

*CURRICULUM VITAE*  
**WILLIAM O. HANCOCK, Ph.D.**

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**Education**

Duke University	Biomedical Engineering and Electrical Engineering (Graduated with distinction)	B.S.E., 1988
University of Washington	Bioengineering (Advisors: Lee Huntsman and Albert Gordon)	Ph.D., 1994
University of Washington	Physiology and Biophysics (Advisor: Jonathon Howard)	11/94 – 11/99 (postdoctoral)

**Appointments**

Associate Professor, 7/2006 – present, Bioengineering Department, Pennsylvania State University, University Park, PA

Assistant Professor, 1/2000 – 6/2006, Bioengineering Department, Pennsylvania State University, University Park, PA

Member, Huck Institutes of the Life Sciences, 2000 - present  
Member, Materials Research Institute, 2002 - present

Senior Fellow, 1/1995 – 11/1999, Department of Physiology and Biophysics, University of Washington, Seattle, WA

Research Assistant, 8/1989 – 8/1994, Bioengineering Program, University of Washington, Seattle, WA

**Research Overview**

Focus of research is understanding the molecular mechanism of the motor protein kinesin, understanding the roles of diverse kinesins in cell biology, and using microengineering and nanotechnology to develop experimental platforms and microscale devices integrating motor proteins. Investigations into kinesin mechanochemistry involve single-molecule experiments integrated with extensive computational modeling of the kinesin hydrolysis cycle. Kinesin application work includes developing microfabrication and protein patterning techniques and is focused both on developing an “Artificial Mitotic Spindle” and developing devices that integrate motor proteins and carry out microscale separations and sensing.

**Refereed Publications**

(41 total peer-reviewed journal publications, 1181 total citations, h-index 19 as of 8/30/2011).

- $\text{Ca}^{2+}$  and segment length dependence of isometric force kinetics in intact ferret cardiac muscle, **W.O. Hancock**, D.A. Martyn, and L.L. Huntsman. 1993. *Circ Res.* 73:603-11.
- Influence of  $\text{Ca}^{2+}$  on force redevelopment kinetics in skinned rat myocardium, **W.O. Hancock**, D.A. Martyn, L.L. Huntsman, and A.M. Gordon. 1996. *Biophys J.* 70:2819-29.
- Models of calcium activation account for differences between skeletal and cardiac force redevelopment kinetics, **W.O. Hancock**, L.L. Huntsman, A.M. Gordon. 1997. *J Muscle Res Cell Motil.* 18:671-81.
- Processivity of the motor protein kinesin requires two heads. **W.O. Hancock** and J. Howard. 1998. *J Cell Biol.* 140:1395-405.
- Kinesin's processivity results from mechanical and chemical coordination between the ATP hydrolysis cycles of the two motor domains, **W.O. Hancock** and J. Howard. 1999. *Proc Natl Acad Sci.* 96:13147-52.
- Kinesin's tail domain is an inhibitory regulator of the motor domain. D.L. Coy, **W.O. Hancock**, M. Wagenbach, and J. Howard. 1999. *Nature Cell Biol.* 1:288-92.
- Susalka, S.J., **W.O. Hancock**, and K.K. Pfister. 2000. Distinct cytoplasmic dynein complexes are transported by different mechanisms in axons. *Biochimica et Biophysica Acta* 1496:76-88.
- The *Arabidopsis thaliana* protein, ATK1, is a minus-end directed kinesin that exhibits non-processive movement, A.I. Marcus, J.C. Ambrose, L. Blickley, **W.O. Hancock** and R.J. Cyr. 2002. *Cell Motility and the Cytoskeleton* 52:144-50.
- Reconstitution and characterization of budding yeast gamma-tubulin complex, D. B. Vinh, J. W. Kern, **W. O. Hancock**, J. Howard, and T. N. Davis. 2002. *Mol Biol Cell* 13:1144-57.
- A polarized microtubule array for kinesin-powered nanoscale assembly and force generation, T.B. Brown and **W.O. Hancock**. 2002. *NanoLetters* 2:1131-1135.
- The Kinesin-Related Protein MCAK Is a Microtubule Depolymerase that Forms an ATP-Hydrolyzing Complex at Microtubule Ends. A.W. Hunter, M. Caplow, D.L. Coy, **W.O. Hancock**, S. Diez, L. Wordeman, and J. Howard. 2003. *Molecular Cell* 11: 445-457.
- Lithographically patterned channels spatially segregate kinesin motor activity and effectively guide microtubule movements. S.G. Moorjani, L. Jia, T.N. Jackson and **W.O. Hancock**. 2003. *NanoLetters* 3:633-637.
- Microscale transport and sorting by kinesin molecular motors, L. Jia, S.G. Moorjani, T.N. Jackson and **W.O. Hancock**. 2004. *Biomedical Microdevices* 6(1): 67-74.
- Patterning surface-bound microtubules through reversible DNA hybridization. G. Muthukrishnan, C.A. Roberts, Y.C. Chen, J.D. Zahn and **W.O. Hancock**. 2004. *NanoLetters* 4:2127-2132.
- The two motor domains of KIF3A/B coordinate for processive motility and move at different speeds, Y. Zhang and **W.O. Hancock**. 2004. *Biophysical Journal*, 87:1795-1804.

- Millimeter scale alignment of magnetic nanoparticle functionalized microtubules in magnetic fields. M. Platt, G. Muthukrishnan, **W.O. Hancock**, and M.E. Williams. 2005. *Journal of the American Chemical Society*, 127(45):15686-15687.
- Micro- and nanofabrication processes for hybrid synthetic and biological system fabrication. V. Verma, **W.O. Hancock**, and J.M. Catchmark. 2005. *IEEE Transactions on Advanced Packaging*, 28(4):584-593.
- Microfabricated capped channels for biomolecular motor-based transport. Y.M. Huang, M. Uppalapati, **W.O. Hancock**, and T.N. Jackson. 2005. *IEEE Transactions on Advanced Packaging*, 28(4):564-570.
- Transport of semiconductor nanocrystals by kinesin molecular motors. G. Muthukrishnan, B.M. Hutchins, M.E. Williams, and **W.O. Hancock**. 2006. *Small*, 2(5):626-630.
- Magnet assisted fabrication of microtubule arrays. B.M. Hutchins, **W.O. Hancock** and M.E. Williams. 2006. *Phys. Chem. Chem. Phys.* 8(30):3507-3509.
- Motility of CoFe<sub>2</sub>O<sub>4</sub> nanoparticle-labelled microtubules in magnetic fields. B.M. Hutchins, **W.O. Hancock** and M.E. Williams. 2006. *Micro and Nano Letters*. 1(1): 47-52.
- Directing transport of CoFe<sub>2</sub>O<sub>4</sub>-functionalized microtubules with magnetic fields B.M. Hutchins, M. Platt, **W.O. Hancock** and M.E. Williams. 2007. *Small* 3(1): 126-131.
- Microtubule transport, concentration and alignment in enclosed microfluidic channels. Y.-M. Huang, M. Uppalapati, **W.O. Hancock** and T.N. Jackson. 2007. *Biomedical Microdevices* 9:175-184.
- Enhancing the stability of kinesin motors for microscale transport applications. M. Uppalapati, Y.-M. Huang, T.N. Jackson and **W.O. Hancock**. 2008. *Lab on a Chip* 8:358-361.
- Transport and detection of unlabeled nucleotide targets by microtubules functionalized with molecular beacons. M. Raab and **W.O. Hancock**. 2008. *Biotechnology and Bioengineering*, 99(4): 764-773.
- Microtubule alignment and manipulation using AC electrokinetics. M. Uppalapati, Y. M. Huang, T.N. Jackson and W.O. Hancock. 2008. *Small* 4(9): 1371-81.
- The role of casein in supporting the operation of surface bound kinesin. V. Verma, **W.O. Hancock**, and J.M. Catchmark. 2008. *Journal of Biological Engineering* 2:14.
- Neutravidin micropatterning by deep UV irradiation. Y.M. Huang, M. Uppalapati, **W.O. Hancock** and T.N. Jackson. 2008. *Lab on a Chip* 8(10): 1745-7.
- Nanoscale patterning of kinesin motor proteins and its role in guiding microtubule motility. V. Verma, **W.O. Hancock**, and J.M. Catchmark. 2009. *Biomedical Microdevices* 11(2):213-22.
- Surface-bound casein modulates the adsorption and activity of kinesin on SiO<sub>2</sub> surfaces. T. Ozeki, V. Verma, M. Uppalapati, Y. Suzuki, M. Nakamura, J.M. Catchmark and **W.O. Hancock**. 2009. *Biophysical Journal* 96(8):3305-18.

The Processivity of Kinesin-2 Motors Suggests Diminished Front-Head Gating. G. Muthukrishnan, Y. Zhang, S. Shastry and **W.O. Hancock**. 2009. *Current Biology* **19**(5):442-7.

Anterograde microtubule transport drives microtubule bending in LLC-PK1 epithelial cells. A.D. Bicek, E. Tüzel, A. Demtchouk, M. Uppalapati, **W.O. Hancock**, D.M. Kroll, D.J. Odde. 2009. *Molecular Biology of the Cell* **20**(12):2943-53.

Insights into the mechanical properties of the kinesin neck linker domain from sequence analysis and molecular dynamics simulations. V. Hariharan and **W.O. Hancock**. 2009. *Cellular and Molecular Bioengineering* **2**(2):177-89.

Likelihood Inference for Fluorescence Microscopy Images. J. Hughes, J. Fricks, and **W.O. Hancock**. 2010. *Annals of Applied Statistics* **4**: 830-848.

Neck linker length determines the degree of processivity in Kinesin-1 and Kinesin-2 motors. S. Shastry and **W.O. Hancock**. 2010. *Current Biology* **20**: 939-943.

Monte Carlo analysis of neck linker extension in kinesin molecular motors. M.L Kutys, J. Fricks and **W.O. Hancock**. 2010. *PLoS Computational Biology* **6**(11): e1000980. doi:10.1371/journal.pcbi.1000980.

“Artificial Mitotic Spindle” generated by dielectrophoresis and protein micropatterning supports bidirectional transport of kinesin-coated beads. M. Uppalapati, Y.-M. Huang, V. Aravamuthan, T.N. Jackson and **W.O. Hancock**. 2011. *Integrative Biology* **3**:57-64.

A matrix computational approach to kinesin neck linker extension. J. Hughes, **W.O. Hancock**, J. Fricks. 2011. *Journal of Theoretical Biology* **269**(1):181-194.

Engineering Tubulin: Microtubule Functionalization Approaches for Nanoscale Device Applications. J.L. Malcos and **W.O. Hancock**. 2011. *Applied Microbiology and Biotechnology*. **90**:1-10.

Kinesins with Extended Neck Linkers: A Chemomechanical Model for Variable-Length Stepping. J. Hughes, **W.O. Hancock**, J. Fricks. 2011. *Bulletin of Mathematical Biology*. Epub: October 14, 2011.

Inter-head Tension Determines Processivity Across Diverse N-Terminal Kinesins. S. Shastry and **W.O. Hancock**. 2011. *Proc. Natl. Acad. Sci.*, 108(29):16253-8.

#### Articles published in refereed proceedings

Hancock, W.O., Y. Zhang and Y.C. Lee. 2002. Interdomain interactions in the KIF3 kinesin family motor. *IEEE Transactions Conference Proceedings of the 2<sup>nd</sup> Joint EMBS-BMES Conference*, pp 176-177.

Verma, V., W.O. Hancock, and J.M. Catchmark. 2005. Approaches for hybrid biological and synthetic system integration. *The 38<sup>th</sup> International Symposium on Microelectronics and Packaging Society*, p 244-249.

Williams, M. E.; Hutchins, B. M.; Platt, M.; Hancock, W. O. 2006. “Controlling Placement, Alignment and Transport of Microtubules with Magnetic Fields” *ECS Transactions* **3**(19):1-7.

#### Book Chapters

- Hancock, W.O. and J. Howard. 2002. "Kinesin: Processivity and Chemomechanical Coupling." Molecular Motors. M. Schliwa, editor, Wiley-VCH, Weinheim, Germany, 10:243-269.
- Hancock, W.O. "Protein-Based Nanotechnology: Kinesin-Microtubule Driven Systems for Bioanalytical Applications." In Nanotechnology for Life Sciences Volume 4: Nanodevices for Life Sciences. C. Kumar, Editor, Wiley-VCH, Weinheim, Germany. In Press, 2006.
- Uppalapati, M., Y-M Huang, S. Shastry, T.N. Jackson and W.O. Hancock, (2009). Microtubule Motors in Microfluidics. Methods in Bioengineering: Microfabrication and Microfluidics, J.D. Zahn and L.P. Lee, Eds. Artech House Publishers, Boston, MA. In Press, 2009.

## News and Views and Special Issue Introductions

- Special Issue: Cytoskeleton, Cell Adhesion and Motility. **W.O. Hancock** and W.H. Guilford. 2009. *Cellular and Molecular Bioengineering* **2**(2):175.
- Intracellular transport: kinesins working together. **W.O. Hancock**. 2008. *Current Biology* **18**(16): R715-7.
- Foreword: Special Section on Micro- and Nanoscale Packaging. Y.C. Lee, J.A. Chiou, T. Velten and **W.O. Hancock**. 2005. *IEEE Transactions on Advanced Packaging* **28**(4):531-2.

## Research Support

### Research projects in progress

National Institutes of Health, "Molecular Mechanism of Kinesin-2 Motility", 2R01GM076476, 7/1/2011 - 4/30/2015 (R01 Renewal), \$1,190,656 total, Principal Investigator. Goal is to understand chemomechanical mechanism of Kinesin-2 class of molecular motors.

National Science Foundation, "Diffusion and Kinetics in Processive Molecular Motors", DMS #0714939, 9/1/2007-8/31/2012 (including 1 year no cost extension), \$672,320 total, Co-Investigator (John Fricks, PI). Goal is to combine quantitative models and experiments to understand the interdomain coordination that underlies the mechanochemistry of Kinesin-1.

Pennsylvania State University Colleges of Engineering and Medicine Grace Woodward Grant, "Single-molecule nanomechanical investigations of cardiomyopathy-linked myosin motors", 7/1/2011-6/30/2012, \$50,000 total, Co-Principal Investigator (with Chris Yengo, PSU Hershey Medical Center). Goal is to use single-molecule fluorescence and optical tweezers to study force-dependent conformational changes in Myosin V.

### Research projects completed

National Institutes of Health, "Directed Assembly of Artificial Mitotic Spindles", 5R21GM083297, 6/1/2008-5/31/2011 (including one year no-cost extension), \$390,299 total, Principal Investigator. Goal is to use microfabrication and reconstitution to assemble mitotic spindles in vitro and test role of mitotic kinesins in cell division.

National Institutes of Health, "Molecular Mechanism of Kinesin-2 Motility", 5R01GM076476, 5/1/2006-4/30/2011 (including one year no-cost extension), \$987,904 total, Principal Investigator. Goal is to understand chemomechanical mechanism of Kinesin-2 class of molecular motors.

National Science Foundation, Division of Bioengineering and Environmental Systems, #0323024, "Biophotonics: Molecular Motor Biophotonics," 09/01/03-08/31/06, \$531,444 total, Principal Investigator. Goal is to integrate molecular motors into microfabricated devices for optical detection

of RNA. Long-term goal is lab-on-a-chip systems in which microscale transport is driven by molecular motors and integrated photonics detect analytes.

National Science Foundation, Materials Research Science and Engineering Center, DMR0213623, “MRSEC: Center for Molecular Nanofabrication and Devices,” 09/01/02-8/31/08, \$5,060,000 total for two Interdisciplinary Research Groups, Co-Investigator and Leader of Interdisciplinary Research Group 2: Molecular Motors, (PI, Paul Weiss), Renamed “PSU Center for Nanoscale Science”. Multidisciplinary center focusing on nanoscale patterning and investigating applications of synthetic and biological motors to nanotechnology.

American Heart Association, PA/DE Affiliate, Beginning Grant-in-aid #0365347U, “Regulation of KinII Kinesin Motors by Their Cargo-Binding Tail Domains,” 07/01/03-6/30/05, \$100,000 total, Principal Investigator. Goal is to test whether KinII tail fragments inhibit motility and ATP hydrolysis of the motor.

Whitaker Foundation Biomedical Engineering Research Grant, “Interdomain Coordination in the Molecular Motor KIF3,” 09/1/00-02/28/04, \$240,000 total, Principal Investigator. Goal is to test coordination between two heads of KIF3 kinesin using motility assays of homo and heterodimeric constructs.

Defense Advanced Research Projects Agency, “Motor Protein Driven Liquid Crystal Based Biosensors,” \$152,000 total, 02/01/04-07/31/04, (Subcontract from GeoCenters, GeoCenters subcontract from DARPA), Principal Investigator. Goal is to combine microscale transport abilities of kinesins with sensitive analyte detection of lyotropic liquid crystals to investigate feasibility of autonomous microscale sensors for biowarfare agent detection.

National Science Foundation, Nanoscale Exploratory Research Grant #0209687, “NER: Oligonucleotide-Directed Alignment of Cytoskeletal Filaments for Nanoscale Assembly,” 09/01/02-8/31/03, \$95,000, Principal Investigator. Goal is to assemble microtubules on surfaces using complementary oligonucleotides; tracks will be used for microscale transport or directed assembly *in vitro*.

Pennsylvania State University, Life Sciences Consortium Biotechnology Fund Seed Grant, “A Molecular Motor-Based Biomolecule Detector,” 06/01/02-5/31/03, \$38,169 total, Principal Investigator. Goal is to make microtubule array to concentrate molecules of interest that are bound to molecular motors.

### Proposals under review

National Institutes of Health, “Kinesin and +TIP-dependent Microtubule Steering”, 12/1/2011-11/30/2016, \$3,066,971 total requested, Principal Investigator. Goal is use *in vitro* reconstitution, imaging in living fly embryos, and computational modeling to test a proposed mechanism for the formation of uniform polarity microtubule arrays in neurons.

Impact/Priority Score: 26, Percentile: 17% (Council meeting Oct, 2011).

National Institutes of Health, “Multiscale modeling of microtubule-based transport in neurons”, 4/1/2012-3/31/2017, \$2,255,175 total requested, Co-Principal Investigator (of four) with J. Fricks (PSU), Peter Kramer (RPI), and Scott McKinley (U. Florida). Goal is to model transport in neurons from nano-scale (individual motors), through mesoscale (multiple motors) to microscale (complex microtubule geometries), supported by experiments at all three scales.

To be reviewed MABS Study Section, September, 2011.

## Invited Seminars and Lectures

- Invited Speaker, *Gordon Research Conference: Motile and Contractile Systems*, Colby-Sawyer College, New London, NH, 2011
- Invited Speaker, *European Materials Research Society Annual Meeting*, Nice, France, 2011
- Invited Speaker, Motility Subgroup at *Biophysical Society Annual Meeting*, Baltimore, MD, 2011
- Invited Speaker, *Biomedical Engineering Department*, Northwestern University, Chicago, IL, 2011
- Panelist, *Departments of Biology and Computer Science Workshop: Challenges in Interdisciplinary Innovations in Undergraduate Curriculum*, Penn State University, University Park, PA, 2010
- Invited Speaker, *Departments of Physics and Biology*, Worcester Polytechnic Institute, Worcester, MA, 2010
- Invited Speaker, *Department of Biomedical Engineering and Institute of Mathematics and Applications*, University of Minnesota, Minneapolis, MN, 2009
- Instructor and Invited Speaker, *Center for Functional Materials NanoBioMaterials Summer School*, Karlsruhe, Germany, 2009
- Invited Speaker, *American Chemical Society National Meeting*, Philadelphia, PA, 2008
- Invited Speaker, *Max Planck Institute for Cell Biology and Genetics*, Dresden, Germany, 2007.
- Invited Speaker, *European Science Foundation Conference on Biological Surfaces and Interfaces*, San Feliu, Spain, 2007
- Invited Speaker, *Departments of Mechanical and Biomedical Engineering*, University of Michigan, Ann Arbor, MI, 2007
- Invited Speaker, *Section on Cell Biophysics, National Institute of Child Health and Human Development*, National Institutes of Health, Bethesda, MD, 2006
- Invited Speaker, *Department of Biological Science*, Florida State University, Tallahassee, FL, 2006
- Participant, *Whitaker Biomedical Engineering Education Summit II*, Landsdowne, VA, 2005
- Invited Speaker, *DARPA BioMolecular Motors Meeting*, Jackson, WY, 2004
- Invited Speaker, *Department of Cellular and Molecular Physiology*, Hershey Medical Center, Hershey, PA, 2003
- Invited Speaker, *DARPA BioMolecular Motors Meeting*, San Francisco, CA, 2003
- Invited Speaker, *Department of Biomedical Engineering*, University of Virginia, Charlottesville, VA, 2003
- Invited Speaker, *American Chemical Society National Meeting*, San Diego, CA, 2001
- Invited Speaker, *Department of Biomedical Engineering*, University of Michigan, Ann Arbor, MI, 2000
- Invited Speaker, *National Institute of Arthritis, Musculoskeletal and Skin Diseases*, National Institutes of Health, Bethesda, MD, 1999
- Invited Speaker, *Department of Biomedical Engineering*, University of California Irvine, Irvine, CA, 1999
- Invited Speaker, *Department of Biological Systems Engineering*, Washington State University, Pullman, WA, 1999
- Invited Speaker, *Department of Anatomy*, University of British Columbia, Vancouver, British Columbia, Canada, 1998
- Invited Speaker, *European Molecular Biology Laboratory*, Heidelberg, Germany, 1997
- Invited Speaker, *Institut fuer Zellbiologie*, Ludwig-Maximilian University, Munich, Germany, 1997
- Invited Speaker, *Department of Biomedical Engineering*, Tulane University, New Orleans, LA, 1994

## Meeting Presentations (Abstracts listed for last 5 years out of 56 total)

- Hancock, W.O. 2011. Tethered diffusion and strain-dependent gating in Kinesin-2 motors. *Biophysical Society Annual Meeting*, cdrom. (Principal author)
- Shastry, S. and W.O. Hancock. 2011. Differences in processivity between kinesin motor families 1, 2, 3, 5 and 7 result from diversity in the length of their neck-linker domains. *Biophysical Society Annual Meeting*, cdrom. (First author supervised)
- Andreasson, J., B. Clancy, W.O. Hancock, S.M. Block. 2011. Mechano-Chemical Properties of Kinesin-2 motor KIF3A/B Studied With Optical Trapping. *Biophysical Society Annual Meeting*, cdrom. (Contributing author)
- Hancock, W.O., S. Shastry, M. Kutys, M. Hariharan, V. Hughes, J. Fricks. 2010. Implications of the diversity of neck linker lengths across the kinesin superfamily. *American Association for Cell Biology Meeting*, cdrom. (Principal author)
- Shastry, S. and W.O. Hancock. 2010. Processivity of motors in kinesin families 1, 2, 3, 5 and 7 is regulated by strain-dependent coordination of heads through the neck-linker domain. *American Association for Cell Biology Meeting*, cdrom. (First author supervised)
- Lancelle, S, W.O. Hancock, J. Ross and O. Quintero. 2010. Incorporating Mathematics into the Cell Biology Teaching Laboratory: A Modular, Affordable, Approach for the YouTube Generation. *American Association for Cell Biology Meeting*, cdrom. (Contributing author)
- Hancock, W.O., M.L. Kutys, and J. Fricks. 2010. Monte Carlo analysis of neck linker extension in native and mutant kinesin molecular motors. *Biomedical Engineering Society Annual Meeting*, cdrom. (Principal author)
- Shastry, S. and W.O. Hancock. 2010. Molecular biomechanics of the kinesin neck linker domain. *Biomedical Engineering Society Annual Meeting*, cdrom. (First author supervised)
- Shastry, S. and W.O. Hancock. 2010. Neck-linker length is a critical determinant of kinesin processivity. *Biophysical Society Annual Meeting*, cdrom. (First author supervised)
- Shastry, S. and W.O. Hancock. 2009. The extended neck linker of Kinesin-2 diminishes its processivity. *American Association for Cell Biology Meeting*, pg 864. (First author supervised)
- Hancock, W.O. and S. Shastry. 2009. Kinesin neck linker and neck-coil both contribute to motor processivity. *Biophysical Society Annual Meeting*, 96(8):511a. (Principal author)
- Kutys, M.L., V. Hariharan, J. Fricks and W.O. Hancock. 2009. How does the tethered kinesin head diffuse to the next microtubule binding site? *Biophysical Society Annual Meeting*, 96(3):511a. (First author supervised)
- Shastry, S. and W.O. Hancock. 2009. The extended neck linker of Kinesin-2 diminishes its processivity. *Biomedical Engineering Society Annual Meeting*, cdrom. (First author supervised)
- Lata, J. and W.O. Hancock. 2009. Stepping and skipping of qdot labeled kinesin motors. *Biomedical Engineering Society Annual Meeting*, cdrom. (First author supervised)
- Uppalapati, M., Y. Huang, V. Aravamuthan, T.N. Jackson, and W.O. Hancock. 2008. Artificial mitotic spindles assembled using dielectrophoresis and UV protein patterning support complex kinesin-driven dynamics. *Biophysical Society Annual Meeting*, cdrom. (First author supervised).
- Tuzel, E., A.D. Bicek, A. Demtchouk, M. Uppalapati, W.O. Hancock, D.M. Kroll, and D.J. Odde. 2008. Origins of microtubule bending in LLC-PK1 epithelial cells. *Biophysical Society Annual Meeting*, cdrom. (Equal authors)
- Hancock, W.O., G. Muthukrishnan, and S. Shastry. 2008. Experimental and computational investigations of kinesin-2 mechanochemistry. *Biomedical Engineering Society Annual Meeting*, pp 109. (First author)
- Uppalapati, M., Y.M. Huang, T.N. Jackson, and W.O. Hancock. 2007. Microscale manipulation and spindle-like assembly of microtubules using dielectrophoresis. *Biophysical Society Annual Meeting*, cdrom. (First author supervised).



- Muthukrishnan, G. and W.O. Hancock. 2007. Kinesin-1 and Kinesin-2 differ in both the magnitude and the ATP-dependence of processivity. *American Association for Cell Biology Meeting*, cdrom. (First author supervised).
- Bicek, A.D., E. Tuzel, M. Uppalapati, W.O. Hancock, D.M. Kroll, and D.J. Odde. 2008. Origins of microtubule bending in LLC-PK1 epithelial cells. *Biophysical Society Annual Meeting*, cdrom. (Contributing author)
- Uppalapati, M., Y.M. Huang, T.N. Jackson, and W.O. Hancock. 2007. Assembling artificial mitotic spindles in vitro using dielectrophoresis and microscale patterning. *American Association for Cell Biology Meeting*, cdrom. (First author supervised).

## **Students and Postdocs Advised**

### Postdoctoral Fellows

- Z. Donhauser (06/2003-08/2004), Project: Kinesin-driven transport of T Lymphocytes.  
(Currently Asst. Prof. of Chemistry, Vassar College).

### Bioengineering Doctoral Students

- Y. Zhang, Ph.D. awarded 12/2005, Title: The Two Motor Domains of Kinesin-2 Coordinate for Processive Motility.
- G. Muthukrishnan, Ph.D. awarded 5/2008, Title: Experimental and Theoretical Investigations of Kinesin-2 Mechanochemistry.
- M. Uppalapati, Ph.D. awarded 8/2008, Title: Controlled Assembly of Microtubules and Manipulation of Kinesin Driven Microtubule Motion.
- S. Shastry, Ph.D. awarded 8/2011, Title: Investigations into Structural and Biochemical Determinants of Kinesin Processivity.

### Bioengineering Masters Students

- Y.C. Lee, M.S. awarded 12/2002, Thesis: Expression and Biochemical Characterization of Chimaeric KIF3-Conventional Kinesin Motor Proteins.
- S. Moorjani, M.S. awarded 08/2003, Thesis: Manipulating Microtubule Movements for *In Vitro* Microscale Transport.
- K. H. Ahn, M.S. awarded 08/2004, Thesis: Kinesin Displacements and Force Measurements by Optical Trap.
- M. Hwang, M.S. awarded 08/2004, Thesis: ATPase Rates of KIF3A/B and its Chimaeric Homodimers.
- G. Muthukrishnan, M.S. awarded 12/2004, Thesis: Patterning Surface-Bound Microtubules Through Reversible DNA Hybridization.
- D. Baskar, M.S. awarded 08/2005, Thesis: Compatibility of Liquid Crystals with Kinesin-Microtubule System for Biosensor Applications.
- M. Raab, M.S. awarded 08/2007, Thesis: Construction, Expression, and Functional Characterization of Single-Headed Kinesins.
- V. Aravamuthan, MS awarded 08/2008 (Co-Chair with R. Cyr, Biology). Thesis: In Vitro Assembly of Artificial Mitotic Spindles Using Dielectrophoresis.

### Undergraduate Honors Theses Supervised

- C. Roberts (Eng. Sci. and Mechanics), BS 12/2004, Honors Thesis: Oligonucleotide-Directed Patterning of Microtubules Through Microcontact Printing

- J. Robosky (Bioe), BS 05/2005, Honors Thesis: Artificial Calcium- Calmodulin Regulation in Conventional Kinesin Adapted from Kinesin-Like Calmodulin-Binding Protein. (Awarded Best Bioengineering Honors Thesis, 2005)
- M. Raab (Bioe), BS 05/2006, Honors Thesis: Molecular Motor-Driven Transport and Detection of Viral mRNA. (Awarded Best Bioengineering Honors Thesis, 2006)
- J. Belair (Bioe), BS 05/2006, Honors Thesis: Modeling the KIF3 Hydrolysis Cycle.
- D. Dunn (Mech. Eng.), BS 05/2008, Honors Thesis: Single-headed Kinesin Assay Development.
- J. Lata (Bioe), BS 05/2010, Honors Thesis: Tracking Kinesin Stepping Using Quantum Dots.
- M. Kutys (Bioe), BS 05/2009, Honors Thesis: The Role of Tethered Diffusion in the Processive Stepping of Kinesin Molecular Motors. (Co-advised with J. Fricks, Statistics)
- V. Hariharan (Bioe), BS 05/2009, Honors Thesis: Insights into the Mechanical Properties Of the Kinesin Neck Linker Domain from Sequence Analysis and Molecular Dynamics Simulations. (Awarded Best Bioe Honors Thesis 2009).
- N. Bizzaro (Bioe), BS 12/2010, The Effects of Multiple Kinesin Motors on Cargo Transport Velocity.

## Teaching Overview

Hancock was hired in 2000 as part of the expansion of the Bioengineering Program and introduction of the new Bioengineering major at Penn State. He developed graduate and undergraduate cell and molecular bioengineering courses and a graduate laboratory, and since 2009 he has been responsible for the undergraduate systems analysis course and laboratory. He was the first Schreyers Honors advisor in the department, he developed and runs the senior thesis course every other year, and he sits as a reader on virtually every honors thesis in the department.

## Courses Developed and Taught

- Developed and taught Bioengineering 201, “Analysis of Molecules and Cells”. Biochemistry, molecular biology and molecular cell biology for Bioengineering majors, taught from a quantitative and physical perspective. Required for major. Taught yearly from 2003 - present.
- Developed and taught Bioengineering 512, “Cell and Molecular Bioengineering”. Graduate level cell and molecular biology course for engineers emphasizing molecular mechanisms. Required for MS and PhD. Taught yearly from 2001 – present.
- Developed and taught (with J. Zahn, P. Butler and C. Dong) Bioengineering 513: “Biomedical Techniques Laboratory”. Teaches graduate students fundamental experimental tools, quantitative analysis of biological process, and microscopic and subcellular investigation of cells and molecules. Taught yearly 2004-2009.
- Developed and taught Bioengineering 494H: “Senior Thesis”. Required course for honors students to conduct thesis research and submit thesis draft and present results at end of semester. Taught every other year since 2004.
- Taught Bioengineering 301: “Analysis of Physiological Systems”. Required Junior-level course covering circuits, systems analysis and frequency domain analysis with applications to biomedical devices and biological systems. Taught 2009 and 2010.
- Taught Bioengineering 302: “Physiological Simulation Laboratory”. Required Junior-level MatLab computer lab. Taught 2009 and 2010.

## Team Taught Courses and Selected Guest Lectures

Bioe 100S: Bioengineering Seminar

Bioe 403: Biomedical Instrumentation Lab  
Bioe 401: Intro to Bioengineering  
Bioe 494: Senior Thesis – supervised every other year since 2005  
Bioe 590: Bioengineering Colloquium  
Chem 12: Chemical Principles I  
Chem 13: Chemical Principles II  
Chem 597: Nanoscience

## **Professional Activities and Service**

### Bioengineering Departmental Duties

Bioengineering Department Schreyers Honors College Advisor, 2001- present  
Bioengineering Department Graduate Admissions Committee, 2000 - present  
Bioengineering Department Candidacy Exam Committee, 2000 - 2004  
    Led development of new exam format, Spring 2004  
    Chair of Candidacy Exam Committee – 2004 - present  
Bioengineering Department Promotion and Tenure Committee, 2006 - 2010  
Bioengineering Department Faculty Search Committee, 2006 - present  
Bioengineering Internal Curriculum Review Committee for ABET Accreditation, 2005  
Faculty Advisor, Biomedical Engineering Society Student Chapter, 2001 - 2003

### College of Engineering Duties

Engineering Faculty Council, 2001- 2004  
Graduate Studies and Research Committee (Chairman 2002 - 2004), 2001- 2004  
Teaching Life Sciences in the COE Study Group, 2000 – 2002  
Sabbatical Leave Committee, 2006 - 2009  
Strategic Planning Task Force on Health Sciences and Medicine, 2007  
College of Engineering Computer Use Committee, 2009 - present  
Search Committee, Synthetic Biology Position, Department of Agricultural and Biological Engineering, 2007-2009  
Faculty Search Committee (2 Nanobiotechnology positions), Engineering Science and Mechanics Department, 02/02 – 2005  
Bioengineering Department Head Search Committee, 2010-2011

### University Level Duties

Huck Institute for Life Sciences Steering Committee, 2001- present  
Nanomedicine Study Group (Hershey College of Medicine), 2007  
Molecular Motors Thrust Leader and Member of Executive Council, Penn State Center for Nanoscale Science, 2002- present  
External Review Panel, Huck Institute for Life Sciences, Integrative Biosciences Graduate Degree Program Options, 2005

### Minority and K-12 Outreach Activities

Research Advisor, Women in Science and Engineering (WISE) Program, 2002, 2003

Supervised High School Science Teacher/Science Museum Display Developer for 5 weeks in the lab (NSF:MRSEC RET Program), 2004.

Research Lectures for High School Science Teachers, 2003-2006

### **Editorial Positions**

Board of Associate Editors, *Cellular and Molecular Bioengineering*, 2008 - present

Associate Editor, *Cellular and Molecular Bioengineering*, Special Issue: Cytoskeleton, Cell Adhesion, and Motility, 2009

Associate Editor, *IEEE Transactions on Advanced Packaging*, Special Issue on Biological Applications, 2005

### **Peer Review for Scientific Journals**

ACS Nano, ACS Chemical Biology, Advanced Materials, BBA Bioenergetics, Biochemistry, Bioelectromagnetics, Biophysical Journal, Biotechnology and Bioengineering, Cellular and Molecular Bioengineering, Current Biology, FEBS Letters, IEEE Transactions on Nanotechnology, Journal of the American Chemical Society, Journal of Biological Chemistry, Journal of Biomedical Engineering, Journal of Molecular Biology, Lab on a Chip, Langmuir, Microfluidics and Nanofluidics, Molecular Cell, NanoLetters, Nanotechnology, Physical Review E, Phys. Chem. Chem. Phys., PLoS One, PNAS, Science, Small

### **Professional Conference Session Organizer and Chairmanship**

Session Organizer and Chair: "Molecular Biomechanics," *Biomedical Engineering Society Annual Meeting*, Durham, NC, 2001.

Session Organizer and Chair: "Nanoscale Biological Systems," *Penn State Life Science Consortium Biomolecular Transport Dynamics Symposium*, University Park, PA, 2002.

Session Chair: "System and Device Concepts Based on Bio-Motors," and "Fundamentals of Bio-Motors, Integration with Synthetic Engineered Materials and Novel Interfaces to Control Bio-Motor Properties and Performance," *DARPA Biomolecular Motors Meeting*, San Francisco, CA, 2003.

Session Organizer and Chair: "Molecular Motors and Mechanics of the Cytoskeleton," *Biomedical Engineering Society Annual Meeting*, Baltimore, MD, October, 2005.

Session Chair: "Molecular Motors" and "Mechanobiology of the Cytoskeleton", *Biomedical Engineering Society Annual Meeting*, Chicago, IL, October 11-14, 2006.

Session Chair: "Nanoscale Tuning of Cell Microenvironment," *Biomedical Engineering Society Annual Meeting*, St. Louis, MO, 2008.

Session Chair: "Cell Mechanics", *Biomedical Engineering Society Annual Meeting*, Austin, TX, 2010.

Organizer and Chair, Motility Subgroup. *Biophysical Society Annual Meeting*, San Diego, CA, 2012.

### **Grant Reviewing**

NSF site visit panel for Nanoscale Science and Engineering Center (NSEC) Grants, Arlington, VA – 2004

NSF site visit panel for Cornell Nanobiotechnology Center (NBTC), Ithaca, NY – 2001, 2002, 2003

Netherlands Organization for Scientific Research – 2004

PSU MRSEC/MRI Seed Grant Program – 2003, 2004, 2005

Johnson and Johnson and the Pennsylvania State University Innovative Technology Research Seed Grant Awards – 2005

American Heart Association Grant Review Study Section – 2006, 2007, 2009

NSF Mathematical Biology Study Section – 2007

Army Research Office, Life Sciences Division – 2008

NIH Nanoscience in Medicine and Biology (NANO) Study Section – 2009

NSF Emerging Frontiers in Research and Innovation (EFRI) Program – 2009

Grace Woodward Grant Reviewer (PSU) – 2009

Biotechnology and Biological Sciences Research Council (UK) – 2009

NIH Challenge (ARRA) Grant Review – 2009

NSF MCB-Cellular systems (mail review) – 2010

NIH Special Emphasis Panel NIGMS – 2010

NIH Macromolecular Structure/Function B (MSFB) Study Section – 2011

### **Honors and Awards**

Muscular Dystrophy Association Postdoctoral Fellow, 1995-98

NIH Predoctoral Fellowship in Cardiovascular Bioengineering, 1993

Biophysical Society Travel Award, 1993

NIH Predoctoral Fellowship in Molecular Biophysics, 1992

### **Industry Activities**

Scientific Advisory Board, Molecmo, Inc. 2007-present

### **Society Membership**

Biophysical Society, 03/93 – present

American Society for Cell Biology, 12/00 – present

Biomedical Engineering Society, 10/01- present

### **Personal Information**

U.S. Citizen, married, two children (Freddy born 7/26/2000, Eliza born 4/18/2003).

Lead singer and guitarist, Allegheny Ridgerunners bluegrass band.