

Jerome M. Fox

Department of Chemistry and Chemical Biology
Harvard University
M-234, 12 Oxford Street
Cambridge, MA 02138

Lab: (617)-495-9433
Cell: (608)-215-0553

Education

- University of California, Berkeley 2007-2012
Ph.D., Chemical Engineering
- Johns Hopkins University 2003-2007
B. Sc., Environmental Engineering
2nd Major: Natural Science with a concentration in chemistry
Minor: Mathematics

Research Interests

Biocatalysis, Complex Reaction Networks, Protein Engineering, Synthetic Biology, Nanotechnology

Research Experience

Postdoctoral Fellow, Harvard University Jan 2013-present

Advisor: Professor George M. Whitesides, Department of Chemistry and Chemical Biology

- *Biophysics: the Hydrophobic Effect*. Employed calorimetry, crystallography, and solvent maps to study the influence of networks of water on the hydrophobic interactions that drive ligand binding to the active site of human carbonic anhydrase II.
- *Microfluidics: Transparent Sensors*. Used soft lithography and three-dimensional printing to construct transparent, stretchable, and biocompatible skins for sensing pressure and strain via ionic conduction through microfluidic channels.
- *Optical Metamaterials*. Employed novel methods of nanofabrication to construct gold and multi-metal metamaterials active in the near- and mid-infrared spectral ranges.
- *Dynamical Systems: Physical Models for the Spread of Wildfires*. Developed several physical models, each based on ignition of nitrocellulose and cellulose structures, to study complex combustion phenomena that occur as fire propagates through forest-like environments.

Ph. D. Student, University of California – Berkeley Aug 2007 – Dec 2012

Advisors: Professors Douglas S. Clark and Harvey W. Blanch, Department of Chemical and Biomolecular Engineering

- *Photoactivated Localization Microscopy (PALM) of Enzyme Targets*: Developed a single-molecule approach to quantify the different binding patterns of proteins adsorbed on the surface of structurally heterogeneous substrates, and employed that approach to show that cellulases that bind similar but non-identical cellulose morphologies can have synergistic activity.
- *Enzymology of Cellulases*. Developed a combined experimental and analytical method to identify rate limitations imposed upon *Trichoderma longibrachiatum* cellobiohydrolase as it degrades crystalline cellulose alone and in the presence of companion enzymes.
- *Kinetic Modeling of Cellulose Hydrolysis*. Developed mechanistic kinetic models of enzymatic cellulose hydrolysis and used them to show how the structure of cellulosic substrates (e.g. particle shape) and the conditions of depolymerization (e.g. simultaneous microbial growth) influence hydrolysis kinetics.

Undergraduate Research Assistant, Johns Hopkins Medical School Jan 2007 – May 2007

Advisor: Dr. Daniel Hanley, Department of Neurology

- *Delivery of tissue-type plasminogen activator to the brain*. Developed a preliminary model for the delivery of tissue type plasminogen activator to blood clots in stroke victims using a combination of clinical data, literature research, and computer-based thrombus reconstructions.

Undergraduate Research Assistant, Johns Hopkins School of Public Health Sep 2006 – May 2006
 Advisor: Dr. Kellogg Schwab, Center for Water and Health

- *Ecology*. Dissected oysters for viral RNA tests and took water measurements to help study the depuration processes carried out by two oyster variants relevant to the Chesapeake Bay.

Vredenburg Scholar, University of Sydney Jun 2006 – Jul 2006
 Advisor: Professor Dong-sheng Jeng, Department of Civil Engineering

- *Pollutant transport*. Explored methods of accounting for inertial and compressibility effects on pore water and sediment in mathematical models of wave-driven advective transport within flat and rippled coastal seabeds.

Undergraduate Research Assistant, Johns Hopkins Jan 2005 – July 2005
 Advisor: Professor Lynn Roberts, Department of Environmental Engineering

- *Fate of pollutants*. Helped to develop a qualitative and quantitative analytical method to detect dilute concentrations of the antineoplastic drug 5-fluorouracil in natural water samples

Teaching Experience

- Graduate Student Instructor, Kinetics and Reaction Engineering 2011
 Core graduate course taught by Professor Berend Smit, Chemical Engineering
- Graduate Student Instructor, Biochemical Engineering 2008
 Senior elective taught by Professor Douglas Clark, Chemical Engineering
- Mentor to six undergraduate researchers 2008-2012
 Three enrolled in graduate school (Princeton, Univ. of Pennsylvania, and Univ. of Copenhagen); two joined industry (chemical companies in Los Angeles, California and Kharagpur, India); and one became a high school teacher.

Awards and Honors

- *NSF Graduate Fellow* 2008-2011
- *Best Student Poster Award in the Area of Fundamental Science*, 2010
 Symposium on Biotechnology for Fuels and Chemicals
- General and departmental honors, Johns Hopkins 2007
- *Lucien Brush Award for Excellence in Environmental Engineering* 2007
- *Certificate in the Arts*, Johns Hopkins 2007
- *Vredenburg Scholar: Australia*, Summer 2006
- *Tau Beta Pi Engineering Honor Society* 2006
- *Golden Key Society* 2005
- *National Society of Collegiate Scholars* 2005

Grant-writing

- Between March, 2013 and November, 2013, I helped to write seven grants for the Whitesides Group: two in the area of biophysics, two in the area of dissipative systems, two in the area of low-cost diagnostics, and one pertaining to the origin of life. 2013

Professional Service

- Referee: *Biotechnology and Bioengineering, Proceedings of the National Academy of Sciences*
- *Co-Chair*, The Berkeley Energy Symposium 2008, 2009, 2011
 The main energy conference at Berkeley and the largest student-run conference on the West Coast.
- *Member of Executive Board*, Berkeley Energy and Resources Collaborative 2010-2011
 A multidisciplinary student group consisting of undergraduates, graduate students, and faculty members interested in energy and environmental research, technology, and policy.

Other Service

- *Team Leader*, Hopkins 4K for Cancer 2007
A 4,000-mile bicycle ride that raised over \$100,000 for cancer research.
- *Treasurer*, JHU Engineers without Borders – South Africa 2007
A project to evaluate the public health impact of ram pumps on rural households.
- *Team Member*, JHU Engineers without Borders – South Africa 2006
A project to install electricity-free water pumps (ram pumps) in South Africa.

Publications

- **Fox JM**, Jess P, Jambusaria RB, Moo GM, Liphardt J*, Clark DS*, Blanch HW* (2013). A Single-Molecule Analysis Reveals Morphological Targets for Cellulase Synergy. *Nature Chemical Biology*, 9 (6), 356-61. Featured in articles in *Nature Chemical Biology's* "News and Views" and on Lawrence Berkeley National Lab's News Center.
- **Fox JM**, Levine SE, Blanch HW*, and Clark DS* (2012). An Evaluation of Cellulose Saccharification and Fermentation with an Engineered *Saccharomyces cerevisiae* capable of cellobiose and xylose utilization. *Biotechnology Journal* 7, 351-373. Featured as a cover article.
- **Fox JM**, Levine SE, Clark DS*, and Blanch HW* (2012). Initial- and Processive-Cut Products Reveal Cellobiohydrolase Rate Limitations and Role of Companion Enzymes. *Biochemistry*, 51, 442-452.
- Levine SE, **Fox JM**, Clark DS*, and Blanch HW* (2011). A Mechanistic Model for Rational Design of Optimal Cellulase Mixtures. *Biotechnology and Bioengineering*, 108, 2561-2570.
- Levine SE, **Fox JM**, Blanch HW*, and Clark DS* (2010). A Mechanistic Kinetic Model of the Enzymatic Hydrolysis of Cellulose. *Biotechnology and Bioengineering*, 107, 37-51.

Presentations

- **Fox, JM**. Cellulases on the Cellulose Surface: Single Molecule Investigations and Mathematical Modeling Reveal Kinetic Insights. Genencor, invited oral presentation.
- **Fox JM**, Levine SE, Clark DS, and Blanch HW. Initial- and Processive-cut Products Reveal Cellobiohydrolase Rate Limitations and Role of Companion Enzymes. Society for Industrial Microbiology (SIM): Symposium on Biotechnology for Fuels and Chemicals, oral presentation, 2012.
- **Fox JM**, Jess P, Liphardt J, Clark DS, and Blanch HW. Elucidation of Cellulase-cellulose Interactions with Photoactivation Localization Microscopy (PALM). Gordon Conference on Cellulases, Cellulosomes, and Other Carbohydrate Modifying Enzymes, poster presentation, 2011.
- **Fox JM**, Levine SE, Clark DS, and Blanch HW. Experimental and Computational Investigations of Cellobiohydrolase Complexation Behavior. Society for Industrial Microbiology: Symposium on Biotechnology for Fuels and Chemicals, poster presentation, 2010.
- **Fox JM**, Jess P, Liphardt J, Clark DS, and Blanch HW. Assessment of the Importance of Cellulase Sub-site Specificity on Rate of Enzymatic Cellulose Hydrolysis. Society for Industrial Microbiology: Symposium on Biotechnology for Fuels and Chemicals, poster presentation, 2009.
- Levine SE, **Fox JM**, Jess P, Liphardt J, Clark DS, and Blanch HW. Cellulase Kinetics and Surface Phenomena. Society for Industrial Microbiology: Symposium on Biotechnology for Fuels and Chemicals, poster presentation, 2008.

Patents

- Fox JM, Clark DS, and Blanch HW. "Enzyme Compositions and Methods for Cellulose Hydrolysis." U.S. Provisional Application.

References

- George M. Whitesides
Woodford L. and Ann A. Flowers University Professor
Department of Chemistry and Chemical Biology
Harvard University
Phone: 617-495-9430
Email: mlegrand@gmwgroup.harvard.edu
- Douglas S. Clark
Dean, College of Chemistry and
Gilbert Newton Lewis Professor
Department of Chemical and Biomolecular Engineering
University of California, Berkeley
Phone: 510-642-2408
Email: clark@berkeley.edu
- Harvey W. Blanch
CSTO, Joint BioEnergy Institute and
Merck Professor of Biochemical Engineering
Department of Chemical and Biomolecular Engineering
University of California, Berkeley
Phone: 510-642-1387
Email: blanch@berkeley.edu
- Christopher R. Somerville
Director, Energy Biosciences Institute and
Philomathia Professor of Alternative Energy
Department of Plant and Microbial Biology
University of California, Berkeley
Phone: 510-643-6265
Email: crs@berkeley.edu