

Curriculum Vitae: Xiaowei Zhuang

Professor of Chemistry and Chemical Biology

Professor of Physics

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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

Professional Appointments

09/2005- Investigator, Howard Hughes Medical Institute
01/2006- Professor, Department of Chemistry and Chemical Biology,
Department of Physics, Harvard University
07/2005-12/2005 Associate Professor, Department of Chemistry and Chemical Biology,
Department of Physics, Harvard University
08/2001-06/2005 Assistant Professor, Department of Chemistry and Chemical Biology,
Department of Physics, Harvard University

Honors and awards

2008 HHMI collaborative Innovation Award
2008 Coblenz Award
2006 Pure Chemistry Award
2005 Camille Dreyfus Teacher-Scholar Award
2004 Alfred P. Sloan Research Fellowship
2004 Technology Review Worlds Top 100 Young Innovators Award
2003 MacArthur Fellowship
2003 Packard Fellowship for Science and Engineering
2003 CAREER award, National Science Foundation
2003 Searle Scholar
2003 Beckman Young Investigator Award
2002 Young Investigator Award, Office of Naval Research
2000 Individual National Research Service Award, National Institute of Health
1997 Chodorow Postdoctoral Fellowship, Stanford University,
1993 Victor F. Lenzen Memorial Scholarship, University of California
1992 George C. and Helen N. Pardee Scholarship, University of California
1991 Bernice Teuteberg Memorial Scholarship, University of California

Professional Services

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)
Editorial Board, *Cell*
Editorial Board, *Annual Review on Biophysics*

NIH Study Section: Review panel on Nanomedicine Development Centers for the NIH Roadmap Nanomedicine Initiative (2008), Interview panel of the NIH Director's Pioneer Award (2007), Study section on Molecular Structure and Function C (2007), Study section on Cell Structure and Function (2006), Study section on Nanomedicine Development Centers for the NIH Roadmap Nanomedicine Initiative (2005), Study section on Bioanalytical, Engineering, and Chemistry Emphasis (2003)

Member, Center for Brain Science, Harvard University (since 2008)

Member, Systems Biology Program, Harvard University (Since 2005)

Member, Virology Program, Harvard University (Since 2007)

Standing committee member, Biophysics program, Harvard University (Since 2002)

Standing committee member, Chemical Physics program, Harvard University (Since 2002)

Publications

1. B. Huang, M. Bates, X. Zhuang. Super-resolution fluorescence microscopy. ***Annu. Rev. Biochem.*** (in press)
2. E. Abbondanzieri, X. Zhuang. Concealed enzyme coordination. ***Nature* 457**, 392-393 (2009).
3. 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 (in press)
4. 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).
5. B. Huang, S. Jones, B. Brandenburg, X. Zhuang. Whole cell 3D STORM reveals interactions between cellular structures with nanometer-scale resolution. ***Nat. Meth.* 5**, 1047 - 1052 (2008).
6. M. Bates, B. Huang, X. Zhuang. Super-resolution microscopy by nanoscale localization of photo-switchable fluorescent probes. ***Curr. Opin. Chem. Biol.* 208**, 1-10 (2008)
7. C. Chen, X. Zhuang. Epsin1 is a cargo specific adaptor for the clathrin-mediated endocytosis of influenza virus. ***Proc. Natl. Acad. Sci. USA* 105**, 11790-11795 (2008)
8. J. Zheng, X. Zhuang. Luminescent and Raman active silver nanoparticles with polycrystalline structure. ***J. Am. Chem. Soc.* 130**, 10472-10473 (2008)
9. 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).
10. B. Huang, W. Wang, M. Bates, X. Zhuang. Three-dimensional super-resolution imaging by stochastic optical reconstruction microscopy. ***Science* 319**, 810-813 (2008).
11. M. Bates, B. Huang, G. Dempsey, X. Zhuang. Multicolor super-resolution imaging with photo-switchable fluorescent probes. ***Science* 317**, 1749-1753 (2007).
12. S. Liu, G. Bokinsky, N. G. Walter, X. Zhuang. Dissecting the multi-step reaction pathway of an RNA enzyme by single-molecule kinetic fingerprinting. ***Proc. Natl. Acad. Sci. USA* 104**, 12634-12639 (2007).
13. 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).

14. 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).
15. B. Brandenburg, X. Zhuang. Virus trafficking – learning from single-virus tracking. *Nat. Rev. Microbiol.* **5**, 197-208 (2007).
16. Y. Zhou, X. Zhuang. Kinetic analysis of sequential multi-step reactions. *J. Phys. Chem. B*, **111**, 13600-13610, 2007 (2007).
17. 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).
18. 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).
19. Y. Zhou and X. Zhuang. Robust reconstruction of the rate constant distribution using the phase function method. *Biophys. J.* **91**, 4045-4053 (2006).
20. M. J. Rust, M. Bates, X. Zhuang. Sub-diffraction-limit imaging by stochastic reconstruction optical microscopy (STORM). *Nat. Meth.* **3**, 793-795 (2006).
21. 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).
22. 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).
23. X. Zhuang. Single-molecule RNA Science. *Annu. Rev. Biophys. Biomol. Struct.* **34**, 399-414 (2005)
24. G. Bokinsky, X. Zhuang. Single-molecule RNA folding. *Acct. Chem. Res.* **38**, 566-573 (2005).
25. M. Bates, T. R. Blosser, X. Zhuang. Short-range spectroscopic ruler based on a single-molecule optical switch. *Phys. Rev. Lett.* **94**, 108101 (2005).
26. X. Zhuang. Unraveling DNA condensation by optical tweezers. *Science* **305**, 188-190 (2004).
27. M. Lakadamyali, M. J. Rust, X. Zhuang. Endocytosis of influenza viruses. *Micro. Infect.* **6**, 929-936 (2004).
28. 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).
29. F. Patolsky, G. Zheng, O. Hayden, M. Lakadamyali, X. Zhuang^{*}, C. M. Lieber^{*}. Electrical detection of single viruses. *Proc. Natl. Acad. Sci. USA* **101**, 14017-14022 (2004).
30. H. P. Babcock, C. Chen, X. Zhuang. Using single particle-tracking to study nuclear trafficking of viral genes. *Biophys. J.* **87**, 2749-2758 (2004).
31. 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. *Proc. Natl. Acad. Sci. USA* **101**, 10066-10071 (2004).
32. M. Lakadamyali, M. J. Rust, H P. Babcock, X. Zhuang. Visualizing infection of individual influenza viruses. *Proc. Natl. Acad. Sci. USA* **100**, 9280-9285 (2003).

33. 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. ***Proc. Natl. Acad. Sci. USA* 100**, 9302-9307 (2003).
34. X. Zhuang* and M. Rief*. Single-molecule folding. ***Curr. Opin. Struct. Biol.* 13**, 88-97 (2003).
35. 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).
36. 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).
37. R. Russell, X. Zhuang, H. Babcock, I. S. Millett, S. Doniach, S. Chu*, D. Herschlag*. Exploring the folding landscape of a structured RNA. ***Proc. Natl. Acad. Sci. USA* 99**, 155-160 (2002).
38. 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).
39. X. Zhuang, T. Ha, H. Kim, T. Centner, S. Labeit, S. Chu. Fluorescence quenching: a tool for single-molecule protein-folding study. ***Proc. Natl. Acad. Sci. USA* 97**, 14241-14244 (2000).
40. T. Ha, X. Zhuang, H. Kim, J. Orr, J. Williamson, S. Chu. Ligand-induced conformational changes of single RNA molecules. ***Proc. Natl. Acad. Sci. USA* 96**, 9077-9082 (1999).
41. 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).
42. 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).
43. 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).
44. 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).
45. 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).
46. 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).
47. 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).
48. 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).
49. 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).
50. 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).
 51. 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).
 52. 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).
 53. 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).
 54. X. Zhuang, D. Wilk, L. Marrucci, and Y. R. Shen. Orientation of amphiphilic molecules on polar substrates. *Phys. Rev. Lett.* **75**, 2144-2147 (1995).
 55. 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).
 56. X. Zhuang, L. Marrucci, and Y. R. Shen. Surface-monolayer-induced bulk alignment of liquid crystals. *Phys. Rev. Lett.* **73**, 1513-1516 (1994).