

**BIOGRAPHICAL SKETCH**

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NAME Wirtz, Denis	POSITION TITLE Professor of Chemical and Biomolecular Engineering		
eRA COMMONS USER NAME dwirtz1			
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	YEAR(s)	FIELD OF STUDY
Free University of Brussels, Belgium	Phys. Deg.	1983-1988	Physics Engineering
Stanford University, Stanford, CA	M.S.	1989	Chemical Engineering
Stanford University, Stanford, CA	Ph.D.	1993	Chemical Engineering
ESPCI, Paris, France	postdoc	1993-1994	Biophysics

**A. Personal Statement of Work****Statement**

Denis Wirtz earned a Physics Engineering degree at the Ecole Polytechnique of the Université Libre de Bruxelles (Belgium) in 1988. With a Hoover fellowship, he moved to Stanford University, where he earned a PhD in 1993 in Chemical Engineering for work in polymer physics. With a "Human Capital Mobility" fellowship of the European Union, he did postdoctoral research at the Ecole Supérieure de Physique et Chimie Industrielles (ESPCI) in Paris, France. He joined the faculty of the Department of Chemical and Biomolecular Engineering at Johns Hopkins University in 1994 and was promoted to the rank of full professor in 2003. He is currently T.H. Smoot Professor of Engineering Science. He is Associate Editor of the Biophysical Journal, Physical Biology, and Cell Adhesion and Migration and is Editor-in-Chief of Cell Health and the Cytoskeleton. He is co-Director of the Johns Hopkins Institute for NanoBioTechnology (INBT), Director of the HHMI-funded graduate training program in nanotechnology for biology and Medicine, Director of the NCI-funded postdoctoral training program in nanotechnology for cancer medicine, and Director of the new NCI-funded Engineering in Oncology Center, all at Johns Hopkins University. His research is currently supported by regular and center grants from NIH, NSF, and the American Heart Association.

Wirtz has made important contributions in molecular and biophysical mechanisms of cell motility and adhesion and nuclear dynamics in health and disease. He pioneered the method of particle-tracking microrheology to probe the rheological properties of complex fluids and living cells and tissues. Professor Wirtz is author and co-author of 125 peer-reviewed articles published in top journals including Science, Nature, Nature Cell Biology, Nature Methods, Nature Reviews Cancer, Nature Materials, Nature Protocols, PNAS, and Journal of Cell Biology. Nine of his students and postdoctoral fellows are in faculty positions at research universities. His work at Hopkins has been cited >5000 times and has an h-index of 40. He is regularly invited to give lectures at international conferences and gave the Schwartz Lectureship at Johns Hopkins University in 2009. He has also given numerous presentations at universities and research institutions around the world, including Stanford University, University of Texas, Berkeley, Yale, MIT, The Scripps Research Institute, the Ecole Federale Polytechnique de Lausanne in Switzerland, and Cambridge University in the UK. Wirtz was named fellow of the Institute for Medical and Biological Engineering in 2007, fellow of the American Association for the Advancement of Science (AAAS) in 2009, and fellow of the APS in 2010,

**B. Positions and Honors****Positions and Employment**

1994-2001	Assistant Professor, Department of Chemical Engineering, Johns Hopkins University
1997-2001	Assistant Professor, Department of Materials Science and Engineering, Johns Hopkins University
2001-2004	Associate Professor, Department of Materials Science and Engineering, Johns Hopkins University
2001-2004	Associate Professor, Department of Chemical Engineering, Johns Hopkins University
2004-present	Professor, Department of Chemical and Biomolecular Engineering, Johns Hopkins University

2008-present Professor, Department of Oncology, Johns Hopkins School of Medicine  
2009-present Theophilus H. Smoot Professor of Engineering Science, Johns Hopkins University

### **Other Experience and Professional Memberships**

1993-present Member American Physical Society; Member, American Institute of Chemical Engineers; Member, Biophysical Society; Member, American Society for Cell Biology; Member, American Society of Microbiology  
2005-present Co-Director of the Institute for NanoBioTechnology at Johns Hopkins University  
2005-present Director of the HHMI graduate training program in nanotechnology for medicine  
2010 Director of the NCI-funded Johns Hopkins Physical Sciences - Oncology Center

### **Honors**

1988-1989 Hoover Fellow, Belgian-American Educational Foundation (BAEF)  
1989 Claes Prize for best Engineering/Science Dissertation, Belgian Academy of Science  
1993-1994 Post-Doctoral "Mobility" Fellowship, European Union  
1996-2001 National Science Foundation, Career Award  
1997-2000 Whitaker Foundation, Biomedical Engineering Foundation Award  
2005 Elected Fellow, American Institute for Medical and Biological Engineering (AIMBE)  
2005-present Member Editorial Boards of *Biophysical Journal*, *Cell Adhesion and Migration* and *J. Nanomedicine*  
2008-present Editor-in-Chief, Cell Health and the Cytoskeleton  
2009 Elected Fellow, AAAS – Engineering section  
2010 Elected fellow, APS – Biological Physics section

### **C. Five most relevant publications (out of total of 125).**

- (126) D. Wirtz, K. Konstantopoulos, and P.C. Searson, "Physics of cancer: the role of mechanical forces in cancer metastasis", *Nature Reviews Cancer*, to appear
- (125) D.H. Kim and D. Wirtz, "Recapitulating cancer cell invasion *in vitro*", *Proceedings of the National Academy of Sciences* **108**: 6693-6694 (2011)
- (124) S.I. Fraley, C.M. Hale, R.J. Bloom, A. Celedon, J.S.H. Lee, and D. Wirtz, "Intra- and extracellular microrheology of endothelial cells in a 3D matrix", *Biophysical Regulation of Vascular Differentiation and Assembly; Biological and Medical Physics, Biomedical Engineering, Springer Verlag* (2011)
- (123) P.S. Raman, C.S. Alves, D. Wirtz, K. Konstantopoulos, "Single molecule binding of CD44 to fibrin versus P-selectin predicts their distinct shear-dependent interactions in cancer, *Journal of Cell Science* **124**: 1904-1910 (2011)
- (122) L.S.-L. Cheung, P.S. Raman, E.M. Balzer, D. Wirtz, and K. Konstantopoulos, "Biophysics of selectin-ligand interactions in inflammation and cancer", *Physical Biology* **8**: 015013 (2011)
- (121) S. I. Fraley, Y. Feng, D. Wirtz and G.D. Longmore, "Reply: reducing background fluorescence reveals adhesions in 3D matrices", *Nature Cell Biology* **13**: 5-7 (2011)
- (120) A. Celedon, D. Wirtz, and Sean X. Sun, "Torsional mechanics of DNA are regulated by small-molecule intercalation", *Journal of Physical Chemistry B* **114**: 16929-16935 (2010)
- (119) T.M. Dobrowsky and D. Wirtz, "Single-molecule analysis of cell-virus binding interactions", *Cell Signalling Reactions: Single-Molecular Kinetic Analysis, Springer Verlag*, 153-166 (2010)
- (118) B.R. Daniels, C.M. Hale, S.B. Khatau, S. Kusuma, T.M. Dobrowsky, S. Gerecht, and D. Wirtz, "The difference in microrheology between human induced pluripotent stem (iPS) cells and human embryonic stem (hES) cells", *Biophysical Journal* **99**: 3563-3570 (2010)
- (117) P. Mali, D. Wirtz, and P.C. Searson, "Interplay of RhoA and motility in the programmed spreading of daughter cells post mitosis", *Biophysical Journal* **99**: 3526-3534 (2010)
- (116) D. Wirtz and S.B. Khatau, "Bundles from boundaries", *Nature Materials* **9**: 788-790 (2010)
- (115) A. Dajkovic, S. Pichoff, J. Lutkenhaus, and D. Wirtz, "Cross-linking FtsZ polymers into coherent Z rings", *Molecular Microbiology* **78**, 651–668 (2010)

- (114) P.J. Stahl, N.H. Romano, D. Wirtz, and S.M. Yu, "PEG-based hydrogels with collagen mimetic peptide-mediated and tunable physical cross-links", *Biomacromolecules* **11**: 2336–2344 (2010).
- (113) B.R. Daniels, T.M. Dobrowsky, E.M. Perkins, S.X. Sun, and D. Wirtz, "MEX-5 enrichment in *C. elegans* early embryos mediated by differential diffusion", *Development* **137**: 2579-2585 (2010)
- (112) S. I. Fraley, Y. Feng, D.H. Kim, A. Celedon, G.D. Longmore, and D. Wirtz, "The distinctive role of focal adhesion proteins in three-dimensional cell motility", *Nature Cell Biology* **12**: 598-604 (2010)
- (111) T.M. Dobrowsky, B.R. Daniels, R.F. Siliciano, S.X. Sun, and D. Wirtz, "Organization of cellular receptors into a nanoscale junction during HIV-1 adhesion", *PLOS Computational Biology* **6**: e1000855 (2010)
- (110) B. Wildt, D. Wirtz\*, and P.C. Searson, "Triggering cell detachment from patterned electrode arrays by programmed subcellular release", *Nature Protocols* **5**: 1273-1280 (2010) (\*=corresponding author)
- (109) S.B. Khatau, D.H. Kim, C.M. Hale, and D. Wirtz, "The perinuclear actin cap in health and disease", *Nucleus* **1**: 337-342 (2010).
- (108) E. Esue, L. Ruppercht, D. Wirtz, "Dynamics of the bacterial intermediate filament crescentin *in vitro* and *in vivo*", *PLOS One* e8855 (2010)
- (107) S.B. Khatau, C.M. Hale, P.J. Stewart-Hutchinson, M.S. Patel, C.L. Stewart, P.C. Searson, D. Hodzic, and D. Wirtz, "A perinuclear actin cap regulates nuclear shape", *Proceedings of the National Academy of Sciences* **106**: 19017-19022 (2009)
- (106) C.M. Hale, S.X. Sun, and D. Wirtz, "Resolving the role of actomyosin contractility in cell microrheology", *PLOS One* e7054 (2009)
- (105) J.F. Galloway, J. Park, K.H. Lee, D. Wirtz, and P.C. Searson, "Exploiting nucleation and growth in the synthesis and electrical passivation of CdSe quantum dots", *Science of Advanced Materials* **1**: 93-100 (2009)
- (104) S. Bajpai, Y. Feng, R. Krishnamurthy, G.D. Longmore, and D. Wirtz, "Loss of a-catenin decreases the strength of single E-cadherin bonds between human cancer cells", *Journal of Biological Chemistry* **284**: 18252-18259 (2009)
- (103) D. Wirtz, "Particle tracking microrheology of living cells: principles and applications", *Annual Review of Biophysics* **38**: 301-326 (2009)
- (102) A. Celedon, I.M. Nodelman, B. Wildt, R. Dewan, P.C. Searson, D. Wirtz, G. D. Bowman, and S.X. Sun, "Single molecule torque measurements using nanorods in magnetic tweezers", *Nano Letters* **9**: 1720-1725 (2009)
- (101) B. Wildt, D. Wirtz\*, and P.C. Searson\*, "Programmed sub-cellular release for studying the dynamics of cell detachment", *Nature Methods* **6**: 211-213 (2009) (\*=corresponding author)
- (100) B.R. Daniels, E.M. Perkins, T.M. Dobrowsky, S.X. Sun, and D. Wirtz, "Asymmetric enrichment of PIE-1 in the *C. elegans* zygote is mediated by binary counter-diffusion", *Journal of Cell Biology* **184**: 473-479 (2009)
- (99) O. Esue, Y. Tseng, and D. Wirtz, "a-Actinin and filamin cooperatively enhance the stiffness of actin filament networks", *PLOS One* **4**: e4411 (2009).
- (98) S. K. Lai, Y. Wang, R. Cone, D. Wirtz, and J. Hanes, "Selectively altering mucus rheology to "solidify" human mucus at the nanoscale", *PLOS One* **4**: e4294 (2009)
- (97) G. Lan, B.R. Daniels, T.M. Dobrowsky, D. Wirtz, and Sean X. Sun, "Condensation of FtsZ filaments drives bacterial cell division", *Proceedings of the National Academy of Sciences* **106**: 121-126 (2009)
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- (95) M.S. Thompson and D. Wirtz, "Sensing cytoskeletal mechanics by ballistic intracellular nanorheology (BIN) coupled with cell transfection", *Methods in Cell Biology* **89**: 467-486 (2008)
- (94) T.M. Dobrowsky, P. Panorchan, K. Konstantopoulos, and D. Wirtz, "Live-cell single-molecule force spectroscopy", *Methods in Cell Biology* **89**: 411-432 (2008)
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- (82) P. Panorchan, J.S.H. Lee, T.P. Kole, Y. Tseng, and D. Wirtz, "Probing cell mechanics responses to stimuli using ballistic intracellular nanorheology", *Methods in Cell Biology* **83**: 113-140 (2007)
- (81) O. Esue, A.A. Carson, Y. Tseng, and D. Wirtz, "A direct interaction between actin and vimentin filaments mediated by the tail domain of vimentin", *Journal of Biological Chemistry* **281**: 30393-30399 (2006)
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- (78) P. Panorchan, J.P. George, and D. Wirtz, "Probing intercellular interactions between vascular endothelial cadherin pairs at single-molecule resolution and in living cells" *Journal of Molecular Biology* **358**: 665-674 (2006)
- (77) J. S.H. Lee, P. Panorchan, C.M. Hale, S.B. Khatau, Y. Tseng, and D. Wirtz, "Ballistic intracellular nanorheology reveals ROCK-hard stiffening response in to fluid flow", *Journal of Cell Science* **119**: 1760-1768 (2006)
- (76) O. Esue, D. Wirtz, and Y. Tseng, "GTPase activity, structure and mechanical properties of filaments assembled from bacterial cytoskeleton protein MreB", *Journal of Bacteriology* **188**: 968-976 (2006)
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- (73) E. Atilgan, D. Wirtz, and S. X. Sun, "Mechanics and dynamics of actin-driven thin protrusions", *Biophysical Journal* **90**: 65-76 (2006)
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- (67) S.L. Gupton, R.S. Fischer, T.P. Kole, A. Ponti, G. Danuser, S. E. Hitchcock-DeGregori, V.M. Fowler, D. Wirtz, D. Hanein, and C.M. Waterman-Storer, "Cell migration without a lamellipodium: Translation of actin dynamics into cell movement mediated by tropomyosin", *Journal of Cell Biology* **168**:619-631 (2005)
- (66) J.S.H. Lee, Y. Tseng, and D. Wirtz, "Cdc42 mediates nucleus movement and MTOC polarization in Swiss 3T3 fibroblasts under shear", *Molecular Biology of the Cell* **16**: 871-880 (2005)
- (65) O. Esue, M. Cordero, Y. Tseng, and D. Wirtz, "The assembly of MreB, a prokaryotic homolog of actin", *Journal of Biological Chemistry* **280**: 2628-2635 (2005)
- (64) T.P. Kole, Y. Tseng, J.L. Katz, and D. Wirtz, "Intracellular mechanics of migrating fibroblasts", *Molecular Biology of the Cell* **16**: 328-338 (2005)
- (63) T.P. Kole, Y. Tseng, and D. Wirtz, "Intracellular microrheology as a tool for the measurement of the local mechanical properties of live cells", *Methods in Cell Biology* **79**: 48-64 (2004)
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- (60) P. Panorchan, B. W. Schafer, D. Wirtz, and Y. Tseng, "Nuclear envelope breakdown requires overcoming the mechanical integrity of the nuclear lamina", *Journal of Biological Chemistry* **278**:43462-43467 (2004)
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- (54) S.R. Heidemann and D. Wirtz, "Towards a regional approach to cell mechanics", *Trends in Cell Biology* **14**: 160-166 (2004)
- (53) J. Suh, D. Wirtz\*, and J. Hanes\*, "Real-time intracellular transport phenomena of gene nanocarriers studied by multiple particle tracking", *Biotechnology Progress* **20**: 598-602 (2004)
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- (51) M. Dawson, D. Wirtz\*, and J. Hanes\*, "Enhanced viscoelasticity of human cystic fibrotic sputum correlates with increasing microheterogeneity in particle transport", *Journal of Biological Chemistry* **278**: 50393-50401 (2003) (\*=corresponding authors)
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- (48) S. Yamada, D. Wirtz\*, and P.A. Coulombe\*, "The mechanical properties of simple epithelial keratin 8 and 18: Discriminating between interfacial and bulk elasticities", *Journal of Structural Biology* **143**: 45-55 (2003) (\*=corresponding authors)
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