

Henry Hess

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Research Interests My primary research interest is nanobiotechnology, in particular hybrid nanodevices and materials merging biological and synthetic building blocks. Creative approaches to the design of such devices draw from chemistry, biotechnology, microfabrication, biology, and engineering.

Education **Technical University Clausthal** Clausthal, Germany
Prediploma in Physics, Minor in Chemistry, February 1993.

Technical University Berlin Berlin, Germany
Diploma (M.Sc.), Department of Physics, March 1996.
Thesis: Fragmentation and Condensation Dynamics of Clusters and Small Aggregates.

Free University Berlin Berlin, Germany
Ph.D. Institute for Experimental Physics, Summa Cum Laude, December 1999.
Thesis: Femtosecond Spectroscopy of Cold Metal Clusters.

Awards 6. Place in German High School Physics Competition (1991),
High School Honors Program at the Brookhaven National Lab (1991),
Scholarship from the “Deutsche Studienstiftung” (1991-93),
Erwin-Stephan-Award of the Technical University Berlin for outstanding graduates (1996),
Wolfgang-Paul-Award of the German Society for Mass Spectrometry for best PhD thesis (2000),
Feodor Lynen postdoctoral fellowship of the A. von Humboldt foundation (2000, renewed 2001)
Philip Morris Forschungspreis (together with Viola Vogel, 2005)
Distinguished Mentor Award of the UF/HHMI “Science for Life” program (2007)
Invitation to the National Academy Keck Futures Initiative “Synthetic Biology” (2009)
Invited Speaker, US National Academy of Engineering Frontiers of Engineering Meeting (2010)
Distinguished Faculty Lecturer, 11th International Summer School on Biocomplexity from Gene to Systems, Istanbul, Turkey (2012) and 13th International Summer School on Biocomplexity from Gene to Systems, Istanbul, Turkey (2014)

Research Experience **Technical University Berlin, Institute for Bionics** Berlin, Germany
Undergraduate researcher. Advisor: Rudolf Bannasch (May – July ‘94)
The flow dynamics around penguins was measured using wind channels and fall tubes.

Technical University Berlin, Dep. of Physics Berlin, Germany
Diploma thesis research. Advisor: Adalbert Ding (August 1994 – March 1996)
The fragmentation behavior of Fullerenes (C_{60}) was studied at the BESSY II Synchrotron.
Absorption of deep UV light led to ejection of C_2 fragments from the Fullerene cage.

Research Experience (continued)	<p>Free University Berlin, Institute for Experimental Physics Berlin, Germany Graduate student. Advisor: Ludger Wöste (April 1996 – December 1999) Femtosecond laser pulses were used to observe and control chemical reactions of metal clusters in real time in a cooled RF-ion trap. An amplified fs-laser system with frequency conversion was installed, and a temperature controlled ion trap (20 K – 400 K) designed and integrated into a triple-quadrupole mass spectrometer. The importance of temperature for coherent control of chemical reactions was studied and insight into internal vibrational energy redistribution processes in Ag clusters gained.</p> <p>University of Washington, Dep. of Chemistry Seattle, WA Visiting scholar. Host: Adi Scheidemann (11/94 – 2/95, 6/95 – 12/95, 7/96 - 8/96, 2/98 – 3/98) A new method for soft ionization of large molecules was studied. Electron-impact ionization of molecules inside helium clusters showed reduced fragmentation in mass spectra. The dependence of the pick-up efficiency of the helium clusters on the properties of the molecule was mapped. A miniaturized mass spectrometer was invented.</p> <p>University of Washington, Dep. of Bioengineering Seattle, WA Postdoc. Mentor: Viola Vogel (February 2000 – February 2002) Development of “Molecular Shuttles”, a Nanoscale transport system based on the motor protein kinesin capable of moving single molecules. Soft lithography, atomic force microscopy and optical microscopy are used to pattern and study surfaces.</p> <p>University of Washington, Dep. of Bioengineering Seattle, WA Research Assistant Professor (March 2002 – July 2005) My research is focused on hybrid materials and devices which integrate motor proteins. Motor proteins, serving as unique nanomotors of high efficiency and functionality, can endow materials with the ability to adapt on the molecular scale and can be used to design novel devices for surface imaging or force measurements.</p> <p>University of Florida, Dep. of Materials Science and Engineering Gainesville, FL Assistant Professor (August 2005 – June 2009) Affiliate Assistant Professor, Dep. of Bioengineering, U. of Washington (2005 – 2013) My group was focused on the engineering applications of molecular motors in nanodevices and materials.</p> <p>Columbia University, Dep. of Biomedical Engineering New York, NY Associate Professor (since July 2009) My group focuses on engineering at the molecular scale, in particular the design of active nanosystems incorporating biomolecular motors, the study of active self-assembly, and the investigation of protein-resistant polymer coatings.</p>
Teaching Experience	<p>Technical University Berlin, Dep. of Mathematics Berlin, Germany 4 week intensive preparatory course for freshmen. Teaching Assistant. (September 1994)</p> <p>Free University Berlin, Institute for Experimental Physics Berlin, Germany Physics lab for medical students. Teaching Assistant. (September 1998 - March 1999) Mentoring two students in their diploma thesis research. (10/96 – 4/98, 6/98 -1/00)</p> <p>University of Washington, Department of Bioengineering Seattle, WA Advised four undergraduate students (Jeffrey Edwards, Robert Tucker, James Wang, Ryan Launtz, Brooke Ferguson) during research projects supported by the NASA space grant, the Mary Gates foundation and other sources.</p> <p>Contributed lectures to BIOEN 583 “Frontiers in Nanotechnology (Spring 2002, 2003, 2004), BIOEN 510 “Introduction to Bioengineering (Fall 2002, 2003), BIOEN 299 “Bioengineering</p>

Teaching
Experience
(continued)

Seminar” (Fall 2002, 2003, Spring 2004) and BIOEN 357 “Introduction to Molecular Bioengineering” (Winter 2003, Spring 2004),

Member of the Student Affairs Committee 2004/2005, Department of Bioengineering, UW

University of Florida, Department of Materials Science and Engineering Gainesville, FL
Developed and taught a graduate level course “EMA 6938 - Molecular Motors for Nanodevices and Materials: Principles, System Integration, Applications” (3 credits, Spring semester 2006, above average student evaluations – 4.1 out of 5 vs. department avg. of 3.9)

Taught undergraduate course “EMA 4161C – Physical Properties of Polymers” (4 credits including lab component; Fall semester 2006, average of student evaluations 4.3 out of 5; Fall semester 2007, above average student evaluations – 4.5 out of 5 vs. department avg. of 4.17; Fall semester 2008, above average student evaluations – 5 out of 5 vs. department avg. of 4.17)

Developed and taught a graduate level course “EMA6938 – Bionanotechnology” (3 credits, Spring Semester 2007, above average student evaluations – 4.7 out of 5 vs. department avg. of 4.3)

Taught graduate level course “EMA6580 – Science of Biomaterials” (3 credits, Spring Semester 2008, student evaluations 4.0 out of 5 vs. department avg. of 4.3)

Developed and taught a graduate level course “EMA6938 – Self-Assembly” (3 credits, Spring Semester 2009, above average student evaluations – 4.75 out of 5 vs. department avg. of 4.41)

Member of 20 PhD committees (chair of 8)

Member of the 2006/07 faculty search committee and the 2007/08 student quality improvement committee

Participated in the National Effective Teaching Institute, Pittsburgh, PA, June 19-21, 2008

PhD students graduated: Robert Tucker (2009), Parag Katira (2009), Ashutosh Agarwal (2009), Yolaine Jeune-Smith (2010), In-kook Jun (2010)

Columbia University, Department of Biomedical Engineering New York, NY

Taught undergraduate/graduate course “BMEN E4501 – Tissue Engineering I”

(3 points; Fall semester 2009, 61 students, student evaluations – 3.67 out of 5;

Fall semester 2010, 45 students, student evaluations – 4.00 out of 5

Fall semester 2011, 37 students, student evaluations – 3.70 out of 5

Fall semester 2012, 44 students, student evaluations – 3.15 out of 5,

Fall semester 2013, 47 students, student evaluations – 4.21 out of 5

Fall semester 2014, 42 students, student evaluations – 4.05 out of 5

Fall semester 2015, 53 students, student evaluations - 3.65 out of 5)

Graduate course “BMEN8001 – Current Topics in Nanobiotechnology and Synthetic Biology”

(3 points; Spring semester 2012, 13 students, student evaluations – 4.64 out of 5;

Spring semester 2013, 13 students)

Organized BMEN E9700 Biomedical Engineering Seminar course in Fall 2012, Spring 2013, Fall

2013, Spring 2014, Fall 2014, Spring 2015 (38, 34, 33, 30, 49, 48 students enrolled, respectively)

2009/10 Co-chair of graduate committee

2010/11 Co-chair of graduate studies committee, Secretary of Department, Member of administrative committee

2011/12 Secretary of Department, Member of graduate studies committee

2012/13 Secretary of Department, Member of graduate studies committee

2013/14 Chair of colloquium series committee, Member of graduate studies committee, Member of Faculty Search Committee

2014/15 Chair of colloquium series committee, Member of graduate studies committee,

2014/15 Member of administrative committee, Member of Faculty Search Committee
Member of graduate studies committee, Member of administrative committee,
Member of Faculty Search Committee

PhD students graduated: Emmanuel Dumont (2013), Ofer Idan (2014), Amy Lam (2015)

Professional
Activities

Member:

German Physical Society
Alexander von Humboldt Association of America
Materials Research Society
American Chemical Society
Biomedical Engineering Society
American Society for Mechanical Engineering
Institute for Electrical and Electronics Engineers

Reviewer:

Science, PNAS, Chemical Review, Nature Materials, Nano Letters,
JACS, ACS Nano, Advanced Materials, Advanced Functional Materials,
Analytical Chemistry, Langmuir, Nature Nanotechnology, Biophysical
Journal, Lab on a Chip, Journal of Physical Chemistry, Chemical
Communications, Chemistry – A European Journal, ChemPhysChem,
Soft Matter, Small, Macromolecular Rapid Communications, The
Analyst, Journal of Nanotechnology, Journal of Nanoscience and
Nanotechnology, IEEE Transactions on Advanced Packaging, Trends in
Microbiology, New Journal of Physics, Australian Journal of Chemistry,
Journal of Colloid and Interface Science, Nanomedicine, The Anatomical
Record, Journal of Materials Research, and others

Human Frontiers Science Program,
Netherlands Organization for Scientific Research,
Los Alamos National Laboratory LDRD, Petroleum Research Fund,
US Civilian Research & Development Foundation,
DOE Office of Basic Energy Sciences, Swiss National Fonds,
Science Foundation Ireland
City University of New York Internal Research Awards Program
Marsden Fund of New Zealand, Army Research Office

Panel reviewer, 10 NSF Panels and Site Reviews (2007 – now)

Member of International Steering Committee for the Project “Bio-
inspired Logistics” of the Daimler-Benz-Foundation (2007–2009)

Member of Reviewers Committee, DOE Center for Integrated
Nanotechnologies, 5/2010 - now

Organizer:

Symposium M “Developing Nano-Bio Interfaces”, MRS Spring Meeting
2005, San Francisco, CA (together with George Bachand, SNL, and
Andrew Shreve, LANL)

Symposium FF “Molecular Motors, Nanomachines and Active
Nanostructures”, MRS Spring meeting 2008, San Francisco, CA (together
with Andrew Turberfield, Amar Flood and Heiner Linke), Editor –
Symposium FF proceedings

International Workshop on Micro- and Nanomachines, July 2-5, 2014,
Hannover, Germany (together with Samuel Sanchez and Walter Paxton)

Symposium L: Bioinspired Micro- and Nano-Machines and Devices—Challenges and Perspectives”, MRS Spring Meeting 2015, San Francisco, CA (together with Samuel Sanchez and Walter Paxton)

General Chair (together with Jun Suzuki, U. Mass., and Tadashi Nakano, U. Osaka) of 9th EAI International Conference on Bio-inspired Information and Communications Technologies (BICT) 2015, New York, NY, December 3-5, 2015

Symposium Chemical and Biological Nanomotors 2016, June 29 – July 1, 2016, Hannover, Germany (together with Peer Fischer, Samuel Sanchez and Walter Paxton)

Member of the Technical Program Committee:

Bionetics 2006, Cavalese, Italy, December 11-13, 2006

Bionetics 2007, Budapest, Hungary, December 10-12, 2007

Photonics West 2008, MEMS/MOEMS Components and Their Applications V Special Focus Topics: Transducers at the Micro-Nano Interface, San Jose, CA, January 19-24, 2008

Bionetics 2008, Hyogo, Japan, November 25-28, 2008

Bionetics 2010, Boston, MA, December 1-3, 2010

Bionetics 2011, York, England, December 5-7, 2011

BICT 2014, Boston, MA, December 1-3, 2014

Photonics West 2016, BIOS Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XII, San Francisco, CA, February 16-18, 2016

Editorial service: Member of Steering Committee, IEEE Transactions on Nanobioscience (2009 – 2011)
Associate Editor, Journal of Nanotechnology in Engineering and Medicine (2009-2013)
Guest Editor (together with Luc Jaeger), Nanobiotechnology issue of Current Opinion in Biotechnology (2010)
Member of External Advisory Board of Nano Letters (2010 – now)
Member of Editorial Board of Applied Physics Reviews (2010 – 2013)
Editor-in-Chief, IEEE Transactions on NanoBioscience (2014 – now)

Consultant: Intelligent Ion Inc., Seattle, WA (2001 – 2003)

Research Funding

“Active Assembly of Nanomaterials using Motor Proteins”, PI: V. Vogel/ H. Hess, DOE – Office of Basic Energy Sciences, DE-FG03-03ER46024, 2/1/2003 – 1/31/2005, \$320,000 total cost.
Role: Investigator (Principal Investigator responsibilities 6/10/04 – 1/31/05)

“Developing a biomolecular motor-powered device for detecting biological agents”, Subcontract of a DARPA contract to Sandia National Laboratory, 3/15/2004 – 6/31/2005, \$567,000 total cost.
Role: Principal Investigator

“2005 Materials Research Society Spring Meeting Symposium M: Developing Nano-Bio Interfaces”, AFOSR, April 2005, \$5,000 total cost. Role: Organizer for Symposium Finances

Research
Funding
(continued)

“2005 Materials Research Society Spring Meeting Symposium M: Developing Nano-Bio Interfaces”, Cytoskeleton Inc., April 2005, \$5,000 total cost. Role: Organizer for Symposium Finances

“Active Transport of Nanomaterials using Motor Proteins”, DOE – Office of Basic Energy Sciences, DE-FG02-05ER46193, PI: Henry Hess, 02/01/05-07/31/05, \$80,000 total cost

“Developing a biomolecular motor-powered device for detection of biological agents”, PI: H. Hess, DARPA Defense Science Office (FA9550-05-1-0274), 4/15/2005 – 12/31/2005, \$295,000 total cost

“Fueling and stabilizing a biomolecular motor-powered biosensor for remote detection scenarios”, PI: H. Hess, DARPA Defense Science Office/AFOSR (FA9550-5-1-0366), 8/1/2005 – 7/31/2007, \$425,000 total cost

“CAREER:Creating materials via active self-assembly driven by biomolecular motors”, PI: Henry Hess, NSF-DMR (0645023/1063771), 8/1/2007 – 7/31/2013, \$385,000 total cost

“Center for Sensor Materials and Technologies”, PI: David Norton, Office of Naval Research, 6/1/07 – 5/31/07, Role: co-PI, \$100,000 total cost of Hess portion

“Towards Molecular Engines: Cooperative Coupling of Molecular Motors in Engineered Environments”, PI: Henry Hess, Volkswagen Foundation VWF I/84 438, 7/1/09 – 6/31/12, ~\$250,000 (Euro 183,000) total cost

"Accelerated Degradation of Active Nanosystems by Biomolecular Motors", PI: Henry Hess, NSF-ENG (0926790), 9/1/2009 – 8/31/2014, \$330,000 total cost, REU supplement - \$10,000 (2014)

“Improving Sensing with Tethered Capture and Surface Diffusion”, PI: Henry Hess, Defense Threat Reduction Agency (HDTRA 1-12-1-0037), 6/1/12 – 5/31/2016, \$545,183

“Measurement of velocity fluctuations to infer attachment geometry and interactions of mechanically coupled molecular motors in one-dimensional arrays”, PI: Henry Hess, Army Research Office (W911NF-12-1-0384), 7/1/2012 – 3/31/2013, \$50,000 total cost

“Medical Advances from Nano-enabled Analytics”, PI: Henry Hess, Raymond and Beverly Sackler Program at the Interfaces of Biophysical and Medical Sciences, 7/1/2013 – 6/30/2014, \$60,000

“Information Engines: Nanoscale Control, Computing, and Communication Out of Equilibrium”, PI: J.P. Crutchfield, co-PIs: G.E. Crooks, M.R. DeWeese, H. Hess, C. Jarzynski, P.S. Krishnaprasad, Army Research Office W911NF-13-1-0390, 2013 MURI competition, 5 years, 6 M\$ total cost, 9/1/2013 – 8/31/2018 (Hess portion: \$1,250,000)

“Transport processes on enzyme scaffolds”, PI: Henry Hess, co-PI: Jose Blanchet, Defense Threat Reduction Agency (HDTRA 1-14-1-0051), 7/22/2014 – 7/21/2016, \$294,576 total cost (Hess portion: \$229,667)

“Fluorescence microscope for the observation of biological nanomachines”, PI: H. Hess, Army Research Office W911NF-14-1-0515, 8/1/2014-7/31/2015, \$100,000 total cost

“IEEE Transactions on NanoBioscience Editorial Services Agreement”, PI: H. Hess, The Institute of Electrical and Electronics Engineers, Incorporated (IEEE), 1/1/2014 – 12/31/2016, \$75,000 total cost

“Symposium Chemical and biological nanomotors 2016”, PI: S. Sanchez-Ordonez, co-PIs: H. Hess, W. Paxton, P. Fischer, Volkswagen Foundation, 6/29-7/1/2016, Euro 60,600 total cost

total external support: >4 M\$

- Publications
(* indicates
corresponding
author)
1. A. Scheidemann*, V. Kresin, and **H. Hess**: “Capture of lithium by ^4He clusters“, *J. Chem. Phys.* **107**, 2839-2844 (1997)
 2. **H. Hess**, D. S. Larsen, A. A. Scheidemann*: “Measurement of pick-up cross-sections of 4He clusters: polar versus non-polar molecules“, *Phil. Mag. B*, **79**, 1437-1444 (1999)
 3. **H. Hess**, S. Kwiet, L. Socaciu, S. Wolf, T. Leisner, and L. Wöste*: “The influence of the anion vibrational temperature on the fs-dynamics in a NeNePo experiment“, *Appl. Phys. B*, **B 71**, 337-41 (2000)
 4. **H. Hess**, K.R. Asmis, T. Leisner, and L. Wöste*: “Vibrational wave packet dynamics in the silver tetramer probed by charge-reversal femtosecond pump-probe spectroscopy“, *Eur. Phys. J. D*, **16**, 145-149 (2001)
 5. **H. Hess**, J. Clemmens, D. Qin, J. Howard, and V. Vogel*: “Light-Controlled Molecular Shuttles Made from Motor Proteins Carrying Cargo on Engineered Surfaces“, *Nano Letters*, **1** (5), 235-239 (2001)
 6. **H. Hess*** and V. Vogel: “Molecular shuttles based on motor proteins: Active transport in synthetic environments“, *Reviews in Molecular Biotechnology*, **82**, 67-85 (2001)
 7. **H. Hess**, J. Clemmens, J. Howard, and V. Vogel*: “Self-propelled nanoscale probes for surface imaging“, *Nano Letters*, **2** (2), 113-116 (2002)
 8. **H. Hess***, J. Clemmens, C. M. Matzke, G. D. Bachand, B. C. Bunker, and V. Vogel: “Ratchet patterns guide molecular shuttles“, *Appl. Phys. A*, **A 75**, 309-313 (2002)
 9. **H. Hess***, J. Howard, and V. Vogel: “A piconewton forcemeter assembled from kinesins and microtubules“, *Nano Letters*, **2**(10), 1113-5 (2002)
 10. J. Clemmens, **H. Hess**, J. Howard, V. Vogel*, "Analysis of microtubule guidance by microfabricated channels coated with kinesin", *Langmuir*, **19**, 1738-1744 (2003)
 11. J. Clemmens, **H. Hess**, R. Lipscomb, Y. Hanein, K. Böhringer, C. Matzke, G. Bachand, B. Bunker, V. Vogel*: “Mechanisms of Microtubule Guiding on Microfabricated Kinesin-coated Surfaces: Chemical and Topographic Surface Patterns“, *Langmuir*, **19**, 10967-10974 (2003)
 12. **H. Hess***, M. Antia, and V. Vogel: “Integrating dual-color imaging capability into a monochromator“, *Review of Scientific Instruments*, **75**(1), 266-269 (2004)
 13. **H. Hess***, C. Matzke, R. Doot, J. Clemmens, G. Bachand, B. Bunker, and V. Vogel:” Molecular shuttles operating undercover: A new photolithographic approach for the fabrication of structured surfaces supporting directed motility“, *Nano Letters*, **3**, 1651-1655 (2003)
 14. **H. Hess***, G. D. Bachand, and V. Vogel: “Powering nanodevices with biomolecular motors“, *Chemistry – A European Journal*, **10**(9), 2110-2116 (2004)
 15. J. Clemmens, **H. Hess**, R. Doot, C. M. Matzke, G. D. Bachand, V. Vogel*: “Motor-protein “roundabouts”: Microtubules moving on kinesin-coated tracks through engineered networks“, *Lab on a Chip*, **4**(2), 83-86 (2004)
 16. C. Brunner, K.-H. Ernst, **H. Hess***, V. Vogel: “Lifetime of biomolecules in polymer-based hybrid nanodevices“, *Journal of Nanotechnology*, **15**(10), S540-S548 (2004)

- Publications (continued)
17. **H. Hess***, J. Clemmens, C. Brunner, R. Doot, S. Luna, K.-H. Ernst and V. Vogel*: Molecular self-assembly of “Nanowires” and “Nanospools” using active transport”, *Nano Letters*, **5(4)**, 629-633 (2005)
 18. D. Wu, R. Tucker, **H. Hess***: „Caged ATP – Fuel for Bionanodevices“, *IEEE Transactions in Advanced Packaging*, **28(4)**, 594-599 (2005)
 19. T.Nitta and **H. Hess***: “Dispersion in active transport by kinesin-powered molecular shuttles”, *Nano Letters*, **5(7)**, 1337-1342 (2005)
 20. S. Ramachandran, K-H. Ernst, G. D. Bachand, V. Vogel, **H. Hess***: „Selective loading of kinesin-powered molecular shuttles with protein cargo and its application to biosensing”, *Small* **2(3)**, 330-334 (2006) COVER
 21. G.D. Bachand*, S.B. Rivera, A. Carroll-Portillo, **H. Hess**, and M. Bachand: “Active capture and transport of virus particles using a biomolecular motor-driven, nanoscale antibody sandwich assay”, *Small* **2(3)**, 381-385 (2006)
 22. **H. Hess*** and G.D. Bachand*: “Biomolecular Motors”, *Materials Today (NanoToday supplement)* **8(12) suppl. 1**, 22-29 (2005), invited feature article
 23. **H. Hess***: “Biomolecular motor-powered devices”, *Science* **312**, 861 (2006), invited perspective
 24. **H. Hess***: “Self-assembly driven by biomolecular motors”, *Soft Matter*, **2**, 669 – 677 (2006)
 25. T. Nitta*, A. Tanahashi, M. Hirano, **H. Hess***: “Simulating molecular shuttle movements: Towards computer-aided design of nanoscale transport systems”, *Lab on a Chip* **6(7)**, 881-885 (2006)
 26. J. Kerssemakers, J. Howard, **H. Hess**, S. Diez*: “The distance that kinesin holds its cargo from the microtubule surface measured by fluorescence-interference-contrast microscopy”, *PNAS* **103**, 15812-15817 (2006)
 27. R. Seetharam, Y. Wada, S. Ramachandran, **H. Hess**, P. Satir*: “Long-term storage of bionanodevices by freezing and lyophilization”, *Lab on a Chip*, **6**, 1239-1242 (2006)
 28. R.K. Doot, **H. Hess***, V. Vogel*: “Engineered Networks of Oriented Microtubule Filaments for Directed Cargo Transport”, *Soft Matter* **2007**, **3**, 349-356 (selected as Hot Paper, inside cover)
 29. T. Fischer, **H. Hess***: “Materials chemistry challenges in the design of hybrid bionanodevices: Supporting protein function within artificial environments”, *J. Mater. Chem.*, **17**, 943 – 951 (2007)
 30. P. Katira, A. Agarwal, T. Fischer, H.-Y. Chen, X. Jiang, J. Lahann, **H. Hess***: “Quantifying the performance of protein-resisting surfaces at ultra-low protein coverages using kinesin motor proteins as probes”, *Advanced Materials*, **19**, 3171-3176 (2007)
 31. **H. Hess*** and Y. Tseng*: “Active Intracellular Transport of Nanoparticles: Opportunity or Threat?”, *ACS Nano*, **1**, **5**, 390 – 392 (2007)
 32. R. Tucker, P. Katira, **H. Hess***: “Herding nanotransporters: Localized activation via release and sequestration of control molecules”, *Nano Letters*, **8(1)**, 221-226 (2008) – highlighted in *Nature Materials* **7**, 95 (2008)
 33. T. Nitta*, A. Tanahashi, Y. Obara, M. Hirano, M. Razumova, M. Regnier, **H. Hess***: “Comparing Guiding Track Requirements for Myosin- And Kinesin-Powered Molecular Shuttles”, *Nano Letters* **8**, 2305 - 2309 (2008)

Publications
(continued)

34. P. Katira, A. Agarwal, **H. Hess***: “A random sequential adsorption model for protein adsorption to surfaces functionalized with poly(ethylene oxide)”, *Advanced Materials* 21, 1599-1604 (2009)
35. R. Tucker, A.K. Saha, P. Katira, M. Bachand, G.D. Bachand, and **H. Hess***: “Temperature-compensation for hybrid devices: Kinesin’s K_m is temperature-independent”, *Small* 5(11), 1279-1282 (2009)
36. I. Finger, S. Phillips, E. Mobley, R. Tucker and **H. Hess***: “Absolute brightness of fluorescent microspheres”, *Lab on Chip*, 9, 476 – 478 (2009)
37. T. Fischer, A. Agarwal and **H. Hess***: “A smart dust biosensor powered by kinesin motors”, *Nature Nanotechnology*, 4, 162-166 (2009)
38. A. Agarwal, P. Katira and **Henry Hess***: “Millisecond Curing Time of a Molecular Adhesive Causes Velocity-Dependent Cargo-Loading of Molecular Shuttles”, *Nano Letters*, 9(3), 1170-1175 (2009)
39. J. Kerssemakers, L. Ionov, U. Queitsch, S. Luna, **H. Hess** and S. Diez*: “3D-Nanometer Tracking of Motile Microtubules on Engineered Surfaces”, *Small*, 5(15), 1732-1737 (2009)
40. G. D. Bachand, **H. Hess***, B. Ratna, P. Satir and V. Vogel: “Smart dust biosensors powered by biomolecular motors”, *Lab on a Chip*, 9(12), 1661-1666 (2009)
41. A. Agarwal, **H. Hess***: “Molecular motors as components of future medical devices and engineered materials”, *Journal of Nanotechnology in Engineering and Medicine*, 1(1), 011005 – 9 pages (2010)
42. A. Agarwal and **H. Hess***: “Biomolecular motors at the intersection of nanotechnology and polymer science”, *Progress in Polymer Science*, 35, 252-277 (2010)
43. Y. Jeune-Smith and **H. Hess***: “The length distribution of microtubules polymerized *in vitro* is a generalized Schulz distribution”, *Soft Matter*, 6(8), 1778-1784 (2010)
44. P. Katira and **H. Hess***: “Two-stage capture employing active transport enables sensitive and fast biosensors”, *Nano Letters*, 10, 567-572 (2010)
45. L.T. Sexton, H. Mukaibo, P. Katira, **H. Hess**, S.A. Sherrill, L.P. Horne, and C.R. Martin*: “An Adsorption-Based Model for Pulse Duration in Resistive-Pulse Protein Sensing”, *Journal of the American Chemical Society*, 132(19), 6755-6763 (2010)
46. P.H. Wu, A. Agarwal, **H. Hess**, P.P. Khargonekar, and Y. Tseng*: “Analysis of Video-Based Microscopic Particle Trajectories Using Kalman Filtering”, *Biophysical Journal*, 98, 2822-2830 (2010)
47. I.K. Jun and **H. Hess***: “A biomimetic, self-pumping membrane”, *Advanced Materials*, 22, 4823-4825 (2010)
48. I. Luria, J. Crenshaw, M. Downs, A. Agarwal, S. Banavara Seshadri, J. Gonzales, O. Idan, J. Kamcev, P. Katira, S. Pandey, T. Nitta, S.R. Phillpot and **H. Hess***: “Microtubule nanospool formation by active self-assembly is not initiated by thermal activation”, *Soft Matter*, 7(7), 3108-3115 (2011)
49. J.D. Crenshaw, T. Liang, **H. Hess** and S.R. Phillpot*: “A Cellular Automaton Approach to the Simulation of Active Self-assembly of Kinesin-powered Molecular Shuttles”, *Journal of Computational and Theoretical Nanoscience*, 8(10), 1999-2005 (2011)

Publications
(continued)

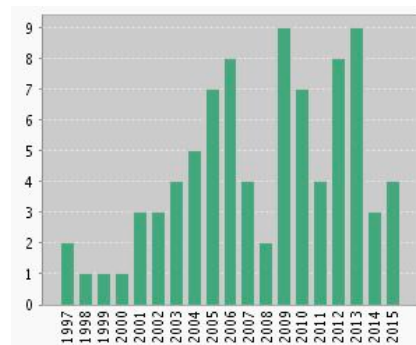
50. **H. Hess*** and E.L.P. Dumont: “Fatigue failure and molecular machine design”, *Small*, 7(12), 1619-1623 (2011)
51. **H. Hess***: “Engineering applications of biomolecular motors”, *Annual Review of Biomedical Engineering*, 13, 429-450 (2011)
52. O. Idan, A.T. Lam, J. Kamcev, J. Gonzales, A. Agarwal, and **H. Hess***: “Nanoscale transport enables active self-assembly of millimeter-scale structures”, *Nano Letters*, 12, 240-245 (2012)
53. A. Agarwal, E. Mobley, X. Deng, J. Lahann, and **H. Hess***: “Landing rate measurements of residual fibrinogen adsorption to highly non-fouling surfaces”, *Journal of Cellular and Molecular Bioengineering*, 5(3), 320-326 (2012)
54. S. He‡, A.T. Lam‡, Y. Jeune-Smith‡, and **H. Hess***: “Modeling negative cooperativity in streptavidin adsorption onto biotinylated microtubules”, ‡ indicates equal contribution, *Langmuir*, 28(29), 10635-10639 (2012)
55. O. Idan and **H. Hess***: “Diffusive transport phenomena in artificial enzyme cascades on scaffolds”, *Nature Nanotechnology*, 7, 769-770 (2012)
56. **H. Hess***: “Optimal loading of molecular bonds”, *Nano Letters*, 12(11), 5813-5814 (2012)
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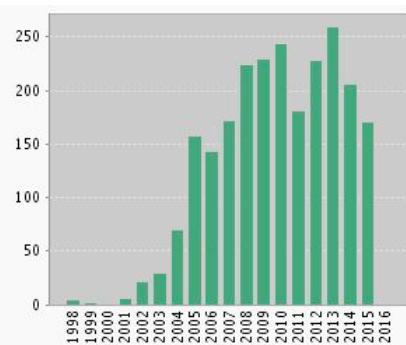
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Publication IDs: orcid.org/0000-0002-5617-606X, **ResearcherID A-5224-2008**

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- H. Hess: “Molecular shuttles, “smart dust” biosensors and active self-assembly powered by kinesin motors”, 36th Annual Northeast Bioengineering Conference, New York, NY (3/27/10) **invited**
- H. Hess: “Molecular shuttles, “smart dust” biosensors and active self-assembly powered by kinesin motors”, 2010 Columbia University Spring Research Symposium, New York, NY (3/28/10) keynote
- H. Hess: “Using Biomolecular Motors for Smart Dust, Active Self-Assembly and Non-Fouling Surfaces”, ARO Bio-directed Assembly workshop, Keystone, CO (5/17/10), **invited**
- H. Hess: “Autonomous Systems and Synthetic Biology”, Max Planck Symposium “Autonomous Systems”, Stuttgart/Tuebingen, Germany (5/29/10), **invited**
- H. Hess: “Autonomous Systems and Synthetic Biology”, National Academies 2010 U.S. Frontiers of Engineering, Armonk, NY (9/25/10), **invited**
- H. Hess: “Using Biomolecular Motors for Smart Dust, Active Self-Assembly and Non-Fouling Surfaces”, Seminar of the Chemistry Department, Hunter College, NY (10/15/10), **invited**

Presentations
(continued) H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Protein-Resistant Coatings”, AVS 57th International Symposium, Albuquerque, NM (10/21/10), **invited**

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Protein-Resistant Coatings”, International Symposium on Stimuli-Responsive Materials, Hattiesburg, MS (10/26/10), **invited**

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Protein-Resistant Coatings”, DFG-NSF Research Conference “Bioinspired Design and Engineering of Novel Functional Materials”, New York, NY (3/23/11)

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Protein-Resistant Coatings”, Topics in Bioengineering Seminar Series, Harvard University, Cambridge, MA (3/29/11), **invited**

H. Hess: “Development of filament array-based linear force transducers”, 1st International Symposium on Integration of Molecular Components in Functional Macroscopic Systems, Dresden, Germany (5/19/11)

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Protein-Resistant Coatings”, Colloquium of the Faculty of Physics, University Bielefeld, Germany (5/23/11), **invited**

H. Hess: “Engineering nanodevices based on molecular motors”, Photonics West – BIOS, San Francisco, CA (1/25/12), **keynote**

H. Hess: “Modeling nanodevices and self-assembly processes driven by biomolecular motors”, Multiscale Methods and Validation in Medicine and Biology I Meeting, San Francisco, CA (2/13/12) **invited**

H. Hess: “Engineering nanodevices based on molecular motors”, 2012 Columbia University Spring Research Symposium, New York, NY (4/09/12) keynote address

H. Hess: “Biomolecular motor-powered devices”, 4th International Conference for Smart Materials, Structures, Systems (CIMTEC), Montecatini Terme, Italy (6/13/12) **invited**

H. Hess: “Modeling active transport for biosensing”, Workshop for Micro and Nanomotors – Challenges and Perspectives, Dresden, Germany (9/11/12) **invited**

H. Hess: “Collecting analytes with active surfaces”, International Symposium on Stimuli-Responsive Materials, Santa Rosa, CA (10/22/12) **invited**

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Protein-Resistant Coatings”, Department of Bioengineering, Stanford University (3/28/2013)

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Protein-Resistant Coatings”, Department of Bioengineering, McGill University (4/16/2013) **invited**

H. Hess: “Transport Processes in Nanobiotechnology”, The 2013 US Turkey Advanced Study Institute On Global Healthcare Grand Challenges (6/17/2013) **invited plenary talk**

H. Hess: “Active Self-Assembly Powered by Kinesin Motors”, Conference on Programmable Self-Assembly of Matter, New York City, NY (7/1/2013) **invited**

H. Hess: “Active Transport for Biosensing”, Symposium “Nanoscale and Nanomaterials: Enhanced Motion”, 246th Annual Meeting of the ACS, Indianapolis, IN (9/9/2013) **invited**

Presentations (continued) H. Hess: “Velocity fluctuations, alignment, and assembly in kinesin gliding motility assays”, Symposium “Multiscale Motility of Molecular Motors”, Max-Planck-Institute for Colloid Research Potsdam-Golm, Germany (9/25/2013) **invited**

H. Hess: “Autonomous Systems and Synthetic Biology”, Symposium “Gender-Specific Medicine After the Age of Darwin: Achievements and Challenges for Biomedical Science in the 21st Century”, New York, NY (12/7/13), **invited**

H. Hess: “Biomolecular Motors Connect the Study of Bionanodevices, Self-Assembly, and Non-Fouling Coatings”, The 14th RIES-Hokudai International Symposium, Hokkaido University, Sapporo, Japan (12/12/2013), **invited**

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Non-Fouling Coatings”, The Pennsylvania Muscle Institute Seminar, University of Pennsylvania, Philadelphia, PA (3/10/2014), **invited**

H. Hess: “Using biomolecular motors for smart dust, active self-assembly and non-fouling surfaces”, International Workshop for Motor Proteins toward Emerging Nano Systems, Kyoto University, Japan (4/30/2014), **plenary talk**

H. Hess: “Molecular Shuttles for 'Smart Dust' Biosensors, Active Self-Assembly, and Non-Fouling Coatings”, Seminar of the Physics Department, Lund University, Sweden (9/12/2014), **invited**

A. Sitt and H. Hess: “Chemical potential gradients for accelerated molecular transport”, International Symposium on Stimuli-Responsive Materials, Santa Rosa, CA (10/26/14) **invited**

E.L.P. Dumont, C. Do, H. Hess: “Molecular wear of microtubules propelled by surface-adhered kinesins”, Annual Meeting of the German Physical Society, Berlin, Germany (3/18/2015)

H. Hess: “Engineering with Biomolecular Motors”, 2015 Gordon Research Conference on Self-Assembly & Supramolecular Chemistry, Lucca, Italy (5/19/2015) **invited**

H. Hess: “Using biomolecular motors for smart dust, active self-assembly and non-fouling surfaces”, Physics Colloquium, Texas A&M University (9/10/2015), **invited**

H. Hess: “Engineering with Biomolecular Motors”, Center for Integrated Nanotechnologies User Meeting, Santa Fe, New Mexico (9/22/2015) **invited**

H. Hess: “Engineering with Biomolecular Motors”, ASRC Active and Adaptive Materials Workshop, New York, NY (10/22/2015)

110 total oral presentations (75 invited)

upcoming: invited talk at Motor Workshop Vancouver June 2016, invited talk at Telluride workshop Information Engines at the Frontiers of Nanoscale Thermodynamics – July 2016, invited talk at Telluride Workshop on Molecular Rotors, Motors, and Switches – July 2016

Poster Contributions

German-Polish conference on Modern Optics, Jaszowiec, Poland (1996)
 German Cluster Meeting, Herzogenhorn, Germany (1997)
 Femtochemistry III, Lund, Sweden (1997)
 German-Polish conference on Modern Optics, Eurata, Poland (1998)
 Femtochemistry IV, Lausanne, Switzerland (1999)
 Gordon-Conference “Quantum control of atomic and molecular motion”, Plymouth, NH (1999)
 ISSPIC 10 (International Symposium on Small Particles and Inorganic Clusters), Atlanta, GA (2000)
 Nanospace 2001, Galveston, TX (2001)
 Foundations of Nanoscience, Snowbird, UT (2005)
 NSF-NASA-French workshop on Bionanotechnology, Washington, DC (2006)

Foundations of Nanoscience, Snowbird, UT (2007)
National Academies Keck Futures Initiative “Synthetic Biology”, Irvine, CA (2009)
NSF CMMI Grantee Conference (2011)
NSF CMMI Grantee Conference (2012)
Conference on “Multiscale Motility of Biomolecular Machines” (2015)

Oral group presentations

T. Nitta and H. Hess: “Molecular shuttles powered by kinesin motors: Fluctuations in velocity and direction of motion impact performance”, Annual Meeting of the Biophysical Society 2005, Long Beach, CA (2005)

S. Ramachandran, K.-H. Ernst, C. Brunner, V. Vogel, H. Hess: „Designing Nanoscale Cargo Carriers: Selective Loading of Functionalized Microtubules with Diverse Targets“, MRS Spring Meeting, San Francisco, CA (2005)

R. Tucker, S. Ramachandran, D. Wu, T. Nitta, H. Hess: “Bionanodevices Integrating Molecular Motors”, 52nd International Symposium of the AVS, Boston (MA) 2005

A. Agarwal, Th. Fischer, W. He, P. Katira, I. Luria, R. Tucker, and H. Hess: “Biomolecular motors and their application towards self-healing materials”, Eighth International Conference on Nanostructured Materials, Bangalore, India, August 20-25, 2006

T. Fischer, A. Agarwal, P. Katira, I. Luria and H. Hess: “Biomolecular Motors - The Natural Way of Active Transport in Nanofluidic Devices” MRS Fall Meeting, Boston, MA (11/30/2006)

A. Agarwal and H. Hess: “Unexpected velocity-dependent cargo loading onto molecular shuttles”, MRS Spring Meeting, San Francisco, CA (3/25/2008)

A. Agarwal, P. Katira, T. Fischer, H.-Y. Chen, X. Jiang, J. Lahann, H. Hess: “Measuring the performance of non-fouling coatings at ultra-low protein densities”, 8th World Biomaterials Congress, Amsterdam, Netherlands, May 31, 2008

Y. Jeune and H. Hess: “Using microtubules to illustrate polymer properties”, ASEE 2008 Annual Conference, Pittsburgh, PA, June 24, 2008

P. Katira, I. Luria, S. Seshadri, H. Hess: "Self-assembly via Active Transport By Biomolecular Motors", 53rd Annual Meeting of the Biophysical Society, Boston (MA) 2009

A. Agarwal, H. Hess: "Biomimetic Self-Healing Reflective Coatings using Hybrid Systems", Second International Conference on Self Healing Materials, Chicago (IL) 2009

J. Davenport-Crenshaw: “Lattice Simulations of Microtubule “Nanospool” Formation Dynamics”, 36th Annual National Society of Black Engineers Conference, Toronto, Canada (4/1/2010)

H. Palacci, O. Idan, M. Armstrong, A. Agarwal, T. Nitta and H. Hess: "Velocity Fluctuations in Kinesin-Microtubule Gliding Motility Assays originate from Variations in Motor Attachment Geometry", Foundations of Nanoscience 2015, Snowbird, UT, 4/16/2015

Group highlights

- 2006 Michelle Kinahan (undergraduate researcher) received NSF Graduate Fellowship
- 2006 Robert Tucker (graduate student) receives Fulbright Scholarship to study at the Max Planck Institute for Cell Biology and Genetics (Germany)
- 2006 Yolaine Jeune-Smith received McKnight Fellowship
- 2006 Yolaine Jeune-Smith received NSF Southeast Alliance for Graduate Education and the Professoriate Fellowship
- 2006 Thorsten Fischer (postdoctoral researcher) receives Feodor Lynen postdoctoral fellowship from the Alexander-von-Humboldt foundation supporting his research in the Hess group
- 2007 Elizabeth Mobley and Matthew Downs receive HHMI Undergraduate Research Award
- 2008 Jason Rudman receives HHMI Undergraduate Research Award
- 2008 Yolaine Jeune-Smith received Alfred P. Sloan Fellowship
- 2009 Matthew Downs is awarded an “Honorable Mention” for his NSF graduate fellowship application
- 2010 Jasmine Davenport Crenshaw (graduate student co-advised with Simon Phillpot) was awarded the first place in the oral presentation competition at the 36th Annual National Convention of the National Society of Black Engineers (NSBE) Tech Talk session, March 31 - April 4, 2010 in Toronto, Canada. Her oral presentation was entitled "Lattice Simulations of Microtubule 'Nanowire' and 'Nanospool' Formation Dynamics"
- 2010 Siheng He (graduate student) receives a 4-year scholarship from the China Scholarship Council
- 2011 Amy Lam (graduate student) is awarded an “Honorable Mention” for her NSF graduate fellowship application
- 2011 The “Motor Pro-Team” of undergraduate researchers (A. Ghazi, P. Agrawal, E. Shapiro) mentored by H. Hess wins a Silver Award at the inaugural International Bio-Molecular Design Competition BIOMOD2011 organized by the Wyss Institute at Harvard University
- 2011 Emmanuel Dumont (graduate student) is awarded the Shelley Liu-Ping fellowship by the Department of Biomedical Engineering, Columbia University
- 2012 Emmanuel Dumont (graduate student) is invited as Distinguished Student Speaker to the 3rd US-Turkey Advanced Study Institute on Global Healthcare Challenges, Antalya, Turkey (7/9-15, 2012)
- 2012 Postdoctoral researcher Amit Sitt receives a fellowship from the Fulbright Foundation
- 2012 The “Kinesin Kings” (Megan Armstrong, Ruchir Khaitan, Elyse Shapiro, Veronica Reynolds, Hari Raman, Gabriela Barth) mentored by H. Hess win a Bronze Award at the BIOMOD2012 International Bio-Molecular Design Competition organized by the Wyss Institute at Harvard University
- 2013 Postdoctoral researcher Amit Sitt receives a Raymond and Beverly Sackler Postdoctoral Fellowship
- 2013 Postdoctoral researcher Corina Curschellas receives a Fellowship from the Swiss National Science Foundation
- 2013 The “Dynein Dynasty” (Obiora Azie, David Verdi, David Miller) mentored by H. Hess win a Bronze Award at the BIOMOD2013 International Bio-Molecular Design Competition organized by the Wyss Institute at Harvard University
- 2014 The “Motorocracy” (Leon An, Ankita Gore, Amanda Groziak, Joshua Hughes, David Miller, David Verdi) mentored by Amy Lam wins a Gold Award, the MolBot Award, and achieves 2nd place in the presentation category at the BIOMOD2014 International Bio-Molecular Design Competition organized by the Wyss Institute at Harvard University
- 2015 Megan Armstrong (graduate student) is awarded a NSF Graduate Fellowship