

Curriculum Vitae: Xiaowei Zhuang

Howard Hughes Medical Institute Investigator
David B. Arnold Professor of Science
Harvard University

12 Oxford Street, Cambridge, MA 02138

Tel: (617) 496-9558

Fax: (617) 496-9559

Email: zhuang@chemistry.harvard.edu

Website: <http://zhuang.harvard.edu>

Education

1987-1991 B.S., Physics, University of Science and Technology of China
1991-1996 Ph.D., Physics, University of California, Berkeley
1997-2001 Chodorow Postdoctoral Fellow, Stanford University

Positions

2015- Director, Center for Advanced Imaging at Harvard University
2014- David B. Arnold Professor of Science, Harvard University
2006- Professor, Department of Chemistry and Chemical Biology,
Department of Physics, Harvard University
2005- Investigator, Howard Hughes Medical Institute
2005-2006 Associate Professor, Department of Chemistry and Chemical Biology,
Department of Physics, Harvard University
2001-2005 Assistant Professor, Department of Chemistry and Chemical Biology,
Department of Physics, Harvard University

Elected membership

Member, US National Academy of Sciences
Member, American Academy of Arts and Sciences
Foreign member, Chinese Academy of Sciences
Foreign member, European Molecular Biology Organization (EMBO)
Fellow, American Association of the Advancement of Science
Fellow, American Physical Society
Honorary fellow, Royal Microscopical Society

Awards and honors

2018 Breakthrough Prize in Life Sciences
2018 Dr. H.P. Heineken Prize for Biochemistry and Biophysics, Royal Netherlands Academy of
Arts and Sciences (KNAW)
2017 Pittsburgh Analytical Chemistry Award
2017 Lennart Nilsson Award, Karolinska Institute, Sweden
2017 Honorary doctorate, Delft University of Technology
2016 Honorary doctorate, Stockholm University
2016 Vallee Visiting Professorship
2015 National Academy of Sciences Award in Molecular Biology
2015 Pearse Prize, Royal Microscopical Society
2011 Raymond & Beverly Sackler International Prize in Biophysics
2010 Max Delbrück Prize in Biological Physics, American Physical Society
2008 Coblentz Award
2006 Pure Chemistry Award, American Chemical Society
2005 Camille Dreyfus Teacher-Scholar Award
2004 Sloan Research Fellowship
2004 Technology Review Worlds Top 100 Young Innovators Award
2003 MacArthur Fellowship
2003 Packard Fellowship for Science and Engineering

- 2003 Searle Scholar
- 2003 CAREER award, National Science Foundation
- 2003 Beckman Young Investigator Award
- 2002 Young Investigator Award, Office of Naval Research

Award committee positions

- 2016- Lasker Award Jury
- 2014- Welch Award Committee
- 2015 National Academy of Sciences Alexander Hollaender Biophysics Award Committee
- 2014 National Academy of Sciences Scientific Discovery Award Committee
- 2013 National Academy of Sciences Initiatives in Research Award Committee
- 2011- Pew Scholars National Advisory Committee, The Pew Foundation

Editorial board positions

- 2009- *Cell*
- 2009- *Annual Review on Biophysics*
- 2014- *ACS Central Science*
- 2014- *ACS Photonics*
- 2016- *Neurophotonics*
- 2012-2016 *eLife*
- 2012-2016 *Optical nanoscopy*
- 2010-2015 *Chemical Physics Letter*
- 2009-2012 *Biophysical Journal*

Scientific advisory board positions

- 2017- Scientific Advisory Board, Stowers Institute for Medical Research
- 2014- Scientific Advisory Board, The Welch Foundation
- 2013- Scientific Advisory Board, ICFO – Institute of Photonics Science, Barcelona, Spain
- 2011- Scientific Advisory Board, School of Life Sciences, University of Science of Technology of China
- 2011- External advisory Board, NSF Center for the Physics of Living Cells (CPLC), UIUC
- 2011-2015 Scientific Advisory Board, Biodynamic Optical Imaging Center, Peking University, China

Distinguished lectureship

- 2018 Keynote Lecture, Gordon Research Conference on Molecular and Cellular Neurobiology
- 2018 Keynote Lecture, CSHA conference on Systems Biology of Genome Regulation and Engineering
- 2018 Keynote Lecture, Royal Swedish Academy of Engineering Sciences (IVA) Symposium
- 2018 Harkins Lecture, University of Chicago
- 2018 Keynote Lecture, H Foundation Basic Science Symposium, Northwestern University
- 2018 Keynote Lecture, Single-Cell Biology Conference, Cambridge, UK
- 2018 John Kendrew Lecture, MRC Laboratory of Molecular Biology, Cambridge, UK
- 2017 Presidential Lecture, Society for Neuroscience annual meeting
- 2017 Rinehart Lecture, University of Illinois at Urbana Champaign
- 2017 Franklin Lecture, Rice University
- 2017 Keynote Lecture, Frontiers in Neurophotonics, Bordeaux, France
- 2017 Keynote Lecture, EMBO/EMBL Symposium on Seeing is Believing
- 2017 Keynote Lecture, ChinaNANO 2017 Conference, Beijing, China
- 2017 Svedberg Lecture, Uppsala University, Sweden
- 2017 Hooke Lecture, CYTO2017 conference
- 2017 Keynote Lecture, Gordon Research Conference on Chromosome Dynamics
- 2017 Keynote Lecture, EMBO Symposium on Chromatin and Epigenetics

2017 Keynote Lecture, British Society of Cell Biology, Development Biology and Genetics Meeting
 2017 Keynote Lecture, Cold Spring Harbor Meeting on System Biology: Global gene regulation
 2017 Sigman Lecture, University of California at Los Angeles
 2016 Alexander M. Cruickshank Keynote Lecture, Gordon Research Conference on Synaptic Transmission
 2016 Keynote Lecture, Gordon Research Conference on Single-molecule approaches to biology
 2016 Herbert Lecture, Vollum Institute
 2016 Commencement speech, Departments of Physics and Astronomy, University of California at Berkeley
 2016 Kavli Lecture, American Physical Society Annual Meeting
 2016 Keynote Lecture, ASBMB Annual Meeting
 2016 University Lecture, UT Southwestern Medical Center
 2016 Honors Lecture, New York University School of Medicine
 2015 Andrew Huxley Lecture, Cambridge Neuroscience Symposium, University of Cambridge
 2015 IUBMB Lecture, FEBS Congress
 2015 Astbury Lecture, Astbury Center for Structural Molecular Biology, University of Leeds
 2015 Pearse Prize Lecture, Microsciences Microscopy Conference
 2015 Ferry Lecture, University of Wisconsin, Madison
 2015 Keynote Lecture, Gordon Research Conference on Three Dimensional Electron Microscopy
 2015 Keynote Lecture, Gordon Research Conference on Proteins
 2014 Harvey Lecture, Harvey Society
 2014 President's Plenary Lecture, American College of Neuropsychopharmacology Meeting
 2014 Krimm Lecture, University of Michigan
 2014 Huck Distinguished Lecture, Penn State University
 2014 Laureate Lecture, University of Pittsburg
 2014 McLean Lecture, Baylor College
 2014 Caspar Lecture, Florida State University
 2014 Keynote Lecture, Conference on Labeling and Nanoscopy
 2013 Dow Lecture, University of British Columbia
 2013 Global Lecture, Peking University
 2013 Keynote Lecture, American Society of Virology Annual Meeting
 2012 Danny Thomas Lecture, St Jude Research Hospital
 2012 Sproul Lecture, Cornell University
 2012 Wang Ying-Lai Lecture, University of Texas Medical Branch
 2012 Leica Scientific Forum Lectures, California (UCSF, UCLA, UCSD)
 2011 Leica Scientific Forum Lectures, Germany (Munich, Heidelberg, Berlin)
 2011 Greenfield Lecture, Case Western University
 2011 Fredric Fay Lecture, University of Massachusetts School of Medicine
 2011 Closs Lecture, University of Chicago
 2011 Max Delbruck Prize Lecture, American Physical Society Annual Meeting
 2011 Maggie & Nick DeWolf Public Lecture, Aspen Center for Physics
 2010 Director's WALSH Lecture, National Institutes of Health
 2010 Magomedov-Shcherbinina Memorial Prize Lecture, University of Rochester
 2009 Keynote Lecture, Annual Dutch Meeting on Molecular & Cellular Biophysics
 2009 Keynote Lecture, Cold Spring Harbor Conference on Single Cell Analysis
 2008 ST Huang Memorial Lecture, Hong Kong University
 2008 Brockman Lecture, University of Michigan
 2008 Morrison Lecture, Cornell University
 2008 Coblenz Award Lecture, International Symposium on Molecular Spectroscopy
 2006 Seymour Rothchild Lecture, University of Rochester
 2004 Gunnar and Gunnel Kallén Memorial Lecture, Lund University, Sweden
 2004 Jean-Francois Lefèvre Lecture, Ecole Supérieure de Biotechnologie de Strasbourg, France

Partial List of other profession services

Co-Chair, Cold Spring Harbor Conference on "New Advances in Optical Imaging of Live Cells and Organisms" (2011, 2013)
Chair, American Society of Cell Biology Meeting, Symposium on "Breaking the diffraction barrier" (2009)
Co-Chair, 355th Xiangshan Science Conference, "Single-Molecule Imaging, Spectroscopy and Manipulation of Biological Systems," Beijing, 2009
Co-chair, Gordon Research Conference on "Single Molecule Approaches to Biology" (2008)
Co-chair, American Chemical Society National Meeting, Symposium on "Single-molecule imaging, spectroscopy, and manipulation of biomolecular systems" (2007)
Co-vice chair, Gordon Research Conference on "Single Molecule Approaches to Biology" (2006)
Member, NIH College of CSR Reviewers (2010-)
NIH Study Sections: Review Panel for the NIH Director's Pioneer Award (2007, 2012, 2014), Review panel for the Nanomedicine Development Centers for the NIH Roadmap (2005, 2008), Study sections on Molecular Structure and Function C (2007), Cell Structure and Function (2006), Bioanalytical, Engineering, and Chemistry Emphasis (2003)

Former graduate students and postdocs

Former graduate students and postdocs currently in faculty positions (current institutions)

Bo Huang (Professor, UCSF)
Ethan Garner (Associate Professor, Harvard University)
Michael Rust (Associate Professor, University of Chicago)
Jeffrey Moffitt (Assistant Professor, Harvard Medical School)
Alistair Boettiger (Assistant Professor, Stanford University)
Steven Wang (Assistant Professor, Yale University)
Christine Payne (Associate Professor, Duke University)
Shixin Liu (Assistant Professor, Rockefeller University)
Ke Xu (Assistant Professor, UC Berkeley)
Melike Lakadamyali (Assistant Professor, University of Pennsylvania)
Colenso Speer (Assistant Professor, University of Maryland)
Doory Kim (Hanyang University, South Korea)
Shu Jia (Assistant Professor, Stony Brook University)
Gregory Bokinsky (Assistant Professor, Delft University of Technology, the Netherlands)
Joshua Vaughan (Assistant Professor, University of Washington)
Sebastian Deindl (Assistant Professor, Uppsala University, Sweden)
Guisheng Zhong (Assistant Professor, ShanghaiTech University, China)
Sang-Hee Shim (Assistant Professor, Ulsan National Institute of Sci. & Tech., South Korea)
Michael Stone (Associate Professor, UC Santa Cruz)
Jie Zheng (Associate Professor, University of Texas at Dallas)

Former graduate students and postdocs currently in academic research scientist or industrial positions

Hazen Babcock (Lead Senior Scientist, Center for Advanced Imaging, Harvard University)
Timothy Blosser (Research Scientist, Broad Institute)
William Hwang (Resident physician, Massachusetts General Hospital)
Graham Dempsey (Director of Research and Development, Q-State Biosciences)
Eileen Sun (Scientist, Aspyrian Therapeutics)
John Wu (Principal, Boston Consulting Group)
Wenqin Wang (Vice President, Blackrock)
Yajun Zhou (Research Scientist, Peking University)
Mariana Mihalusova (Senior Director, Global Project Leader, Celgene)
Chen Chen (Patent attorney, Cooley LLP)
Mirium Buiny (Director of Biomarkers, ProQR Therapeutics)

Youxin Zhang (Managing Consultant, Navigant Consulting)
Borries Brandenburg (Principal Scientist, Janssen Pharmaceutical, Johnson & Johnson),
Lucas Nivon (Co-Founder & CEO, Cyrus Biotechnology)
Minh Hong (Marketing Manager for Bioscience Solutions, Lonza)

Publications

1. J. R. Moffitt, D. Bambah-Mukku, S. W. Eichhorn, E. Vaughn, K. Shekhar, J. D. Perez, N. D. Rubinstein, J. Hao, A. Regev, C. Dulac, X. Zhuang. Molecular, Spatial and Functional Single-Cell Profiling of the Hypothalamic Preoptic Region. **Science** **362**, eaau5324 (2018) (DOI: 10.1126/science.aau5324).
2. B. Bintu, L. J. Mateo, J. Su, N. A. S.-A., M. Parker, S. Kinrot, K. Yamaya, A. N. Boettiger, X. Zhuang. Super-resolution chromatin tracing reveals domains and cooperative interactions in single cells. **Science** **362**, eaau1783 (2018) (DOI: 10.1126/science.aau1783).
3. Y. M. Sigal, R. Zhou, X. Zhuang. Visualizing and discovering cellular structures with super-resolution microscopy. **Science** **361**, 880–887 (2018).
4. C. Y. Chan, A. M. Pedley, D. Kim, C. Xia, X. Zhuang, S. J. Benkovic. Microtubule-directed transport of purine metabolons drives their cytosolic transit to mitochondria. **PNAS** (in press).
5. G. Wang, J. R. Moffitt, X. Zhuang. Multiplexed imaging of high density libraries of RNAs with MERFISH and expansion microscopy. **Scientific Report** **8**, 4847 (2018).
6. G. Emanuel, J. R. Moffitt, X. Zhuang. High-throughput, image-based screening of pooled genetic variant libraries. **Nature Methods** **14**, 1159-1162 (2017).
7. B. Han, R. Zhou, C. Xia, X. Zhuang. Structural Organization of the Actin-spectrin-based Membrane Skeleton in Dendrites and Soma of Neurons. **PNAS** **114**, E6678–E6685 (2017).
8. J. -J. Chung, K. Miki, D. Kim, S. -H. Shim, H. Shi, J. Y. Hwang, X. Cai, Y. Iseri, X. Zhuang, D. E. Clapham. CatSper ζ Regulates the Structural Continuity of Sperm Ca²⁺ Signaling Domains and is Required for Normal Fertility. **eLife** **6**, e23082 (2017).
9. L. A. Timashev, H. P. Babcock, X. Zhuang, and T. de Lange. The DDR at telomeres lacking intact shelterin does not require substantial chromatin decompaction. **Genes & Dev.** **31**, 578–589 (2017)
10. E. Gropelli, H. C. Levy, E. Sun, M. Strauss, C. Nicol, S. Gold, X. Zhuang, T. J. Tuthill, J. M. Hogle, D. J. Rowlands. Picornavirus RNA is protected from cleavage by ribonuclease during virion uncoating and transfer across cellular and model membranes. **PLoS Pathogen** DOI: 10.1371/journal.ppat.1006197 (2017).
11. H. Babcock, X. Zhuang. Analyzing single molecule localization microscopy data using cubic splines. **Scientific Report** **7**, 552 (2017).
12. S. Wang, J. -H. Su, B. J. Beliveau, B. Bintu, J. R. Moffitt, C. -t. Wu, X. Zhuang. Spatial organization of chromatin domains and compartments in single chromosomes. **Science** **353**, 598-602 (2016).
13. J. R. Moffitt, J. Hao, D. Bambah-Mukku, T. Lu, C. Dulac, X. Zhuang. High-performance multiplexed fluorescence in situ hybridization in culture and tissue with matrix imprinting and clearing. **PNAS** **113**, 14456–14461 (2016)
14. C. Wang, B. Han, R. Zhou, X. Zhuang. Real-time imaging of translation on single mRNA transcripts in live cells. **Cell** **165**, 990-1001 (2016).
15. J. R. Moffitt, J. Hao, G. Wang, K. H. Chen, H. P. Babcock, X. Zhuang. High-throughput single-cell gene expression profiling with multiplexed error-robust fluorescence in situ hybridization (MERFISH). **PNAS** **113**, 11046–11051 (2016).
16. A. N. Boettiger, B. Bintu, J. R. Moffitt, S. Wang, B. J. Beliveau, G. Fudenberg, M. Imakaev, L. A. Mirny, C. -t. Wu, X. Zhuang. Super-resolution imaging reveals distinct chromatin folding for different epigenetic states. **Nature** **529**, 418-422 (2016).

17. J. B. French, S. A. Jones, H. Deng, A. M. Pedley, D. Kim, C. Y. Chan, H. Hu, R. J. Pugh, H. Zhao, Y. Zhang, T. J. Huang, Y. Fang, X. Zhuang, S. J. Benkovic. Spatial colocalization and functional link of purinosomes with mitochondria. **Science** **351**, 733-737 (2016).
18. J. He, R. Zhou, Z. Wu, M. Carrasco, P. Kurshan, J. Farley, D. Simon, G. Wang, B. Han, J. Hao, E. Heller, M. R. Freeman, K. Shen, T. Maniatis, M. Tessier-Lavigne, X. Zhuang. Prevalent presence of periodic actin-spectrin-based membrane skeleton in a broad range of neuronal cell types and animal species. **PNAS** **113**, 6029-6034 (2016).
19. J. R. Moffitt, S. Pandey, A. N. Boettiger, S. Wang, X. Zhuang. Spatial organization shapes the turnover of a bacterial transcriptome. **eLife**, e13065 (2016). DOI: 10.7554/eLife.13065
20. B. T. Harada, W. L. Hwang, S. Deindl, N. Chatterjee, B. Bartholomew, X. Zhuang. Stepwise nucleosome translocation by RSC remodeling complexes. **eLife** e10051 (2016) DOI: 10.7554/elife.10051
21. J. R. Moffitt, X. Zhuang. RNA Imaging with Multiplexed Error-Robust Fluorescence In Situ Hybridization (MERFISH). **Methods in Enzymology** **572**, 1 – 49 (2016)
22. S. Wang, J.H. Su, F. Zhang, X. Zhuang. An RNA-aptamer-based two-color CRISPR labeling system. **Sci. Rep.** **6**, 26857 (2016)
23. A. Wani, A. N. Boettiger, P. Schorderet, A. Ergun, C. Munger, R. Sadreyev, X. Zhuang, R. Kingston, N. Francis. Chromatin topology is coupled to Polycomb group protein subnuclear organization. **Nat. Communications** **7**: 10291(2016) DOI:10.1038/ncomms10291
24. Y. M. Sigal, C. M. Speer, H. P. Babcock, X. Zhuang. Mapping synaptic input fields of neurons with super-resolution imaging. **Cell** **163**, 493-505 (2015)
25. K. H. Chen, A. N. Boettiger, J. R. Moffitt, S. Wang, X. Zhuang. Spatially resolved, highly multiplexed RNA profiling in single cells. **Science** **348**, 412, aaa6090 (2015) DOI: 10.1126/science.aaa6090.
26. S. Viswanathan, M. E. Williams, E. B. Bloss, T. J. Stasevich, C. M. Speer, A. Nern, B. D. Pfeiffer, B. M. Hooks, W. -P. Li, B. P. English, T. Tian, G. L. Henry, J. J. Macklin, R. Patel, C. R. Gerfen, X. Zhuang, Y. Wang, G. M. Rubin, L. L. Looger. High-performance probes for light and electron microscopy. **Nat. Methods** **12**, 568-576 (2015).
27. B. Beliveau, A. Boettiger, M. Avendaño, R. Jungmann, R. McCole, E. Joyce, C. Kim-Kiselak, F. Bantignies, C. Fonseka, J. Erceg, M. Hannan, H. Hoang, D. Colognori, J. Lee, W. Shih, P. Yin, X. Zhuang, C. -t. Wu. Single-molecule super-resolution imaging of chromosomes and in situ haplotype visualization using Oligopaint FISH probes. **Nat. Communications** **6**, 7147 (2015) DOI: 10.1038/ncomms8147.
28. D. Kim, T. J. Deerinck, Y. M. Sigal, H. P. Babcock, M. H. Ellisman, X. Zhuang. Correlative Stochastic Optical Reconstruction Microscopy and Electron Microscopy. **PLoS ONE** **10**: e0124581 (2015). DOI: 10.1371/journal.pone.0124581
29. C. Y. Chan, H. Zhao, R. J. Pugh, A. M. Pedley, J. French, S. A. Jones, X. Zhuang, H. Jinnah, T. J. Huang, S. J. Benkovic. Purinosome formation as a function of the cell cycle. **PNAS** **112**, 1368-1373 (2015).
30. G. Zhong, J. He, R. Zhou, D. Lorenzo, H. P. Babcock, V. Bennett, X. Zhuang. Developmental mechanism of the periodic membrane skeleton in axons. **eLife** **3**: e04581 (2014) DOI: 10.7554/eLife.04581
31. T. Shemesh, R. W. Klemm, F. B. Romano, S. Wang, J. C. Vaughan, X. Zhuang, H. Tukachinsky, M. M. Kozlov, T. A. Rapoport. A model for the generation and interconversion of ER morphologies. **PNAS** **111**, E5243-E5251 (2014)
32. D. N. Lorenzo, A. Badea, J. Q. Davis, J. Hostettler, J. He, G. Zhong, X. Zhuang, V. Bennett. A PIK3C3–Ankyrin-B–Dynactin pathway promotes axonal growth and multiorganelle transport. **J. Cell Biol** **207**, 735-752 (2014).
33. W. L. Hwang, S. Deindl, B. T. Harada, X. Zhuang. Histone H4 tail mediates allosteric regulation of nucleosome remodelling by linker DNA. **Nature** **512**, 213-217 (2014).

34. A D. Blunk, Y. Akbergenova, R. W. Cho, J. Lee, U. Walldorf, K. Xu, G. Zhong, X. Zhuang and J. T. Littleton. Postsynaptic actin regulates active zone spacing and glutamate receptor apposition at the Drosophila neuromuscular junction. **Mol. Cell. Neurosci** **61**, 241-254 (2014).
35. S. Wang, J. R. Moffitt, G. T. Dempsey, X. S. Xie, X. Zhuang. Characterization and development of photoactivatable fluorescent proteins for single-molecule-based superresolution imaging. **PNAS** **111**, 8452-8457 (2014).
36. J. -J. Chung, S. -H. Shim, R. A. Everley, S. P. Gygi, X. Zhuang, D. E. Clapham. Structurally Distinct Ca²⁺ Signaling Domains of Sperm Flagella Orchestrate Tyrosine Phosphorylation and Motility. **Cell** **157**, 808-822 (2014)
37. S. Jia, J. C. Vaughan, X. Zhuang. Isotropic 3D super-resolution imaging with a self-bending point-spread function. **Nat. Photonics** **8**, 302-306 (2014)
38. A. M. Avalos, A. M. Bilate, M.D. Witte, A. K. Tai, J. He, M. P. Frushicheva, P. D. Thill, F. Meyer-Wentrup, C. S. Theile, A. K. Chakraborty, X. Zhuang, H. L. Ploegh. Monovalent engagement of the BCR activates ovalbumin-specific transnuclear B cells. **J. Exp. Med.** **211**, 365-79 (2014)
39. K. Xu, G. Zhong, X. Zhuang. Actin, spectrin and associated proteins form a periodic cytoskeleton structure in axons. **Science** **339**, 452-456 (2013).
40. Y. Doksani, J. Wu, T. de Lange, X. Zhuang. Super-resolution fluorescence imaging of telomeres reveals TRF2-dependent t-loop formation. **Cell** **155**, 345-356 (2013).
41. S. Deindl, W. L. Hwang, S. K. Hota, T. R. Blosser, P. Prasad, B. Bartholomew, X. Zhuang. ISWI remodelers slide nucleosomes with coordinated multi-base-pair entry steps and single-base-pair exit steps. **Cell** **152**, 442-452 (2013).
42. H. Babcock, J. Moffitt, Y. Zhao, X. Zhuang. Fast compressed sensing analysis for super-resolution imaging using L1-homotopy. **Optics Express** **21**, 28583-28596 (2013).
43. J. He, E. Sun, M. B. Bujny, D. Kim, M. W. Davidson, X. Zhuang. Dual function of CD81 in influenza uncoating and budding. **PLoS Pathogen** **9**, e1003701 (2013).
44. S. K. Hota, S. K. Bhardwaj, S. Deindl, Y. C. Lin, X. Zhuang, B. Bartholomew. Nucleosome mobilization by ISW2 requires the concerted action of the ATPase and SLIDE domains. **Nat. Struct. Mol. Biol.** **152**, 442-452 (2013).
45. J.C. Vaughan, G.T. Dempsey, E. Sun, X. Zhuang. Phospine Quenching of Cyanine Dyes as a Versatile Tool for Fluorescence Microscopy. **J. Am. Chem. Soc.** **135**, 1197-1200 (2013).
46. E. Sun, J. He, X. Zhuang, Live cell imaging of viral entry. **Curr Opin Virol.** **3**, 34-43 (2013).
47. A. P. Alivisatos, A. M. Andrews, E. S. Boyden, M. Chun, G. M. Church, K. Deisseroth, J. P. Donoghue, S. E. Fraser, J. Lippincott-Schwartz, L. L. Looger, S. Masmanidis, P. L. McEuen, A. V. Nurmikko, H. Park, D. S. Peterka, C. Reid, M. L. Roukes, A. Scherer, M. Schnitzer, T. J. Sejnowski, K. L. Shepard, D. Tsao, G. Turrigiano, P. S Weiss, C. Xu, R. Yuste, X. Zhuang. Nanotools for neuroscience and brain activity mapping. **ACS nano** **7**, 1850-1866 (2013)
48. E. Sun, J. He, X. Zhuang. Dissecting the role of COPI complexes on influenza virus infection. **J. Virol.** **87**, 2673-2685(2013)
49. Kim, W. Pan, S. A. Jones, Y. Zhang, X. Zhuang, D. Wu. Clathrin and AP2 are required for PtdIns(4,5)P₂-mediated formation of LRP6 signalosomes. **J. Cell Biol.** **200**, 419-428 (2013).
50. J. Vaughan, S. Jia, X. Zhuang. Ultra-bright Photoactivatable Fluorophores Created by Reductive Caging. **Nat. Methods** **9**, 1181-1184 (2012).
51. V. Berk, J. C. N. Fong, G. T. Dempsey, O. N. Develioglu, X. Zhuang, J. Liphardt, F. H. Yildiz, S. Chu. Molecular architecture and assembly principles of Vibrio Cholerae biofilms. **Science** **337**, 236-239 (2012).
52. S. -H. Shim, C. Xia, G. Zhong, H. P. Babcock, J. C. Vaughan, B. Huang, X. Wang, C. Xu G.-Q. Bi, X. Zhuang. Super-resolution fluorescence imaging of organelles in live cells with photoswitchable membrane probes. **PNAS** **109**, 13978–13983 (2012).

53. S. Deindl, X. Zhuang. Monitoring conformational dynamics with single-molecule fluorescence resonance energy transfer: Application in Nucleosome Remodeling. **Methods Enzymol** **513**, 59–86 (2012)
54. H. Babcock, Y. Sigal, X. Zhuang. A high-density 3D localization algorithm for stochastic optical reconstruction microscopy. **Nanoscopy** **1**: 6 (2012).
55. E. A. Mukamel, H. P. Babcock, X. Zhuang. Statistical deconvolution for super-resolution fluorescence Microscopy. **Biophys. J.** **102**, 2391-2400 (2012)
56. K. Xu, H. P. Babcock, X. Zhuang. Dual-objective STORM reveals three-dimensional filament organization in the actin cytoskeleton. **Nat. Methods** **9**, 185-188 (2012).
57. M. Lakadamyali, H. Babcock, M. Bates, X. Zhuang, J. Lichtman. 3D Multicolor Super-Resolution Imaging Offers Improved Accuracy in Neuron Tracing. **PLoS One** **7**: e30826 (2012)
58. M. Bates, G. T. Dempsey, K. H. Chen, X. Zhuang. Multicolor super-resolution fluorescence imaging through via multi-parameter fluorophore detection. **Chemphyschem** **13**, 99-107 (2012)
59. G. T. Dempsey, J. C. Vaughan, K. H. Chen, M. Bates, X. Zhuang. Evaluation of fluorophores for optimal performance in localization-based super-resolution imaging. **Nat. Methods** **8**, 1027-1036 (2011).
60. J. C. Vaughan, X. Zhuang. New fluorescent probes for super-resolution imaging. **Nat. Biotechnol.** **29**, 880-881 (2011)
61. W. Wang, G.W. Li, C. Chen, X. S. Xie, X. Zhuang. Chromosome organization by a nucleoid associated protein. **Science** **333**, 1445-1449 (2011).
62. E. C. Garner, R. Bernard, W. Wang, X. Zhuang, D. Z. Rudner, T. Mitchison. Circumferential motions of the cell wall synthesis machinery drive cytoskeletal dynamics in *B. subtilis*. **Science** **333**, 222-225 (2011).
63. S. Jones, S.-H. Shim, J. He, X. Zhuang. Fast three-dimensional super-resolution imaging of live cells. **Nat. Methods** **8**, 499-505 (2011).
64. M. Mihalusova, J. Y. Wu, X. Zhuang. Functional importance of telomerase pseudoknot revealed by single-molecule analysis. **PNAS** **108**, 20339-20344 (2011).
65. B. Huang, H. Babcock, X. Zhuang, Breaking the diffraction barrier: Super-resolution imaging of cells. **Cell** **143**, 1047-1058 (2010).
66. S. Liu, B. T. Harada, J. T. Miller, S. F. J. Le Grice, X. Zhuang. Initiation complex dynamics direct the transitions between distinct phases of early HIV reverse transcription. **Nat. Struct. Mol. Biol.** **17**, 1453-1460 (2010).
67. A. Dani, B. Huang, J. Bergan, C. Dulac, X. Zhuang. Super-resolution imaging of chemical synapses in the brain. **Neuron** **68**, 843-856 (2010).
68. M. Wu, B. Huang, M. Graham, A. Raimondi, J. E. Heuser, X. Zhuang, P. De Camilli. Coupling between clathrin-dependent endocytic budding and F-BAR-dependent tubulation in a cell-free system. **Nat. Cell Biol.** **12**, 902-908 (2010).
69. S. Chung, M. Wendeler, J. W. Rausch, G. Beilhartz, M. Gotte, B. R. O'Keefe, A. Bermingham, J. A. Beutler, S. Liu, X. Zhuang, S. F.J. Le Grice. Structure-Activity Analysis of Vinylogous Urea Inhibitors of Human Immunodeficiency Virus-Encoded Ribonuclease H. **Antimicrob Agents Chemother** **54**, 3913-3921 (2010).
70. E. Schuman, X. Zhuang. New technologies, Editorial overview. **Curr Opin Neurobiology** **20**, 608-690 (2010).
71. M. Bates, S. A. Jones, X. Zhuang. Stochastic Optical Reconstruction Microscopy (STORM) - A Method for Superresolution Fluorescence Imaging. Chapter 35 in *Imaging: A Laboratory Manual*. Ed. Rafael Yuste. Cold Spring Harbor Laboratory Press (2010).
72. G. Dempsey, W. Wang, X. Zhuang, Fluorescence Imaging at Sub-Diffraction-Limit Resolution with Stochastic Optical Reconstruction Microscopy. Pp. 95-127 in *Handbook of Single-*

molecule Biophysics (ed. Hinterdorfer P, van Oijen AM), Springer Science and Business Media, New York.

73. T. Blosser, J. Yang, M. Stone, G. Narlikar, X. Zhuang. Dynamics of nucleosome remodeling by individual ACF complexes. **Nature** **462**, 1022-1027 (2009).
74. G. T. Dempsey, M. Bates, W. E. Kowtoniuk, D. R. Liu, R. Y. Tsien, X. Zhuang. Photoswitching mechanism of cyanine dyes. **J. Am. Chem. Soc.** **131**, 18192-18193 (2009).
75. M. Bates, B. Huang, M. Rust, G. Dempsey, W. Wang, X. Zhuang. Sub-diffraction-limit Imaging with Stochastic Optical Reconstruction Microscopy (STORM). **Nobel Volume on Single Molecule Spectroscopy in Chemistry**, Springer Publishing (2009).
76. J. Wu, M. Stone, X. Zhuang. A Single-molecule assay for telomerase structural-function analysis. **Nucleic Acid Res.** doi:10.1093/nar/gkp1033 (2009)
77. J. Vaughan, B. Brandenburg, J. Hogle, X. Zhuang. Rapid actin-dependent viral motility in live cells. **Biophysical Journal** **97**, 1647-1656 (2009)
78. X. Zhuang. Nano-imaging with STORM. **Nat. Photonics** **3**, 365-367 (2009)
79. Huang, M. Bates, X. Zhuang. Super-resolution fluorescence microscopy. **Annu. Rev. Biochem.** **78**, 993 – 1016 (2009)
80. E. Abbondanzieri, X. Zhuang. Concealed enzyme coordination. **Nature** **457**, 392-393 (2009).
81. H. M. van der Schaar, M. J. Rust, C. Chen, H. van der Ende-Metselaar, J. Wilschut, X. Zhuang, J. M. Smit. Dissecting the cell entry pathway of single Dengue virus particles in living cells. **PLoS Pathogen** **4**, e1000244 (2009)
82. S. Liu, E. Abbondanzieri, J. W. Rausch, S. F. J. Le Grice, X. Zhuang. Slide into action: dynamic shuttling of HIV reverse transcriptase on nucleic acid substrate. **Science** **322**, 1092-1097 (2008).
83. B. Huang, S. Jones, B. Brandenburg, X. Zhuang. Whole cell 3D STORM reveals interactions between cellular structures with nanometer-scale resolution. **Nat. Methods** **5**, 1047 - 1052 (2008).
84. M. Bates, B. Huang, X. Zhuang. Super-resolution microscopy by nanoscale localization of photo-switchable fluorescent probes. **Curr. Opin. Chem. Biol.** **208**, 505-514 (2008)
85. C. Chen, X. Zhuang. Epsin1 is a cargo specific adaptor for the clathrin-mediated endocytosis of influenza virus. **PNAS** **105**, 11790-11795 (2008)
86. J. Zheng, X. Zhuang. Luminescent and Raman active silver nanoparticles with polycrystalline structure. **J. Am. Chem. Soc.** **130**, 10472-10473 (2008)
87. E. Abbondanzieri, G. Bokinsky, J. W. Rausch, J. X. Zhang, S. F. J. Le Grice, X. Zhuang. Dynamic binding orientations direct activity of HIV reverse transcriptase. **Nature** **453**, 184-189 (2008).
88. B. Huang, W. Wang, M. Bates, X. Zhuang. Three-dimensional super-resolution imaging by stochastic optical reconstruction microscopy. **Science** **319**, 810-813 (2008).
89. M. Bates, B. Huang, G. Dempsey, X. Zhuang. Multicolor super-resolution imaging with photo-switchable fluorescent probes. **Science** **317**, 1749-1753 (2007).
90. S. Liu, G. Bokinsky, N. G. Walter, X. Zhuang. Dissecting the multi-step reaction pathway of an RNA enzyme by single-molecule kinetic fingerprinting. **PNAS** **104**, 12634-12639 (2007).
91. M. D. Stone, M. Mihalusova, C. M. O'Connor, R. Prathapam, K. Collins, X. Zhuang. Stepwise protein-mediated RNA folding directs assembly of telomerase ribonucleoprotein. **Nature** **446**, 458-461 (2007).
92. B. Brandenburg, L. Y. Lee, M. Lakadamyali, M. J. Rust, X. Zhuang, and J. M. Hogle. Imaging poliovirus entry in live cells. **PLoS Biol.** **5**, 1543-1555 (2007).
93. B. Brandenburg, X. Zhuang. Virus trafficking – learning from single-virus tracking. **Nat. Rev. Microbiol.** **5**, 197-208 (2007).

94. M. J. Rust, M. Lakadamyali, B. Brandenburg, and X. Zhuang. Single-virus tracking in live cells. In *Single Molecule Techniques* Ed. P.S. Selvin and T.Ha (Cold Spring Harbor Laboratory Press).
95. Y. Zhou, X. Zhuang. Kinetic analysis of sequential multi-step reactions. *J. Phys. Chem. B*, **111**, 13600-13610, 2007 (2007).
96. H. M. van der Shaar, M. J. Rust, B. Waarts, H. van der Ende Metselaar, R. J. Kuhn, J. Wilschut, X. Zhuang, J. M. Smit. Characterization of the early events in Dengue virus cell entry by biochemical assays and single-virus tracking. *J. Virol.*, **81**, 12019-12028 (2007).
97. C. K. Payne, S. Jones, C. Chen, X. Zhuang. Internalization and trafficking of cell surface proteoglycans and proteoglycan binding ligands. *Traffic* **8**, 389-401 (2007).
98. Y. Zhou and X. Zhuang. Robust reconstruction of the rate constant distribution using the phase function method. *Biophys. J.* **91**, 4045-4053 (2006).
99. M. J. Rust, M. Bates, X. Zhuang. Sub-diffraction-limit imaging by stochastic optical reconstruction microscopy (STORM). *Nat. Methods* **3**, 793-795 (2006).
100. G. Bokinsky, L. G. Nivon, S. Liu, G. Chai., M. Hong, K. M. Weeks, X. Zhuang. Two distinct binding mode of a protein cofactor with its target RNA. *J. Mol. Biol.* **361**, 771-784 (2006).
101. M. Lakadamyali, M. J. Rust, X. Zhuang. Ligands for clathrin-mediated endocytosis are differentially sorted into distinct populations of early endosomes. *Cell* **124**, 997-1009 (2006).
102. X. Zhuang. Single-molecule RNA Science. *Annu. Rev. Biophys. Biomol. Struct.* **34**, 399-414 (2005)
103. G. Bokinsky, X. Zhuang. Single-molecule RNA folding. *Acct. Chem. Res.* **38**, 566-573 (2005).
104. M. Bates, T. R. Blosser, X. Zhuang. Short-range spectroscopic ruler based on a single-molecule optical switch. *Phys. Rev. Lett.* **94**, 108101 (2005).
105. X. Zhuang. Unraveling DNA condensation by optical tweezers. *Science* **305**, 188-190 (2004).
106. M. Lakadamyali, M. J. Rust, X. Zhuang. Endocytosis of influenza viruses. *Micro. Infect.* **6**, 929-936 (2004).
107. M. J. Rust, M. Lakadamyali, F. Zhang, X. Zhuang. Assembly of endocytic machinery around individual influenza viruses during viral entry. *Nat. Struct. Mol. Biol.* **11**, 567-573 (2004).
108. F. Patolsky, G. Zheng, O. Hayden, M. Lakadamyali, X. Zhuang, C. M. Lieber. Electrical detection of single viruses. *PNAS* **101**, 14017-14022 (2004).
109. H. P. Babcock, C. Chen, X. Zhuang. Using single-particle tracking to study nuclear trafficking of viral genes. *Biophys. J.* **87**, 2749-2758 (2004).
110. D. Rueda, G. Bokinsky, M. M. Rhodes, M. J. Rust, X. Zhuang, N. G. Walter. Single-molecule enzymology of RNA: Essential functional groups impact catalysis from a distance. *PNAS* **101**, 10066-10071 (2004).
111. M. Lakadamyali, M. J. Rust, H P. Babcock, X. Zhuang. Visualizing infection of individual influenza viruses. *PNAS* **100**, 9280-9285 (2003).
112. G. Bokinsky, D. Rueda, V. K. Misra, A. Gordus, M. M. Rhodes, H. P. Babcock, N. G. Walter, X. Zhuang. Single-molecule transition-state analysis of RNA folding. *PNAS* **100**, 9302-9307 (2003).
113. X. Zhuang and M. Rief. Single-molecule folding. *Curr. Opin. Struct. Biol.* **13**, 88-97 (2003).
114. L. E. Bartley, X. Zhuang, R. Das, S. Chu, D. Herschlag. Exploration of the transition state for tertiary structure formation between an RNA helix and a large structured RNA. *J. Mol. Biol.* **328**, 1011-1026 (2003).
115. X. Zhuang, H. Kim, M. Pereira, H. Babcock, N. Walter, S. Chu. Correlating structural dynamics and function in single ribozyme molecules. *Science* **296**, 1473-1476 (2002).
116. R. Russell, X. Zhuang, H. Babcock, I. S. Millett, S. Doniach, S. Chu, D. Herschlag. Exploring the folding landscape of a structured RNA. *PNAS* **99**, 155-160 (2002).

117. X. Zhuang, L. Bartley, H. Babcock, R. Russell, T. Ha, D. Herschlag, S. Chu. A single-molecule study of RNA catalysis and folding. **Science** **288**, 2048-2051 (2000).
118. X. Zhuang, T. Ha, H. Kim, T. Centner, S. Labeit, S. Chu. Fluorescence quenching: a tool for single-molecule protein-folding study. **PNAS** **97**, 14241-14244 (2000).
119. T. Ha, X. Zhuang, H. Kim, J. Orr, J. Williamson, S. Chu. Ligand-induced conformational changes of single RNA molecules. **PNAS** **96**, 9077-9082 (1999).
120. S.-C. Hong, M. Oh-e, X. Zhuang, Y. R. Shen, J. J. Ge, F. W. Harris, S. Z. D. Cheng. Orientation of side chains and adsorbed liquid crystal molecules on a rubbed polyimide surface studied by optical harmonic generation. **Phys. Rev. E** **63**, 0517061-7 (2001).
121. J. J. Ge, C. Y. Li, G.I. Xue, I. K. Mann, S. Z. D. Cheng, J. Z. Zhang, D. Zhang, S. Wang, F. W. Harris, S.-C. Hong, X. Zhuang, Y. R. Shen. Rubbing-induced molecular reorientation on an alignment surface of an aromatic polyimide containing cyanobiphenyl side chains. **J. Am. Chem. Soc.** **123**, 5768-5776 (2001).
122. X. Wei, X. Zhuang, D. Kim, S.-C. Hong, T. Goto, and Y. R. Shen. Vibrational spectroscopy of rubbed polymer surfaces. **Mole. Cryst. Liq. Cryst.** **358**, 103-108 (2001).
123. X. Wei, S. Hong, X. Zhuang, T. Goto, Y. R. Shen. Nonlinear optical studies of liquid crystal alignment on a rubber polyvinyl alcohol surface. **Phys. Rev. E** **62**, 5160-5172, (2000).
124. X. Wei, X. Zhuang, S. Hong, T. Goto, Y. R. Shen. Sum-Frequency vibrational spectroscopic study of a rubbed polymer surface. **Phys. Rev. Lett.** **82**, 4256-4259 (1999).
125. X. Zhuang, P. B. Miranda, D. Kim, Y. R. Shen. Mapping molecular orientation and conformation at interfaces by surface nonlinear optics. **Phys. Rev. B** **59**, 12632-12640 (1999).
126. T. Qian, X. Zhuang, Y. R. Shen. Surface-monolayer-induced bulk alignment of liquid crystals: from nematic to smectic-a phase. **Phys. Rev. E** **59**, 1873-1879 (1999).
127. X. Zhuang, R. Muenster, M. Jarasch, Y. R. Shen. "Dye-induced enhancement of optical nonlinearity in liquid crystals and ordinary liquids. **Mole. Cryst. Liq. Cryst.** **321**, 165-172 (1998).
128. J. J. Ge, G.Xue, K. W. McCreight, S. Wang, F. W. Harris, S. Z. D. Cheng, X. Zhuang, S. Hong, Y. R. Shen. Surface studies of polyimide thin films via surface enhanced Raman scattering and second harmonic generation. **Macromol. Rapid Comm.** **19**, 619-623 (1998).
129. R. Muenster, M. Jarasch, X. Zhuang, Y. R. Shen. Enhanced optical Kerr effect of dye-doped isotropic liquid. **Phys. Rev. Lett.** **78**, 42-45 (1997).
130. X. Zhuang and Y. R. Shen. The application of nonlinear optics to the study of polymers at interfaces. **Trends Polym. Sci.** **4**, 258-264 (1996).
131. A. Le Calvez, S. Montant, E. Freysz, A. Ducasse, X. Zhuang, Y. R. Shen. Ultrafast orientation dynamics of liquid crystals in smectic phase. **Chem. Phys. Lett.** **258**, 620-625 (1996).
132. X. Zhuang, H. S. Lackritz, and Y. R. Shen. Photo-isomerization of polymer monolayers and multi-layers on water. **Chem. Phys. Lett.** **246**, 279-284 (1995).
133. X. Zhuang, D. Wilk, L. Marrucci, and Y. R. Shen. Orientation of amphiphilic molecules on polar substrates. **Phys. Rev. Lett.** **75**, 2144-2147 (1995).
134. X. Zhuang, L. Marrucci, D. Johannsmann, and Y. R. Shen. Dependence of liquid crystal bulk alignment on its surface monolayer. **Mole. Cryst. Liq. Cryst.** **262**, 35-43 (1995).
135. X. Zhuang, L. Marrucci, and Y. R. Shen. Surface-monolayer-induced bulk alignment of liquid crystals. **Phys. Rev. Lett.** **73**, 1513-1516 (1994).