERIENCE

Mentor for Young Researchers in Moerner Lab	2005–present
First-year graduate student who joined project in 2008 Three undergraduates for summer research High-school teacher for summer outreach program	
Advanced TA for Statistical Mechanics	2005–2007
Course: Stanford CHEM175 Taught rotating weekly problem sessions Helped prepare and grade problem sets and exams	
TA for P-Chem Lab	2005
Course: Stanford CHEM174 Guided and supervised students through various labs	
TA for Intro Chemistry	2004
Course: Stanford CHEM31X Taught weekly seminar meetings and led review sessions	
Head TA for Intro Chemistry Lab	2003–2004
Course: UNC CHEM11L Taught one lab section and weekly lab intro for all sections Supervised all sections (5+)	

SERVICE

Platform Co-Chair, Biophysical Society 54th Annual Meeting	2010
Platform N: <i>Emerging Single Molecule Techniques I</i>	
Coordinator, Student-Hosted Physical Chemistry Seminars	2005–2010
Recovered program from obscurity Organized process for selecting and hosting three speakers annually Student host for distinguished speakers: James Gimzewski, Watt Webb, Allen Bard	
Founder, Stanford Chemical Physics Journal Club	2005–2010
Weekly presentations of interesting papers in the field	
Group Responsibilities, Moerner Lab	2004–2010
Representative for recruiting Lab safety coordinator and laser-safety officer	
Elected Member, Chemistry Student Affairs Committee	2006–2008
Served as an Officer Liaison between students and faculty & planned events	
Volunteer Mentor, Local Middle School Science Fair	2005
Participated in a program aimed at under-privileged schools Met with students weekly over multiple months Guided students in choosing a project and completing their experiments and analysis Led students on a field trip to a local science museum	

PUBLICATION RECORD

Journal Articles, Letters, Proceedings, Reviews, and Book Chapters

- Molecules and Methods for Super-Resolution Imaging
Thompson, M. A.; Biteen, J. S.; **Lord, S. J.**; Conley, N. R.; Moerner, W. E. *Methods Enzym.* **2010**, accepted.
- Perspective: Single-Molecule Spectroscopy and Imaging of Biomolecules in Living Cells
Lord, S. J.; Lee, H. D.; Moerner, W. E. *Anal. Chem.* **2010**, accepted.
- Azido Push-Pull Fluorogens Photoactivate to Produce Bright Fluorescent Labels
Lord, S. J.; Lee, H. D.; Samuel, R.; Weber, R.; Liu, N.; Conley, N. R.; Thompson, M. A.; Twieg, R. J.; Moerner, W. E. *J. Phys. Chem. B* **2010**, accepted.
14. Single-Molecule Fluorophores as Environmental Nanoprobes
Liu, N.; Lu, Z.; Ougaddoum, H.; Wang, H.; Weber, R.; Williams, J.; Yang, Z.; Twieg R.; **Lord, S. J.** *Moroccan J. Cond. Matter* **2009**, 11(2), 90–98.
13. Photoactivatable DCDHF fluorophores for single-molecule imaging
Lord, S. J.; Conley, N. R.; Lee, H. D.; Liu, N.; Samuel, R.; Twieg, R. J.; Moerner, W. E. *Proc. SPIE* **2009**, 7190, 719013.
12. Three-Dimensional Single-Molecule Fluorescence Imaging Beyond the Diffraction Limit Using a Double-Helix Point Spread Function
Pavani, S. R. P.; Thompson, M. A.; Biteen, J. S.; **Lord, S. J.**; Liu, N.; Twieg, R. J.; Piestun, R.; Moerner, W. E. *Proc. Natl. Acad. Sci. U.S.A.* **2009**, 106(9), 2995–2999.
11. Bright, Red Single-Molecule Emitters: Synthesis and Properties of Environmentally Sensitive Dicyanomethylenedihydrofuran (DCDHF) Fluorophores with Bisaromatic Conjugation
Lu, Z.; Liu, N.; **Lord, S. J.**; Willets, K. A.; Moerner, W. E.; Twieg, R. J. *Chem. Mater.* **2009**, 21(5), 797–810.
10. Minireview: DCDHF Fluorophores for Single-Molecule Imaging in Cells
Lord, S. J.; Conley, N. R.; Lee, H. D.; Nishimura, S. Y.; Pomerantz, A. K.; Willets, K. A.; Lu, Z.; Wang, H.; Liu, N.; Samuel, R.; Weber, R.; Semyonov, A.; He, M.; Twieg, R. J.; Moerner, W. E. *ChemPhysChem* **2009**, 10(1), 55–65.
9. A Photoactivatable Push-Pull Fluorophore for Single-Molecule Imaging in Live Cells
Lord, S. J.; Conley, N. R.; Lee, H. D.; Samuel, R.; Liu, N.; Twieg, R. J.; Moerner, W. E. *J. Am. Chem. Soc.* **2008**, 130(29), 9204–9205.
8. Nanophotonics and Single Molecules
Moerner, W. E.; Schuck, P. J.; Fromm, D. P.; Kinkhabwala, A.; **Lord, S. J.**; Nishimura, S. N.; Willets, K. A.; Sundaramurthy, A.; Kino, G.; He, M.; Lu, Z.; Twieg, R. J. Chapter in *Single Molecules and Nanotechnology*; R. Rigler and H. Vogel, Eds.; Springer Series in Biophysics, Vol. 12; Springer-Verlag: Berlin, 2008; pp 1–23.
7. Photophysical Properties of Acene DCDHF Fluorophores: Long-Wavelength Single-Molecule Emitters Designed for Cellular Imaging
Lord, S. J.; Lu, Z.; Wang, H.; Willets, K. A.; Schuck, P. J.; Lee, H. D.; Nishimura, S. Y.; Twieg, R. J.; Moerner, W. E. *J. Phys. Chem. A* **2007**, 111(37), 8934–8941.
6. Modifications of DCDHF Single Molecule Fluorophores to Impart Water Solubility
Wang, H.; Lu, Z.; **Lord, S. J.**; Moerner, W. E.; Twieg, R. J. *Tetrahedron Lett.* **2007**, 48(19), 3471–3474.

5. The influence of tetrahydroquinoline rings in dicyanomethylenedihydrofuran (DCDHF) single-molecule fluorophores
Wang, H.; Lu, Z.; **Lord, S. J.**; Willets, K. A.; Bertke, J. A.; Bunge, S. D.; Moerner, W. E.; Twieg, R. J. *Tetrahedron* **2007**, 63(1), 103–114.
4. A Long-Wavelength Analogue of PRODAN: Synthesis and Properties of Anthradan, a Fluorophore with a 2,6-Donor–Acceptor Anthracene Structure
Lu, Z.; **Lord, S. J.**; Wang, H.; Moerner, W. E.; Twieg, R. J. *J. Org. Chem.* **2006**, 71(26), 9651–9657.
3. Diffusion of Lipid-like Single-Molecule Fluorophores in the Cell Membrane
Nishimura, S. Y.; **Lord, S. J.**; Klein, L. O.; Willets, K. A.; Lu, Z.; He, M.; Twieg, R. J.; Moerner, W. E. *J. Phys. Chem. B* **2006**, 110(15), 8151–8157.
2. Synthesis, Properties, and Applications of Dicyanomethylenedihydrofuran (DCDHF) Single Molecule Fluorophores
Twieg, R.; Wang, H.; Lu, Z. Kim, S. Y.; **Lord, S.**; Nishimura, S.; Schuck, P. J.; Willets, K. A.; Moerner, W. E. *Nonlinear Optics, Quantum Optics* **2005**, 34, 241–246.
1. Tadpole conformation of gradient polymer brushes
Lord, S. J.; Sheiko, S. S.; LaRue, I.; Lee, H. I.; Matyjaszewski, K. *Macromolecules* **2004**, 37(11), 4235–4240.

Patents

1. Fluorogenic Compounds Converted to Fluorophores by Photochemical or Chemical Means and Their Use in Biological Systems
Moerner, W. E.; Twieg, R. J.; Lord, S. J.; Liu, N.; Samuel, R. Patent Application Number 61/128,729. Filed May 13, 2009.

Oral Presentations

7. ACS National Meeting
Lord, S. J.; Conley, N. R.; Lee, H. D.; Lee, M. K.; Liu, N.; Samuel, R.; Twieg, R. J.; Moerner, W. E. Photoactivatable azido push-pull fluorophores for single-molecule imaging in and out of cells. Oral presentation at the ACS 239th National Meeting, San Francisco, CA, March 2010.
6. Biophysical Society National Meeting (Platform Co-Chair)
Lord, S. J.; Conley, N. R.; Lee, H. D.; Lee, M. K.; Liu, N.; Samuel, R.; Twieg, R. J.; Moerner, W. E. Photoactivatable azido push-pull fluorophores for single-molecule imaging in and out of cells. Oral presentation at the Biophysical Society 54th National Meeting, San Francisco, CA, February 2010.
5. OSA Annual Meeting
Lord, S. J.; Lee, H. D.; Conley, N. R.; Lee, M. K.; Thompson, M. A.; Samuel, R.; Weber, R.; Liu, N.; Twieg, R. J.; Moerner, W. E. Photoactivatable Push-Pull Fluorophores for Single-Molecule Imaging in and out of Cells. Oral presentation at the 93rd OSA Annual Meeting (Laser Science), San Jose, CA, October 2009.
4. Stanford Molecular Biophysics Seminar
Lord, S. J.; Lee, M. J.; Conley, N. R.; Lee, H. D.; Thompson, M. A.; Liu, N.; Samuel, R.; Williams, J. C.; Twieg, R. T.; Moerner, W. E. Photoactivatable DCDHF Fluorophores for Single-Molecule Imaging in and out of Cells. Oral presentation at the Stanford Molecular Biophysics Seminar, Stanford, CA, March 2009.

3. **Invited:** SPIE Photonics West
Lord, S. J.; Conley, N. R.; Lee, H. D.; Liu, N.; Samuel, R.; Twieg, R. T.; Moerner, W. E.
Photoactivatable DCDHF Fluorophores for Single-Molecule Imaging. Invited oral presentation at SPIE Photonics West, San Jose, CA, January 2009.
2. Stanford Chemistry Student Summer Seminar Series
Lord, S. J.; Conley, N. R.; Lee, H. D.; Liu, N.; Samuel, R.; Twieg, R. T.; Moerner, W. E.
Photoactivatable DCDHF Fluorophores for Single-Molecule Imaging. Oral presentation for the Stanford Chemistry Student Summer Seminar Series, July 2008.
1. OSA Annual Meeting
Lord, S. J.; Wang, H.; Liu, N.; Lu, Z.; Twieg, R. J.; Moerner, W. E. DCDHF Fluorophores Designed for Single-Molecule Cellular Imaging. Oral presentation at the 91st OSA Annual Meeting (Frontiers in Optics), San Jose, CA, September 2007.

Selected Poster Presentations

- Gordon Research Conference
Lord, S. J.; Conley, N. R.; Lee, H. D.; Liu, N.; Samuel, R.; Twieg, R. T.; Moerner, W. E.
Photoactivatable and Photoswitchable Single-Molecule Fluorophores: DCDHFs and More. Poster presented at Gordon Research Conference, Single Molecule Approaches to Biology, New London, NH, August 2008.
- ACS National Meeting
Lord, S. J.; Alyono, J.; Lu, Z.; Wang, H.; Liu, N.; Weber, R.; Twieg, R. J.; Moerner, W. E. DCDHF photophysics: designing new single-molecule fluorophores for cellular imaging. Poster presented at the 232nd ACS National Meeting, San Francisco, CA, September 2006.
- Gordon Research Conference
Lord, S. J.; Alyono, J.; Lu, Z.; Wang, H.; Twieg, R. J.; Moerner, W. E. DCDHF Photophysics: Designing New Single-Molecule Fluorophores for Cellular Imaging. Poster presented at Gordon Research Conference, Single Molecule Approaches to Biology, New London, NH, June 2006.

REFERENCES

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