

Alexander R. Dunn

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Academic Appointments

Assistant Professor of Chemical Engineering, Stanford University, January 2009 – present
Member, Stanford Neurosciences Institute, 2013 – present
Fellow, Stanford Chemical Biology Institute, 2012 – present
Member, Stanford Cardiovascular Institute, 2010 – present

Education

Postdoctoral Scholar, Stanford University Biochemistry Department, July 2003 – Dec. 2008
Advisor: Prof. James Spudich
Ph.D. California Institute of Technology, February 1999 – June 2003
Thesis Title: Sensitizer-Linked Substrates as Probes of Heme Enzyme Structure and Catalysis
Thesis Advisor: Prof. Harry Gray
Graduate Student, Cornell University, September 1998 – January 1999
B.S. in Chemistry (Honors). Caltech, June 1998

Honors and Fellowships

NIH Director's New Innovator Award 2010 – present
Terman Faculty Fellowship (Stanford), June 2008
James H. Clark Faculty Fellowship (Stanford), June 2008
Burroughs Wellcome Career Award at the Scientific Interface, Jan. 2008 – present
NIH K99/R00 Pathway to Independence (declined), June 2008
American Heart Association Postdoctoral Fellowship, July 2007 – Dec. 2007
Jane Coffin Childs Fellowship, July 2003 – July 2006
Herbert Newby McCoy Award (Caltech, outstanding chemistry Ph.D. thesis), June 2003
Fannie and John Hertz Fellowship, 1998 – 2003
Richard P. Schuster Award (Caltech, undergraduate chemistry research), March 1998
Caltech Merit Award (scholarship), June 1997
George W. Green Memorial Prize (Caltech), March 1997
Barry Goldwater Scholarship, 1996 – 1997
Caltech Merit Award, June 1996
Carnation Prize (Caltech), June 1995

Society Memberships

American Institute of Chemical Engineers
American Physical Society
Materials Research Society
Biophysical Society
American Society for Cell Biology
American Society for Biochemistry and Molecular Biology

Publications

* corresponding or first author

13 manuscripts published or submitted as an independent investigator.

11 manuscripts published or submitted as corresponding author.

*35. Buckley, C. D., Tan, J., Pruitt, B. L., Weis, W. I., Nelson, W. J. & **Dunn**, A. R. Force-dependent interactions between actin filaments and a minimal adherens junction complex. *Science in press*. (2014)

*34. Chai, J., Hamilton, A. L., Riedel-Kruse, I. H. & **Dunn** A. R. Cable constriction tension coordinates local and global cell movements during zebrafish epiboly. *Submitted for publication*.

33. Xu, A.M., Aalipour, A., Leal-Ortiz, S., Mekhdjian, A. H., Xie, X., **Dunn**, A. R., Garner, C. C. & Melosh, N.A. Quantification of nanowire penetration into living cells. *Nat. Commun.* **5**, 3613 (2014).

32. Krieg, M., **Dunn**, A. R. & Goodman, M. B. Mechanical control of the sense of touch by β -spectrin. *Nat. Cell Biol.* **16**, 224–233 (2014).

Press coverage:

Futurity.org: “Why Bendy Nerves In Worms Sometimes Break”

Medicalxpress.com: “Researchers find elastic-like protein matrix that keeps nerves resilient”

*31. Ostrowski, M. A., Huang, N. F., Walker, T., Vervijlen, T., Khoo, A. S., Poplawski, C., Cooke, J. P., Fuller, G. G., & **Dunn**, A. R. Microvascular endothelial cells migrate upstream and align against the shear stress field created by impinging flow. *Biophys. J.* **106**, 366-374 (2014).

*30. Masatoshi, M., Mekhdjian, A. H, Adhikari, A. S. & **Dunn**, A. R. Molecular tension sensors report forces generated by single integrin molecules in living cells. *Nano Letters*, **13**, 3985-3989 (2013).

*29. Borghi, N., Sorokina, M., Shcherbakova, O. G., Weis, W. I., Pruitt, B. L., Nelson, W. J., & **Dunn**, A. R. E-cadherin is under constitutive actomyosin-generated tension that is increased at cell-cell contacts upon externally applied stretch. *Proc. Natl. Acad. Sci. U. S. A.* **109**, 12568-12573 (2012).

Press coverage:

Three citations in Faculty of 1000.

“Cadherin-catenin-actin structure exerts force inside and between cells in living tissues, study shows” Phys.org (July 16, 2012).

*28. Adhikari, A. S., Glassey, E. & **Dunn**, A. R. Conformational dynamics accompanying the proteolytic degradation of trimeric collagen I by collagenases. *J. Am. Chem. Soc.* **134**, 13259-13265 (2012).

*27. Adhikari, A. S., Chai, J., & **Dunn**, A. R. Multiplexed single-molecule force proteolysis measurements using magnetic tweezers. *J. Visualized Exp.* **65**, 3520 (2012).

*26. Adhikari, A. S., Mekhdjian, A. H. & **Dunn**, A. R., Strain tunes proteolytic degradation and diffusive transport in fibrin networks. *BioMacromolecules* **13**, 499-506 (2012).

*25. Adhikari, A. S., Chai, J., & **Dunn**, A. R., Mechanical force induces a 100-fold increase in the rate of collagen proteolysis by MMP-1. *J. Am. Chem. Soc.* **133**, 1686-1689 (2011).

Press coverage:

Chemical and Engineering News **89**, 45. (January 31, 2011).

24. Purcell, T. J., Naber, N., Franks-Skiba, K., **Dunn**, A. R., Eldred, C. C., Berger, C. L., Málnási-Csizmadia, A., Spudich, J. A., Swank, D. M., Pate, E. & Cooke, R. Nucleotide Pocket Thermodynamics Measured by EPR Reveal How Energy Partitioning Relates Myosin Speed to Efficiency. *J. Mol. Biol.* **407**, 79-91 (2011).

23. Sung, J., Sivaramakrishnan, S., **Dunn**, A. R. & Spudich, J. A. Single-molecule dual-beam optical trap analysis of protein structure and function. *Methods Enzymol.* **475**, 321-375 (2010).
- *22. Chuan, P.-Y., Spudich, J. A. & **Dunn**, A. R. Force dependence of myosin VI nucleotide binding kinetics. *J. Mol. Biol.* **405**, 105-112 (2010).
- *21. **Dunn**, A. R., Chuan, P.-Y., Bryant, Z. & Spudich, J. A. Contribution of the myosin VI tail domain to processive stepping and intramolecular tension sensing. *Proc. Natl. Acad. Sci U. S. A.* **107** 7746-7750 (2010).
20. Pierobon, P., Achouri, S., Courty, S., **Dunn**, A. R., Spudich, J. A., Dahan, M., Cappello, G. Velocity, processivity, and individual steps of single myosin V molecules in live cells. *Biophys J.* **96**, 4268-4275 (2009).
19. Whited, C. A., Belliston-Bittner, W., **Dunn**, A. R., Winkler, J. R., Gray, H. B. Nanosecond photoreduction of inducible nitric oxide synthase by a Ru-diimine electron tunneling wire bound distant from the active site. *J. Inorg. Biochem.* **103**, 906-911 (2009).
18. Whited, C. A., Belliston-Bittner, W., **Dunn**, A. R., Winkler, J. R., Gray, H. B. Probing the heme-thiolate oxygenase domain of inducible nitric oxide synthase with Ru(II) and Re(I) electron tunneling wires. *J. Porphyrins Phthalocyanines* **12**, 971-978 (2008).
- *17. **Dunn**, A. R. & Spudich, J. A. Single-molecule gold-nanoparticle tracking with high temporal and spatial resolution and without an applied load. *Laboratory Manual for Single Molecule Studies*, (Cold Spring Harbor Laboratory Press, Woodbury, NY; 2007).
16. Tang, S., Liao, J.-C., **Dunn**, A. R., Altman, R. B., Spudich, J. A. & Schmidt, J. P. Predicting allosteric communication in myosin via a pathway of conserved residues. *J. Mol. Biol.* **373**, 1361-1373 (2007).
- *15. **Dunn**, A. R. & Spudich, J. A. Dynamics of the unbound head during myosin V processive translocation. *Nat. Struct. Mol. Biol.* **14**, 246-248 (2007).
14. Rock, R. S., Ramamurthy, B., **Dunn**, A. R., Beccafico, S., Rami, B. R., Morris, C., Spink, B. J., Franzini-Armstrong, C., Spudich, J. A. & Sweeney, H. L. A flexible domain is essential for the large step size and processivity of myosin VI. *Mol. Cell* **17**, 603-609 (2005).
13. Contakes, S. M., Juda, G. A., Langley, D. B., Halpern-Manners, N. W., Duff, A. P., **Dunn**, A. R., Gray, H. B., Dooley, D. M., Guss, J. M. & Freeman, H. C. Reversible inhibition of copper amine oxidase activity by channel-blocking ruthenium(II) and rhenium(I) molecular wires. *Proc. Natl. Acad. Sci. U.S.A.* **102**, 13451-12456 (2005).
12. Belliston-Bittner, W., **Dunn**, A. R., Nguyen, Y. H. L., Stuehr, D. J., Winkler, J. R. & Gray, H. B. Picosecond photoreduction of inducible nitric oxide synthase by rhenium(I)-diimine wires. *J. Am. Chem. Soc.* **127**, 15907-15915 (2005).
- *11. **Dunn**, A. R., Belliston-Bittner, W., Winkler, J. R., Getzoff, E. D., Stuehr, D. J. & Gray, H. B. Luminescent ruthenium(II)- and rhenium(I)-diimine wires bind nitric oxide synthase. *J. Am. Chem. Soc.* **127**, 5169-5173 (2005).
10. Rucker, V. C., **Dunn**, A. R., Sharma, S., Dervan, P. B. & Gray, H. B. Mechanism of sequence-specific fluorescent detection of DNA by N-methyl-imidazole, N-methyl-pyrrole, and β -alanine linked polyamides. *J. Phys. Chem. B* **108**, 7490-7494 (2004).
9. Hays, A.-M. A., **Dunn**, A. R., Chiu, R., Gray, H. B., Stout, C. D. & Goodin, D. B. Conformational states of cytochrome P450cam revealed by trapping of synthetic molecular wires. *J. Mol. Biol.* **2**, 455-469 (2004).
- *8. **Dunn**, A. R., Dmochowski, I. J., Winkler, J. R. & Gray, H. B. Nanosecond photoreduction of cytochrome P450cam by channel-specific electron tunneling Ru-diimine wires. *J. Am. Chem. Soc.* **41**, 12450-12456 (2003).

- *7. **Dunn**, A. R., Hays, A.-M. A., Goodin, D. B., Stout, C. D., Chiu, R., Winkler, J. R. & Gray, H. B. Fluorescent probes for cytochrome P450 structural characterization and inhibitor screening. *J. Am. Chem. Soc.* **124**, 10254-10255 (2002).
6. Dmochowski, I. J., **Dunn**, A. R., Wilker, J. J., Crane, B. R., Green, M., Dawson, J. H., Sligar, S. G., Winkler, J. R. & Gray, H. B. Ruthenium probes of P450 structure and mechanism. *Meth. Enzymol.* **357**, 120-133 (2002).
- *5. **Dunn**, A. R., Dmochowski, I. J., Bilwes, A. M., Gray, H. B. & Crane B. R. Probing the open state of cytochrome P450cam with ruthenium-linker substrates. *Proc. Natl. Acad. Sci. U.S.A.* **98**, 12420-12425 (2001).
4. Weck, M., **Dunn**, A. R., Matsumoto, K., Coates, G. W., Lobkovsky, E. B. & Grubbs R. H. Influence of perfluoroarene-arene interactions on the phase behavior of liquid crystalline and polymeric materials. *Angew. Chem. Int. Ed. Engl.* **38**, 2741-2745 (1999).
3. Coates, G. W., **Dunn**, A. R., Henling, L. M., Ziller, J. W., Lobkovsky, E. B. & Grubbs, R. H. Phenyl-perfluorophenyl stacking interactions: Topochemical[2+2] photodimerization and photopolymerization of olefinic compounds. *J. Am. Chem. Soc.* **120**, 3641-3649 (1998).
2. Bloom, C. R., Wu, N., **Dunn**, A., Kaarsholm, N. C. & Dunn, M. F. Comparison of the allosteric properties of the Co(II)- and Zn(II)-substituted insulin hexamers. *Biochemistry* **37**, 10937-10944 (1998).
1. Coates, G. W., **Dunn**, A. R., Henling, L. M., Dougherty, D. A. & Grubbs, R. H. Phenyl-perfluorophenyl stacking interactions: A new strategy for supermolecule construction. *Angew. Chem. Int. Ed. Engl.* **36**, 248-251 (1997).

Selected Presentations

* invited presentation

- *40. "Distribution of mechanical tension within focal adhesions in living cells" World Congress of Biomechanics, Boston, MA, July 6-11, 2014.
- *39. "Force regulation of interactions between the E-cadherin-catenin complex and actin filaments" World Congress of Biomechanics, Boston, MA, July 6-11, 2014.
- *38. "Mechanotransduction at cellular cadherin and integrin complexes" Dept. of Chemistry, University of California, Santa Barbara, CA, May 21, 2014.
- *37. "Mechanotransduction at cadherin and integrin complexes" National Heart, Lung and Blood Institute, NIH, Bethesda, MD, April 8, 2014.
- *36. "Cellular mechanotransduction at the molecule level" University of Maryland Biophysics Program, College Park, MD, April 7, 2014.
35. "Cellular mechanotransduction at the molecular level" NIH High Risk/High Reward Symposium, Bethesda, MD, Nov. 20, 2013.
- *34. "Cellular biomechanics at the molecular scale" Dept. of Physics, U. California, Santa Cruz, Santa Cruz, CA, Nov. 7, 2013.
- *33. "Cellular biomechanics at the molecular scale" Dept. of Chemical Engineering, University of Illinois, Urbana-Champaign, IL, Oct. 31, 2013.
- *32. "Cellular traction at the single molecule level" Physiology Course, Marine Biological Laboratory. Woods Hole, MA June 28, 2013.
- *31. "Mechanotransduction at cell-cell and cell-matrix adhesions" Genomics Institute of the Novartis Research Foundation. Torrey Pines, CA May 13, 2013.
- *30. "Biomechanics at the molecular scale" University of California, San Francisco, Oral and Craniofacial Sciences Seminar Series. February 26, 2013.

- *29. “Biomechanics at the molecular scale” University of Pennsylvania, Dept. of Chemical Engineering Colloquium Series. January 30, 2013.
- *28. “Force” American Society for Cell Biology National Meeting, San Francisco, CA, December 15-19, 2012.
- *27. “Metalloproteinase conformational dynamics accompanying the proteolytic degradation of trimeric collagen I” Gordon Research Conference: Plasminogen Activation & Extracellular Proteolysis Ventura, CA, February 12-17, 2012.
- *26. “Roles of Mechanical Force in Extracellular Matrix Remodeling” Frontiers in Cardiovascular Science, Cardiovascular Institute, Stanford University School of Medicine, February 7, 2012.
- *25. “E-cadherin experiences constitutive mechanical tension in living cells” Bioengineering Department Colloquium, Bioengineering Department, Stanford University. January 27th, 2012.
- *24. “Measurement of cytoskeletal forces in living epithelial cells” Stanford Digestive Disease Center Retreat, Digestive Disease Center, Stanford University School of Medicine, September 24, 2011.
- *23. “Building biology” Biophysics Program Retreat, Biophysics Program, Stanford University. September 23, 2011.
- *22. “Molecular force probes for measuring cellular mechanotransduction” CVI Member Retreat, Cardiovascular Institute, Stanford University School of Medicine, September 9, 2011.
- *21. “Exploring the role of mechanical forces in cell biology” Biomechanical Engineering Seminar Series, Mechanical Engineering, Stanford University, May 9, 2011
- *20. “Using single molecule measurements to study cellular force sensors” Physics Department Colloquium, Dept. of Physics, UC Santa Cruz. February 25, 2011.
- *19. “Mechanical forces in developmental biology” Bioengineering Department Colloquium, Bioengineering Department, Stanford University. January 11, 2011.
18. Dunn, A. R., Adhikari, A. S., Mekhdjian, A., & Chai, J. “Effect of mechanical load on extracellular matrix remodeling from single molecules to millimeters” 3rd USNCB Symposium on Frontiers in Biomechanics: Mechanics of Development. June 21, 2011, Farmington, Pennsylvania, USA.
17. Dunn, A. R., Adhikari, A.S., & Chai, J., “Mechanical force induces a 100-fold increase in the rate of collagen proteolysis by MMP-1” Biophysical Society 55th Annual Meeting. Mar. 5 – 9, 2011, Baltimore, USA.
- *16. Dunn, A. R., Adhikari, A.S., Chai, J, Chuan, P.-Y., & Spudich, J. A. “Using single molecule measurements to study cellular force sensors” UC Santa Cruz Physics Dept. Seminar Series, Feb. 25, 2011.
15. Dunn, A. R., Chuan, P.-Y. & Spudich “Contribution of the myosin VI medial tail domain to processive stepping and intramolecular tension sensing.” Biophysical Society 54th Annual Meeting. Feb. 20 – 24, 2010, San Francisco, USA.
- *14. Dunn, A. R., Chuan, P.-Y. & Spudich “Contribution of the myosin VI medial tail domain to processive stepping and intramolecular tension sensing.” Japanese Molecular Biology Pre-meeting Symposium: Interface between Nano-biology and Molecular Biology. Dec. 8, 2009, Yokohama, Japan.
- *13. Dunn, A. R., Chuan, P.-Y. & Spudich “Myosin VI as a transporter and an anchor: A model for kinetics of the motor under load.” The 32nd Annual Meeting of the Molecular Biology Society of Japan. Dec. 9 – Dec. 12 2009, Yokohama, Japan.
- *12. Dunn, A. R. & Spudich, J. A. “The mechanism of load detection in the molecular motor myosin VI.” American Physical Society March Meeting, Pittsburgh, PA, March 15-20 (2009).

- *11. Dunn, A. R. & Spudich, J. A. "Single molecule measurements link myosin V biophysics and cellular function." University of Oregon, Department of Physics, July 25 (2007).
- *10. Dunn, A. R. & Spudich, J. A. "Structural dynamics of single molecular motors." University of British Columbia, Department of Physics, April 30 (2007).
- *9. Dunn, A. R. & Spudich, J. A. "Regulation of the cell's dynamic city plan and the myosin family of molecular motors." Traffic and Granular Flow, Orsay, France, June 20-22 (2007).
- *8. Dunn, A. R. & Spudich, J. A. "Structural dynamics of myosin V: characterization of the one-head bound intermediate." American Physical Society March Meeting. Denver, CO, March 5-9 (2007).
- 7. Dunn, A. R. & Spudich, J. A. "Characterization of the one-head-bound intermediate that occurs as myosin V walks on actin." Biophysical Society Annual Meeting. Baltimore, MD, March 3-8 (2007).
- 6. Dunn, A. R., Churchman, L. S., Bryant, Z. & Spudich, J. A. "Tracking single gold nanoparticle-myosin V conjugates using darkfield imaging" Biophysical Society Discussions. Molecular Motors: Point Counterpoint. Asilomar, CA, October 19-22 (2006).
- 5. Dunn, A. R., Churchman, L. S., Bryant, Z. & Spudich, J. A. "Tracking single gold nanoparticle-myosin V conjugates using darkfield imaging" Biophysical Society Annual Meeting. Salt Lake City, UT, February 18-22 (2006).
- 4. Dunn, A. R., Hays, A.-M. A., Goodin, D. G., Stout, C. D., Chiu, R., Winkler, J. A. & Gray, H. B. "Luminescent probes for cytochrome P450" 13th International Conference on Cytochromes P450. Prague, Czech Republic, June 29-July 3 (2003).
- 3. Dunn, A. R., Belliston, W., Chiu, R., Hays, A.-M. A., Goodin, D. B., Stout, C. D., Winkler, J. R. & Gray, H. B. "Dark-to-light luminescent probes for metalloenzymes" Graduate Research Seminar: Bioinorganic Chemistry. Ventura, CA February 6-9 (2003).
- 2. Dunn, A. R., Crane, B. R., Dmochowski, I. J., Winkler, J. R. & Gray, H. B. "Sensitizer-linked substrates for cytochrome P450: Photoinduced electron transfer and structural insights" Graduate Research Seminar: Bioinorganic Chemistry. Ventura, CA January 24-27 (2002).
- 1. Dunn, A. R., Crane, B. R., Dmochowski, I. J., Winkler, J. R. & Gray, H. B. "Sensitizer-linked substrates for cytochrome P450: Photoinduced electron transfer and structural insights" 221st ACS National Meeting. San Diego, CA April 1-5 (2001).

Courses Taught

- 4. ChE 420 Growth and Form. Graduate-level advanced topics course examining the role of physical forces in shaping living cells, tissues, and organs. (2013 – present)
- 3. ChE 185A Chemical Engineering Laboratory A. Junior/Senior laboratory course. Experimental aspects of chemical engineering science. Emphasizes laboratory work and development of communication skills. (2010)
- 2. ChE 320 Chemical Kinetics and Reaction Engineering. Graduate-level course on chemical reaction kinetics, with application to heterogeneous catalysis, enzyme engineering, and catalyst design. (2009 – present)
- 1. ChE/Ch 183, 283, Bio Sci 189 Biochemistry II. Advanced biochemistry course for juniors, seniors, and 1st-year graduate students. (2009 – present)

University Service

- 8. Stanford Cardiovascular Institute Advisory Board (2013 – present)
- 7. ABET recertification committee, Department of Chemical Engineering (2013 – present)
- 6. Graduate Admissions Committee, Chemical Engineering Department (2013).
- 5. Graduate Admissions Committee, Stanford Biophysics Program (2012 – present).

4. Scientific Director, Cell Science Imaging Facility Cost Center for Building 4 (2011 – present)
3. Member, Department of Chemical Engineering undergraduate teaching committee (2009 – present)
2. Faculty advisor for the Stanford AIChE student chapter (2009 – present)
1. Co-chair of the Building 4 Laboratory Design Committee (2009-2010)

Service to the Scientific Community

10. DARPA/Hertz Foundation Future Ideation Session, Arlington, VA Jan. 10-11, 2013.
9. NSF Proposal Review Panel, Directorate of Engineering (2013)
8. Secretary, Cellular Mechanobiology Subgroup, Biophysical Society (2013 – present)
7. Scientific Advisory Board, Myokardia, South San Francisco, CA.
6. Co-Organizer, Bay Area Mechanobiology Symposium, Stanford University, November 29, 2012.
5. Session Co-chair, “Cell Adhesion and Migration,” American Institute of Chemical Engineers, Pittsburg, PA, October 28 – November 2, 2012.
4. Invitee, NIH Common Fund Forward Focus Workshop: Strategic Planning For The NIH Common Fund, May 3, 2012, San Francisco, CA, USA.
3. Ad hoc panelist, NIH Biological Chemistry and Macromolecular Biophysics Integrated Review Group, Dec. 6, 2011.
2. Panelist, NICHD Bringing the Vision Together Meeting, June 23-24, 2011, Leesburg, VA, USA.
1. Organized special topics session at the American Society for Cell Biology 2008 National Meeting: “New Applications for AFM and Optical Trapping in Cell Biology.” San Francisco, USA

Ad hoc proposal review

Netherlands Organisation for Scientific Research
Stanford Cardiovascular Institute
Israel Science Foundation (ISF)

Journal article review

Proceedings of the National Academy of Sciences, U.S.A., Biomaterials, Physical Review Letters, Journal of the American Chemical Society, Optics Express, Interface Focus, Physics Review E, Journal of Molecular Biology, Biophysical Journal, PLoS Computational Biology