

ROGER D. KAMM

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Curriculum Vitae

BRIEF NARRATIVE

A primary objective of Kamm's research has been the application of fundamentals in fluid and solid mechanics to better understand essential biological and physiological phenomena. Studies over the past thirty-five years have addressed issues in the respiratory, ocular and cardiovascular systems. More recently, his attention has focused on new areas, the molecular mechanisms of cellular force sensation, cell population dynamics, and the development of new microfluidic platforms for the study of cell-cell and cell-matrix interactions, especially in the context of metastatic cancer. Kamm has been a leader in bringing the fields of mechanics together with biology and chemistry; by exploring the ways in which single molecules transmit force through macromolecular networks and the resulting change in molecular binding or enzymatic activity; and by developing new cell culture methods that enable simultaneous study of multiple cell types communicating in a realistic microenvironment. This cumulative work has led to over 330 refereed publications. Recognition for his contributions is reflected in Kamm's election as Fellow to AIMBE, ASME, BMES, AAAS and the IFMBE. He is also the 2010 recipient of the ASME Lissner Medal and the 2015 recipient of the Huiskes Medal, both for lifetime achievements, the inaugural recipient of the Nerem Medal in 2018, the Shu Chien Award from the BMES, and is a member of the Academy of Medicine.

PROFESSIONAL EXPERIENCE:

1977 : Instructor, M.I.T.
1977-1978 : Lecturer and Research Associate in the Department of Mech. Engineering, M.I.T.
1978-1981 : Assistant Professor of Mechanical Engineering, M.I.T.
1986-1987 : Senior Visiting Scientist, University of Cambridge, Department of Applied Mathematics and Theoretical Physics.
Visiting Fellow, Clare Hall, University of Cambridge.
1981-1988 : Associate Professor of Mechanical Engineering, M.I.T.
1988-2010 : Professor of Health Sciences and Technology, M.I.T. and Harvard University
1988-2011 : Professor of Mechanical Engineering, M.I.T.
1992-1994 : Co-Director: Program in Biomedical Engineering, M.I.T.
1994-2012 : Associate Director, Center for Biomedical Engineering, M.I.T.
1995-2010 : Lecturer on Medicine, Harvard Medical School
1998- : Professor of Mechanical Engineering and Bioengineering, M.I.T.
2005-2010 : Germeshausen Professor of Mechanical and Biological Engineering, M.I.T.
2005-2008 : Associate Head, Department of Mechanical Engineering, M.I.T.
2008- 2010: Director, GEM4 Center@MIT
2010- 2011: Singapore Research Professor of Biological and Mechanical Engineering, M.I.T.
2011- : Cecil and Ida Green Distinguished Professor of Biological and Mechanical Engineering, M.I.T.
2010- : Director, NSF Science and Technology Center on Emergent Behaviors of Integrated Cellular Systems
2018- : Professor Post Tenure

EDUCATION:

NORTHWESTERN UNIVERSITY, Evanston, Illinois
B.S. in Mechanical Engineering, June 1972
MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA
S.M. in Mechanical Engineering, August 1973 (Advisor: C. Forbes Dewey)
MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA

Ph.D. in Mechanical Engineering, May 1977 (Advisor: Ascher Shapiro)

HONORS and AWARDS:

Graduate Student Council Teaching Award (1983)
American Inst. of Medical and Biological Engineering (Founding Fellow) (1993)
Class of 1960 Award (for development of the Undergraduate Minor in Biomedical Engineering) (1999)
Everett Moore Baker Memorial Award for Excellence in Undergraduate Teaching (2001)
Cambridge/MIT Fellow (2001)
Eschbach Distinguished Visiting Scholar Award, Northwestern University (2002)
Fellow, American Society of Mechanical Engineering (2003)
Distinguished Lecturer in Biomechanics, Stanford University, (2004)
Fellow, Biomedical Engineering Society (2004)
Fellow, International Academy of Medical and Biological Engineering (2005)
Skalak Memorial Lecture, UC San Diego, (2007)
Midwest Mechanics Lecturer (2007-8)
Lissner Medal (for lifetime achievement), ASME Bioengineering Division (2010)
Fellow, American Academy for the Advancement of Science (2010)
Elected to the Institute of Medicine (2010)
Honorary Member, American Venous Forum (2011)
Huiskes Medal, European Society of Biomechanics (2015)
Fred S. Grodins Keynote Lecture, U Southern California (2016)
Otto Schmidtt Distinguished Lecture, U Minnesota (2017)
Penner Lecture, UC San Diego (2017)
Nerem Medal (for education and mentoring), ASME Bioengineering (2018)
Shu Chien Award (for research excellence), BMES Cell and Molecular Bioengineering (2020)

PROFESSIONAL SOCIETIES:

American Institute for Medical and Biological Engineering (Founding Fellow)
American Society for the Advancement of Science (Fellow)
American Society of Mechanical Engineering (Fellow)
Biomedical Engineering Society (Fellow)
Biophysical Society
International Federation for Medical and Biological Engineering (Fellow)

SELECTED OTHER PROFESSIONAL ACTIVITIES:

Biomedical Engineering Society; Chair, Awards Committee (1989-91)
Board of Directors (1994-1997) (2003-2007)
Publications Board, Member (2000-2006)
Chair (2004-2006)
ASME Journal of Biomechanical Engrg., Associate Editor (1990-1996)
NHLBI, NIEHS, NASA, NSF; Review Committees (1988-present)
Journal of Fluids and Structures, Associate Editor (1993-2005)
US National Committee on Biomechanics; (1997-2009)
Secretary (2000-2003)
Vice chair (2003-2006)
Chair (2006-2009)
World Council on Biomechanics (1998-present);
Vice chair (2002-2006)
Chair (2006-2010)

Conference Chair (2014)
 External Review Board, City University of New York, Biomedical Engineering Doctoral Program (1999)
 External Advisory Board, Northwestern University, Dept. of Biomedical Engineering (2000-2006)
Summer Bioengineering Conference, Conference Chair, 2001
Biomechanics and Modeling in Mechanobiology, Editorial Board, (2001-present)
 External Review Board, Pennsylvania State University, Dept. of Biomedical Engineering (2003)
 External Review Board, Duke University, Dept. of Biomedical Engineering (2003)
1st Annual Symposium on Frontiers in Biomechanics, Co-organizer, (2003)
Mechanics & Chemistry of Biosystems, Editorial Board (2003-present)
 Hypertension & Microcirculation Study Section, NIH (2004-2008)
 Expert Panel, *Strategy for the EuroPhysiome (STEP) project* (2006-2007)
 External Advisory Board, *Symbios Center*, Stanford University (2006- 2010)
 Chair (2008)
 Co-organizer, *Summer Course on Molecular and Cell Biomechanics*, MIT (2006)
 Co-organizer, *Summit of Experts in Biomechanics*, Keystone, CO (2007)
 Advisory Board, Indian Institute of Technology, Kampur, (2007- 2008)
 External Review Committee, UC Berkeley Bioengineering Dept., (2007)
 Scientific Advisory Board, *VPH Network of Excellence* (2007- 2010)
 Director, Global Enterprise for MicroMechanics and Molecular Medicine (GEM⁴) (2007-2010)
 Co-organizer, *The Cell as a Machine Workshop*, Arlington, VA (2007)
 External Advisory Committee, Chilean Nanotechnology Initiative (2008)
 Organizing Committee, 5th International Biofluids Symposium (2007)
 Community Giving at MIT Campaign Committee (Chair, 2007-2009)
 Scientific Advisory Board, CIBER BBN, Spain (2008-2013)
 Scientific Advisory Board, Global Center of Excellence in Nano-Bioengineering, Sendai, Japan (2006-2012)
 Chair, International Academy of Medical and Biological Engineering (2011-2014)
 Current Editorial Boards: *Journal of Multiscale Modeling*, *Cellular and Molecular Bioengineering*, *Methods in Cell Science*, *Cellular and Molecular Bioengineering*, *Biomedical Engineering Letters*, *Journal Royal Society Interface*
Current Advisory Boards: Imperial College, EPSRC Centre for Doctoral Training in Fluid Dynamics across Scales; EPSRC SoftMech Centre For Mathematics in Healthcare; Biomedical Engineering Department at the University of Texas, Austin; Institute of Biological Engineering in Catalonia; Department of BioMedical Engineering, Technische Universiteit at Eindhoven, Netherlands, Prometheus, division of Skeletal Tissue; Biomedical Engineering , University of Leuven, Belgium

INVITED LECTURES (since 2008)

The Midwest Mechanics Lecture Series, U. Michigan, Michigan State U., U. Iowa, U. Wisconsin, U. Minnesota, Northwestern U., IIT, Purdue U., Notre Dame U., *Sub-cellular mechanics and its influence on biological function*, December, 2007 - January, 2008.
 Plenary Lecture, Keio University 150th Anniversary, *Microfluidic platforms for studies of angiogenesis, cell migration, and cell-cell interactions*, Tokyo, Japan, March, 2008.
 Tohoku University, *Cellular force transmission and mechanotransduction*, Sendai, Japan, March, 2008.
 Northeastern University, *Cellular force transmission and mechanotransduction*, April, 2008.
 Plenary Lecture, 5th Biofluids Symposium, *Microfluidic platforms for studies of angiogenesis, cell migration, and cell-cell interactions*, Caltech, March, 2008.
 University of Santiago, *Cellular force transmission and mechanotransduction*, Santiago, Chile, April, 2008.
 Chilean Workshop on Nanotechnology, *Micro- and Nano-Medicine*, April, 2008.
 Plenary Lecture, ASME DSCC Workshop on BioSystems and Control, *On the application of system dynamics and control in biology: Real-time control of growth / Biological machines*, October 19, 2008
 University of Zaragoza, Bioengineering Seminar, *Regulating capillary morphogenesis in a microfluidic system. Zaragoza, Spain, September 25, 2008*
 Bioengineering 08 Keynote Lecture. *Regulating capillary morphogenesis in a microfluidic system*. Imperial College, London, UK, September 18, 2008

- UNCC, Biology Colloquim, *Regulating capillary morphogenesis in a microfluidic system*. October 17, 2008
University of Zaragoza, *Structural cross-links in the cytoskeleton: Experiments and theory*. Zaragoza, Spain, February, 2009.
- Invited lecture, Department of Bioengineering, University of Texas, '*Regulating Capillary Morphogenesis in a Microfluidic System*', Austin, TX, November, 2008.
- Plenary Lecture, Global COE Symposium, *New horizons in biomechanics: Thinking small*. Sendai, Japan, March, 2009.
- Invited lecture, Department of Bioengineering, University of Houston '*Regulating Capillary Morphogenesis in a Microfluidic System*', Houston, TX, April, 2009.
- Plenary Lecture, Suddath Symposium, *New horizons in biomechanics: Thinking small*. Atlanta, GA, April, 2009.
- Invited lecture, *A Brownian dynamics model for cross-linked actin gels under high prestrain*. ICMAT, Singapore, June, 2009.
- IMAG Webinar, *A computational model for cytoskeletal mechanics – Comparisons with cell and gel experiments*. July, 2009.
- Plenary Lecture, PhysCell2009, *Numerical simulations of cytoskeletal rheology*. Stilbe, Croatia, September, 2009.
- Plenary lecture, International Conference on Computational Biology 2009 '*Regulating Capillary Morphogenesis in a Microfluidic System*', R.D. Kamm, Bertinoro, Italy, November, 2009.
- Invited lecture, *Regulating Capillary Morphogenesis in a Microfluidic System*'. Lausanne, EPFL, May 2009.
- Invited lecture, Department of Bioengineering, Politecnico di Milano '*Regulating Capillary Morphogenesis in a Microfluidic System*'. Milan, Italy, May, 2009.
- Invited lecture, Harvard University, Squishy Physics Seminar, *Numerical simulations of cytoskeletal rheology*, Cambridge, MA, November, 2009
- Invited lecture, Johnson & Johnson Executive Group, *Microfluidic cell culture systems for drug screening or clinical assays*, Cambridge, MA, December, 2009.
- Invited lecture, National University of Singapore, *Using a microfluidic assay to mimic different stages of metastatic cancer*, Singapore, January 2010.
- Invited lecture, University of Connecticut, *Microfluidics for cell culture: Studies of cell populations and cell-cell interactions*, Hartford, CT, February 2010.
- Invited lecture, Northeastern University, *Microfluidics for cell culture: Studies of cell populations and cell-cell interactions*, Boston, MA, March 2010.
- Invited lecture, Brown University, *Microfluidics for cell culture: Studies of cell populations and cell-cell interactions*, Providence, RI, March 2010.
- Invited lecture, University of Toronto, *Microfluidics for cell culture: Studies of cell populations and cell-cell interactions*, Toronto, Canada, May 2010.
- Invited lecture, *Microfluidics for cell culture: Studies of cell populations and cell-cell interactions*, San Sebastian, Spain, May 2010.
- Keynote Lecture, *Bridges to a New Biomechanics*, Lissner Award Lecture, Naples, FL, June 2010.
- Plenary Lecture, *Microfluidic platforms for studies of angiogenesis, cell migration, and cell-cell interactions*, 1st Keio / Korea International Symposium on Microfluidics and Tissue Engineering, Yokohama, Japan, July 2010.
- Invited lecture, *Integrated cellular systems: An integrated approach to the design of biological machines*, World Congress of BioMechanics, Singapore, August 2010
- Invited lecture, *Integrated cellular systems: An engineering approach to constructing multi-cellular systems*, BMES, Austin, TX, Oct. 2010
- Invited lecture, *A multiscale model of cytoskeletal mechanics*, Materials Research Society Fall Meeting, Boston, Nov., 2010
- Invited lecture, *Microfluidics for heterotypic cell culture: Application in angiogenesis and oncology*, Mahidol University, Bangkok, Thailand, Jan., 2011
- Invited lecture, *Microfluidics for heterotypic cell culture: Application in angiogenesis and oncology*, MBI/BioSyM Workshop, Singapore, Jan., 2011
- Invited lecture, *Hemodynamics of venous disease*, Venous Forum, San Diego, CA, Feb., 2011.
- Invited lecture, *Computational insights into cytoskeletal rheology*, Biophysical Society Meeting, Baltimore, MD, March, 2011.
- Invited lecture, *Creating 3D microvascular networks in vitro*, University of Pennsylvania, Feb., 2011.
- Invited lecture, *Creating 3D microvascular networks in vitro*, University of Michigan, March, 2011.

- Plenary lecture, *Controlling angiogenesis and forming microvascular networks in vitro*, Stem Cell and Regenerative Medicine Conference, March, 2011.
- Invited lecture, *The role for mechanotransduction in interstitial flow*, Clemson University, April, 2011.
- Invited lecture, *Computational models of the cytoskeleton and a look forward to simulation of mechanotransduction*, Microscale Modeling in Biomechanics and Mechanobiology, Ericeira, Portugal, May, 2011.
- Plenary lecture, *The Future for biological machines*, Frontiers in Biomechanics: Developmental Biology, Farmington, PA, June, 2011.
- Plenary lecture, *Microfluidic Assays as Models for Metastatic Cancers*, Seoul, Korea, July 2011
- Plenary lecture, *A Computational, Brownian Dynamics Simulation of Cytoskeletal Mechanics*, The 1st KIAS Conference on Subcellular Dynamics, Seoul, Korea, July 2011
- Plenary lecture, *Microfluidic technologies for cell population studies: Examples from cancer biology*, Emerging Paradigms in Physical Biology, NCSB, Bangalore, India, August, 2011
- Invited lecturer, *The unique biomechanical properties of the cell: Insights from computational modeling*, Nanyang Technological University, October, 2011
- Invited lecture, BMES, Hartford, CN, October, 2011
- Invited lecture, *Multi-Cell Interactions in Metastatic Cancer*, MechanoBiology Institute, Singapore, November, 2011
- Invited lecture, *Creating 3D microvascular networks in vitro*, National University of Singapore, November, 2011
- Plenary lecture, *Heterotypic and Homotypic Cell Culture in Microfluidic Systems: Examples from Cancer Biology*, 5th East Asian Pacific Student Workshop on Nano-Biomedical Engineering, December, 2011
- Keynote lecture, *Biomechanical properties of the cell: Insights from computational modeling*, Society of Physical Regulation and Biomolecular Modeling, San Juan, Puerto Rico, January, 2012
- Invited lecture, *Bioengineering in a Mechanical Engineering Department*, The Technion, Haifa, Israel, January 29, 2012.
- Infinity Pharmaceuticals, *Microfluidics for Cancer Applications*, February 24, 2012, Cambridge, MA
- Invited lecture, *Microfluidic Studies of Angiogenesis: Growing Microvascular Networks in vitro*, University of Illinois, Chicago, March, 2012.
- Invited lecture, *The unique biomechanical properties of the cell: Insights from computational modeling*, WPI, Worcester, MA, April, 2012
- Invited lecture, *Fostering Team Science*, FASEB Science Policy Committee, Washington, DC, May, 2012.
- Invited lecture, *Microfluidic Technologies for Cell Population Studies: Examples from Developmental Biology*, GEM⁴ Summer School, Cambridge, MA, July, 2012.
- Keynote lecture, *Biological Machines*, Weizmann Institute, Israel, January 30-31, 2012
- Keynote lecture, *Microfluidic Studies of Cancer Metastasis*, 7th International Biofluids Symposium, Dead Sea, Israel, March 26-30, 2012
- Keynote lecture, *Creating 3D Microvascular Networks in vitro*, American Venous Forum, Orlando, February 10-11, 2012
- Keynote lecture, *The unique biomechanical properties of the cell: Insights from computational modeling*, IFMBE, Beijing, China, May 26-30, 2012
- Invited lecture, *Engineering Microvascular Networks for Therapeutic and in vitro Applications*, IEEE Conference on Life Sciences, Grand Challenges, Washington, DC, October 4-5, 2012.
- Keynote lecture, *Using Microfluidics to Study Multi-Cell Interactions in Cancer*, Symposium on Multi-Cellular Interactions, Rice University and Texas Medical Center, Nov. 9, 2012.
- Invited lecture, *Microfluidic technologies: Where we are, and some future grand challenges*, Lester Wolfe Workshop in Laser Biomedicine, MIT, Cambridge, MA, Tuesday, December 18, 2012
- Invited lecture, *Using microfluidics to study multi-cell interactions in metastatic cancer*, Politecnico di Torino, Italy, December 13, 2012
- Invited lecture, *Using microfluidics to study multi-cell interactions in metastatic cancer*, Tsinghua University, School of Life Sciences, Beijing, China, January 2013
- Invited lecture, *Microfluidic technologies for stem cell differentiation and co-culture*, Stem Cells for Drug Developers, Boston, MA, February, 2013

- Invited lecture, *Microfluidic technologies for growing vascular networks*, American Venous Forum, Phoenix, AZ, February, 2013
- Invited lecture, *Creating living machines (talk given by Rashid Bashir)*, Frontiers in Bioengineering, Atlanta, GA, February, 2013
- Invited lecture, *Mechanotransduction of fluid stress by tumor cells within 3D collagen scaffolds (talk given by William Palacheck)*, FASEB Meeting, San Diego, CA, February, 2013
- Invited lecture, *Using Microfluidics to Study the Roles of 3D Matrices and Physical Factors in Cancer*, NEMB, Boston, MA, February, 2013
- Invited lecture, *Creating Living Machines*, Frontiers in Bioengineering, Georgia Tech, Atlanta, GA, March 2013
- Invited lecture, *Microfluidic studies for stem cell differentiation and co-culture*, Stem Cells for Drug Developers, Boston, MA, March 2013
- Invited lecture, *Using Microfluidics to Study Multi-Cell Interactions in Metastatic Cancer*, Texas A&M, March 2013
- Invited lecture, *Using Microfluidics to Study Multi-Cell Interactions in Metastatic Cancer*, University of Iowa, Iowa City, March 2013
- Invited lecture, *Creating Living Machines*, University of Illinois, Urbana, IL, March 2013
- Invited lecture, *Using Microfluidics to Study Multi-Cell Interactions in Metastatic Cancer*, Illinois Institute of Technology, Chicago, March 2013
- Invited lecture, *Microfluidics: A powerful tool to study multi-cell interactions in metastatic cancer*, Yonsei University, Seoul, June 7, 2013
- Organizer and Lecturer, *Microfluidics & Extravasation – An Overview*, BioSyM Workshop, June 29, 2013
- Invited lecture, *Microfluidics: A powerful tool to study multi-cell interactions in metastatic cancer*, Nanyang Technological University, Singapore, June 27, 2013
- Invited presentation, *Microfluidics: A powerful tool to study multi-cell interactions in metastatic cancer*, Micro- and Nanotechnologies for medicine: Emerging frontiers and applications, Cambridge, MA, August 2, 2013
- Invited Departmental Seminar, *Microfluidics to study multicell interactions*, Oxford University, Applied Maths, September 15, 2013
- Plenary Lecture, *Engineering contractile muscle and its use in engineering biological systems*, Cardiac ElectroMechanical Coupling & Arrhythmias, Oxford, UK, September 12, 2013.
- Invited lecture, *Microfluidic models for metastatic processes*, Physics of Cancer, Leipzig, Germany, September 22, 2013.
- Invited presentation, *Modeling force sensation through modulation of cytoskeletal tension*, TERMIS, Atlanta, November, 2013.
- Invited Presentation, *Building living machines: Microvascular networks for a living machine*, 2014 AAAS Meeting, Chicago, February, 2014.
- Invited Lecture, *Microfluidics to study multicell interactions*, Brigham & Women's Hospital, March 13, 2014.
- Invited Lecture, *Adventures in biomechanics: Past, present, and (a look to) the future*. BioEngineering Seminar Series, Northeastern University, Boston, March 2014.
- Invited Lecture, *Studies of Single Cell and Cell Population Behaviors in 3D Co-Culture Microfluidic Systems*, SCI Distinguished Lecture Series, Scientific Computing Institute, University of Utah, March 21, 2014
- Invited Lecture, *Microfluidics: A powerful tool to study multi-cell interactions in cancer*. University of Pennsylvania, Biomedical Engineering Department, April 2014.
- Invited Lecture, *The effects of interstitial flow on angiogenesis and cell migration*. New England Bioengineering Conference, Boston, April, 2014.
- Invited Lecture, *In vitro models of metastatic cancer*, World Congress of Biomechanics, Boston, July 2014.
- Invited Lecture, *Microfluidic models of microvascular networks to study cell extravasation and metastasis*, Cell-to-Cell Communication in Cancer Workshop, Sloan-Kettering Institute, New York, July 2014
- Invited Lecture, *Mirofluidic models of tumor cell metastasis and their use in drug screening*, Chungbuk National University, Seoul, Korea, August 2014
- Keynote Lecture, *Growing vascularized tissues in vitro*, IEEE Conference on Engineering in Medicine and Biology, Chicago, August 2014
- Invited Lecture, *Biological machines: Creating the essential components*, Frontiers in Bioengineering, Urbana-Champaign, September 2014

- Distinguished Keynote Lecture, *In vitro tissue models, and their use in modeling cancer cell extravasation*, Institute for Engineering in Medicine Annual Conference and Retreat, Minneapolis, October, 2014
- Invited Lecture, *Microfluidic Models with Microvascular Networks to Study Metastatic Disease*, Functional Analysis and Screening Technologies Congress, Boston, November 2014
- Invited Lecture, *Using microfluidics to grow perfusable vascular networks*, Clinical Applications & Clinical Translation of Tissue Engineering, Boston, February, 2015
- Invited Lecture, *Emergent behaviors of cellular systems: Lessons in Making Biological Machines*, University of Texas, Dallas, February 2015
- Invited Lecture, *Microfluidic models of tumor cell metastasis and their use in drug screening*, RPI, Troy, NY, April 2015
- Invited Lecture, *An in vitro neuromuscular junction model with light activation*, Nano Engineering in Medicine and Biology, Minneapolis, MN, April 2015
- Invited Lecture, *The future potential for living, multicellular machines*, IUPESM World Congress, Toronto, Canada, June 2015
- Huiskes Medal Lecture, European Society of Biomechanics, Prague, Czech Republic, July 2015
- Invited Lecture, *Vascularized organs-on-a-chip*, Organ-on-a-Chip World Congress, Boston, MA, July 2015
- Invited Lecture, *Vascularized 3D On-Chip Tissue Models*, Workshop on Micro and Nanotechnologies for Medicine, Boston, July 2015
- Invited Lecture, *Engineered Microvascular Networks for 3D Integrated Biological Systems*, TERMIS, Boston, September 2015
- Invited Lecture, *Modeling the Blood-Brain Barrier in a 3D Co-culture Microfluidic System*, TERMIS, Boston, September 2015
- Invited Lecture, *An In Vitro 3D Model for a Neuromuscular Junction*, TERMIS, Boston, September 2015
- Invited Lecture, *3D In Vitro Models of Tumor Cell Extravasation*, ETH, Zurich, September 2015
- Invited Lecture, *Emergence of organ-on-chip technologies: the hype and the reality*, B-Debates, Barcelona, Spain, October 2015
- Invited Lecture, *3D In Vitro Models of Tumor Cell Extravasation*, UC Santa Barbara, California, October 2015
- Invited Lecture, *The role of interstitial flow on cell migration and angiogenic sprouting*, NSF Workshop, October 2015
- Invited Tutorial, *Emerging technologies encompassing the complexity of cancer; Part 1: Microsystems for modeling tumor development, progression and metastasis*. MRS Annual Meeting, Boston, MA, November 2015
- Invited Lecture, *3D In Vitro Models of Tumor Cell Extravasation*, MRS Annual Meeting, Boston, MA, November 2015
- Keynote Lecture, *3D tissue models for metastatic cancer*, CMBE Annual Meeting, New Orleans, LA, January 2016
- Invited Lecture, *Experiments and models of tumor cell extravasation*, 8th International Biofluids Symposium, Caltech, Pasadena, CA, February 2016
- Invited Lecture, *Creating vascularized tissue constructs in microfluidic assays*. University of Georgia, Athens, GA, March 2016
- Invited Seminar, *What we have learned about tumor cell extravasation from microfluidic models?* University of Pennsylvania PS-OC, Philadelphia, PA, April 2016
- Invited Lecture, *Creating vascularized tissue constructs in microfluidic assays*. Vascular Biology Seminar Series, Harvard Medical School, April 2016
- Invited Seminar, *In vitro vascularized models for metastatic cancer*. Yonsei University, Seoul, Korea, April 2016.
- Invited Lecture, *Engineered living systems and the application in cancer modeling*. KIST Symposium, Seoul, Korea, May 2016
- Invited Lecture, *In vitro vascularized models for metastatic cancer*. Stanford Bio-X Seminar, Palo Alto, CA, May 2016
- Plenary Lecture, *In vitro vascularized models for metastatic cancer*. SelectBio Conference on Organs-on-a-chip. Boston, July 2016
- Invited seminar, *In vitro vascularized models for metastatic cancer*. Amgen, Cambridge, MA, July 2016
- Invited seminar, *In vitro vascularized models for metastatic cancer*. Merck EMD, Cambridge, MA, July 2016
- Invited seminar, *In vitro vascularized models for metastatic cancer*. Gordon Research Conference on Endothelial Phenotypes, Girona, Spain, July 2016

- Invited Keynote, *In vitro vascularized models for metastatic cancer*. MicroNano Fluids 2016, Milan, IT, September, 2016.
- Invited Seminar, *In vitro vascularized models for metastatic cancer*. University of Southern California, Los Angeles, CA, October, 2016.
- Invited Plenary, *Microfluidic models of cancer metastasis*. Korean Biomedical Engineering Society. Minneapolis, MN, October, 2016.
- Invited Seminar, *In vitro vascularized models for metastatic cancer*. University of Massachusetts, Amherst, MA, November, 2016.
- Invited Lecture, *Vascularized microfluidic assays for drug delivery and metastatic cancer*. Novartis, Cambridge, MA, November, 2016.
- Invited keynote, *Microfluidic models for tumor cell trapping/adhesion and extravasation*. 1st Northeast Physical Science Oncology Symposium, Boston, MA, November, 2016.
- Invited keynote, *The role of mechanical force in tumor cell extravasation*. CNIC Conference: Mechanical forces in physiology and disease, Madrid, Spain, November, 2016.
- Invited Seminar, *Vascularized microfluidic assays for drug delivery and metastatic cancer*. Tufts University, MA, December, 2016.
- Invited Seminar, *Microvascular networks in microfluidic systems and their role in modeling metastatic cancer*. Tsinghua University, Beijing, China, February, 2017.
- Invited Seminar, *Models for human disease: An engineering perspective*. Chinese Academy of Sciences, February, 2017.
- Invited Seminar, *Models for human disease: An engineering perspective*. Southeast China University, Nanjing, China, February, 2017.
- Invited Seminar, *Microvascular networks in microfluidic systems and their role in modeling metastatic cancer*. Chinese University of Hong Kong, Hong Kong, China, February, 2017.
- Invited seminar, *Vascularized microfluidic models for metastatic cancer*. SiGN A*START, Singapore, February, 2017.
- Invited Seminar, *In vitro vascularized models for metastatic cancer*. CREATE, Singapore, March, 2017.
- Invited Lecture, *In vitro vascularized models for metastatic cancer*. Otto Schmitt Distinguished Lecture, University of Minnesota, April, 2017.
- Invited seminar, *Microvascular networks in microfluidic systems and their role in modeling metastatic cancer*. University of Michigan, April, 2017.
- Invited Lecture, *Microvascular networks in microfluidic systems and their role in modeling metastatic cancer*, The Stanford S. and Beverly P. Penner Distinguished Lecture, May 2017.
- Invited seminar, *Microvascular networks in microfluidic systems and their role in modeling metastatic cancer*. MIT MMEC Seminar Series, May, 2017.
- Invited speaker, *Vascularized tissue chip models of metastatic cancer*. US-Australia Emerging Cancer Biomedical Technologies Workshop, Arlington VA, June, 2017.
- Invited Keynote Lecture, *What we can learn about tumor cell extravasation from vascular networks using a microfluidic assay*. 7th International Conference on Tumor-Host Interaction and Angiogenesis, Ascona, Switzerland, June 2017.
- Invited keynote, *Matrix densification by single cells and monolayers*. CellMech 2017, Windemere, U.K., June 2017
- Invited Lecture, *Emergence of in vitro vascularized models and their application to studies of metastatic cancer*, Politecnico di Torino, June 2017.
- Invited Webinar, *3d cell culture using primary cells*, Nature Protocols, June 2017.
- Invited Lecture, *In Vitro Vascularized Models for Metastatic Cancer*. Micro- and Nanotechnologies for Medicine: Emerging Frontiers and Applications. Cambridge MA, July 2017.
- Invited Plenary Lecture, *Engineered living systems: Current state and future potential*. Organ-on-a-chip World Congress 2017 and 3D-Culture. Boston Ma, July, 2017.
- Invited Lecture, *Emergence of in Vitro Vascularized Models and their Application to Studies of Metastatic Cancer*, University of Delaware, September 18, 2017
- Invited Lecture, *Tumor Cell Extravasation and the Role of Mechanical Interactions*, IFON/MBI Meeting, Singapore, October 2, 2017

- Plenary Lecture, *Emergence of in Vitro Vascularized Models and their Application to Studies of Metastatic Cancer*, Biomanufacturing Conference, Beijing, October 17, 2018
- Plenary Lecture, *Providing Vascular Perfusion to Organ-on-Chip Disease Models*, SelectBio Meeting, Taipei, Taiwan, November, 2017.
- Invited Lecture, *Emergence of in Vitro Vascularized Models and their Application to Studies of Metastatic Cancer*, University of Bari, Italy, October 23, 2017
- Invited Lecture, *In vitro vascular networks and their use in studies of metastatic cancer*, University of Virginia, January 19, 2018
- Invited Keynote, *The mechanics and mechanisms of tumor cell extravasation*, SPIE Photonic West, San Francisco, January 29, 2018
- Invited Lecture, *In vitro vascular networks and their use in studies of metastatic cancer across the blood-brain barrier*, Yale University, February 14, 2018
- Invited Lecture, *In vitro vascular networks and their use in studies of metastatic cancer across the blood-brain barrier*, Ohio State University, March 9, 2018
- Invited Lecture, *In vitro studies of metastatic cancer across the blood-brain barrier*, Rice University, Bioengineering Dept., March 27, 2018
- Invited Lecture, *Microphysiological models relying on emergence in multi-cellular engineered living systems*, Rice University, Center for Theoretical Biology and Physics, March 27, 2018
- Invited Keynote Lecture, *In Vitro Vascular Models of Metastatic Cancer and the blood-Brain Barrier*, 3th International Symposium on Vascular Biology and Cardiovascular Disease, Emory University, Atlanta, April 12, 2018
- Invited Lecture, *Microphysiological Models Relying on Emergence of Multi-Cellular Engineered Systems*, Northwestern University, Mechanical Engineering, April 20, 2018
- Invited Keynote, *Microfluidic Models for Disease*, Advanced Biomanufacturing Conference, Baltimore, May 4, 2018
- Invited Lecture, *What Can We Learn about Metastatic Cancer from Microphysiological Models?* H-Foundation, Chicago, May 7, 2018
- Invited Lecture, *Microfluidic Models for Disease*, 3D Tissue Models, Boston, May 9, 2018
- Invited Keynote, *Microfluidic Models for Disease*, SelectBio Meeting on 3D Cell Culture, Rotterdam, Netherlands, June 5, 2018
- Invited Keynote, *A model for the blood-brain barrier and its application in modeling metastasis to the brain*, Nanotechnology in Medicine Conference, Albufiera, Portugal, June 7, 2018
- Invited Lecture, *Microphysiological Models Relying on Emergence of Multi-Cellular Engineered Living Systems*, Technical University of Eindhoven, Netherlands, June 11, 2018
- Invited Keynote, *Cell-cell junction dynamics and their role in tumor cell transendothelial migration*, World Congress of Biomechanics, July 11, 2018
- Georgia Tech CMAT Symposium, Technologies and Standards in MPS, Atlanta, GA, 10/02/19
- Invited Lecture, PSN Annual Symposium, Models of Metastasis to the Brain, Minneapolis, MN, 08/05/19
- Invited Keynote, Tsinghua Workshop on Engineering and Manufacture of Living Systems, MPS of Neurological Disease, Beijing, China, 10/10/19
- Invited Lecture, Euromech, Models of Diseases of the Brain, Oxford, UK, 09/23/19
- Invited Lecture, CMBBE Computational Mechanics in Biology and Biomedical Engineering, Models of Diseases of the Brain, New York, NY, 08/10/19
- Workshop Organizer and Speaker, Tissue Engineering Consortium Workshop, Models of Metastasis to the Brain, Boston, MA, 08/05/19
- Invited Speaker, IBEC Symposium, MPS for Neurological Disease, Barcelona, Spain, 07/15/19
- Invited Keynote, World Pre-Clinical Congress, Boston, MA, 06/17/19
- Invited Plenary, European Organ on Chip Conference, MPS for Neurological Disease, Graz, Austria, 07/01/19
- Invited Keynote, SelectBio Organ-on-Chip Congress, Microphysiological Systems for Neurological Disease, Rotterdam, 6/13/19
- Invited Plenary, CMBE Computational Mechanics in Biomedical Engineering, MPS for Neurological Disease, Sendai, Japan, 6/11/19
- Invited Keynote, 3D Models Oncology, Models of Metastasis to the Brain, Boston, MA, 5/7/19

Invited Lecture, Virginia Tech, Microphysiological Systems for Neurological Disease, Departmental Seminar, Blacksburg, VA, 9/5/19

Invited Lecture, Technical University of Vienna, Microphysiological Systems for Neurological Disease, Departmental Seminar, Vienna, Austria, 6/28/19

Invited Lecture, Marie Curie Institute Summer Course on Physical of Cancer, Models for Metastasis to the Brain, Paris, 6/6,7/19

Invited Lecture, UCF, Microphysiological Systems for Neurological Disease, Departmental Seminar, Orlando, 5/21/19

Invited Lecture, UMD, Microphysiological Systems for Neurological Disease, Departmental Seminar, College Park, MD, 3/29/19

Invited Lecture, Gore, Modeling Angiogenesis Across Synthetic Membranes, Delaware, Orlando, 4/4/19

Invited Lecture, MD Anderson, Models for Metastasis to the Brain, Houston, TX, 3/5/19

Invited Lecture, University College London, Microphysiological Systems for Neurological Disease, Departmental Seminar, London, 1/28/19

Invited Lecture, Crick Institute, Models for Metastasis to the Brain, London, 1/28/19

Invited Lecture, Tsinghua Top Talks, Microphysiological Models for Disease, Beijing, China, 10/19

Invited Lecture, Tsinghua, Microphysiological Systems for Neurological Disease, Departmental Seminar, Beijing, China, 10/19

Invited Lecture, Yonsei, Microphysiological Systems for Neurological Disease, Departmental Seminar, Seoul, Korea, 10/19

Invited Lecture, Korea U, Microphysiological Systems for Neurological Disease, Departmental Seminar, Seoul, Korea, 10/19

Invited Lecture, KAIST, Microphysiological Systems for Neurological Disease, Departmental Seminar, Seoul, Korea, 10/19

PATENTS

United States Patent 4,446,747 Kamm May 8, 1984
Method and apparatus for testing lip pressure applied to a smoking article and for calibrating the pressure testing apparatus

United States Patent 5,954,745 Gertler and Kamm, September 21, 1999
Catheter-filter set having a compliant seal
 (patent rights to Embolic Protection, Inc., subsequently purchased by Boston Scientific)

United States Patent 6,117,087 Kamm, et al. September 12, 2000
Method and apparatus for noninvasive assessment of a subject's cardiovascular system

United States Patent 6,605,053 Kamm, et al. August 12, 2003
Conduit designs and related methods for optimal flow control

United States Patent 9,121,847, Kamm et al., September 1, 2015
Three-dimensional microfluidic platforms and methods of use thereof

Provisional patent application, Borenstein et al., October 6, 2009.
Improvements to three-dimensional microfluidic platforms and methods of use thereof

United States Patent 9,261,496, Asada et al., February 16, 2016
Device for High Throughput Investigations of Multi-Cellular Interactions

United States Patent 9,446,031, Ragunath et. al., September 20, 2016
Compositions and Methods for Neovascularization

United States Patent 10,767,149, Kamm and Uzel., 2020
Microfluidic Device for Three Dimensional and Compartmentalized Coculture of Neuronal and Muscle Cells, with Functional Force Readout

COMPANIES FOUNDED

2000 **Cardiovascular Technologies** (with Dr. Jonathan Gertler) Developing vascular filtration systems for

carotid angioplasty. Technology ultimately purchased by Boston Scientific.

2012 AIM Biotech (with Dr. Seok Chung) Developing microfluidic systems for heterotypic, 3D cell culture and drug screening for metastatic cancers.

CURRENT RESEARCH SUPPORT

1 R21 NS105027-01A1

09/01/2019 – 08/31/2021

Development of 3D vascularized model of Blood Brain Barrier (BBB) and its application to Alzheimer disease research

This project aims to develop physiologically human BBB models for use to study the role of the blood-brain barrier on the pathogenesis of Alzheimer's disease.

1 U01CA214381-01A1 NIH (PI: Kamm and D. Barbie)

09/01/2017 – 08/31/2022

Development of Physiologic Tissue Models to Assess Tumor Explant Response to Immune Checkpoint Blockade

The goal of the proposed research is to extend the capabilities and extensively evaluate a novel in vitro tumor model assay to study tumor immune responses directly in patient samples.

Sponsor: Amgen (PI: R Kamm)

12/01/2016 – 12/31/2020

Developing endothelial cell microfluidic models to study protein distribution

The objective of this project is to develop microfluidic models of the vasculature and extracellular matrix as an experimental platform for studies of drug distribution between the vascular and matrix spaces. Results to be used to inform PKDM computational modeling.

1 U01 CA202177-01 NIH (PI: R Kamm)

09/22/2015 – 08/31/2020

Quantitative analyses of tumor cell extravasation

This proposal investigates the force interactions between a metastatic tumor cell and the endothelial monolayer, and seeks to identify changes in gene expression that result for the nuclear deformations that occur.

CBET-0939511 NSF (Director: R. Kamm)

09/01/2010 – 08/31/2020

Science and Technology Center for Emergent Behaviors of Integrated Cellular Systems

The major goals of this Center are to gain a fundamental appreciation of cell population behavior and to use this understanding to develop engineered living systems.

NIH/NCI - Supplement to U01CA214381-01A1 (PI: Kamm)

09/01/2018 – 08/31/2019

Creation of a model for breast cancer metastasis to the brain

In this project, we seek to employ an existing model of the blood-brain barrier and explore the basis for organ specificity of metastases to the brain.

Sponsor: Biogen MA (PI: Kamm)

06/01/2018 – 02/01/2021

Neuromuscular Junction on a Chip

To establish an in vitro model of the human neuromuscular junction (NMJ) to identify disease relevant phenotypes and support medium throughput testing of candidate therapeutic molecules.

Sponsor: W.L. Gore & Associates (PI: Kamm)

07/15/2018 – 12/31/2020

Development of an in vitro, microfluidic-based model to probe microvasculature growth into membranes

The goal of this project is to develop an in vitro, microfluidic-based model to probe microvasculature growth into membranes provided by W.L. Gore & Associates. Successful development of this model may lead to fewer animal studies aimed at understanding the biological response to foreign materials.

RESEARCH INTERESTS

Microfluidic systems for homeotypic or heterotypic cell culture

Developing new methods to study emergent behavior of cell populations

Studies of stem cell differentiation, axon guidance and metastatic disease in novel microfluidic platforms.

In vitro models and drug screening for metastatic cancer

Developing 3D, multi-cell type cultures for intravasation and extravasation

Drug screening platforms for intermediate throughput screens and patient derived explants.

Cell mechanics, molecular mechanics, and mechanotransduction

Cytoskeletal mechanics and computational modeling of cell deformations and force transmission through the cell.

Measurements of intracellular strain fields due to forces applied by adherent beads.

Transduction of mechanical signals by protein conformational changes using both experimental and computational approaches.

Cardiovascular tissue engineering

Using the methods of microfluidics and the concepts of combined biophysical control and biochemical control of cell function to develop microvascular beds in vitro.

Application of these technologies to the development of "organ mimics" for drug testing and toxicity screening.

Neurological diseases

Design of microfabricated systems for the control of neural stem cell differentiation.

Studies of migration and axonal growth in three-dimensional matrices using computational models and microfluidic platforms

PAPERS IN REFEREED JOURNALS

For an up-to-date list, see:

https://scholar.google.com/citations?hl=en&user=tUpRgKwAAAAJ&view_op=list_works&authuser=1&sortby=pubdate

1. Dewey, C.F., Kamm, R.D., and Hackett, C.D. An acoustic amplifier for the detection of atmospheric pollutants. *Appl. Phys. Lett.* 23(11):633-635, 1973.
2. Kamm, R.D. Detection of weakly absorbing gases using a resonant opto-acoustic method. *J. Appl. Phys.* 47(8): 3550-3558, 1976. *J. Fluid Mech.* 95(1): 1-78, 1979.
4. Thirsk, R.B., Kamm, R.D., and Shapiro, A.H. Changes in venous blood volume produced by external compression of the lower leg. *Medical and Biological Engineering and Computing* 18(5): 650-656, 1980.
5. Slutsky, A.S., Drazen, J.M., Ingram, R.H., Jr., Kamm, R.D., Shapiro, A. H., Fredberg, J.J., Loring, S.H. and Lehr, J. Effective pulmonary ventilation with small-volume oscillations at high frequency. *Science* 209: 609-610, 1980.
6. Kececioglu, I., McClurken, M.E., Kamm, R.D., and Shapiro, A.H., Steady supercritical flow in collapsible tubes. Part I: Experimental observations. *J. Fluid Mech.* 109:367-389, 1981.
7. McClurken, M.E., Kececioglu, I., Kamm, R.D., and Shapiro, A.H. Steady supercritical flow in collapsible tubes. Part II: Theoretical studies. *J. Fluid Mech.* 109: 415, 1981.
8. Lueptow, R.M., Karlen, J.M., Kamm, R.D., and Shapiro, A.H. Circulatory model studies in external cardiac assist by counter-pulsation. *Cardiovascular Research* 15: 443-455, 1981.
9. Rossing, T.H. Slutsky, A.S., Lehr, J.L., Drinker, P.A., Kamm, R.D., and Drazen, J.M. Tidal volume and frequency dependence of CO₂ elimination by high frequency ventilation. *NEJM* 305(23): 1375-1397, 1981.
10. Slutsky, A.S., Kamm, R.D., Rossing, T.H., Loring, S.H., Lehr, J. Shapiro, A.H. Ingram, R.H., Jr., and Drazen, J.M. CO₂ elimination in dogs of high frequency (2-30 Hz), low tidal volume ventilation. Effects of frequency, tidal volume and lung volume. *J. Clin. Invest.* 68: 1475-1484, 1981.
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14. Jan, D.L., Kamm, R.D., and Shapiro, A.H. Filling of partially- collapsed compliant tubes. *J. Biomech. Eng.* 105: 12-19, 1983.
15. Johnson, M.C., and Kamm, R.D. The role of Schlemm's canal in aqueous outflow from the human eye. *Invest. Ophthalmol. Vis. Sci.* 24: 320-325, 1983.

16. Joshi, C.H., Kamm, R.D., Drazen, J.M., and Slutsky, A.S. An experimental study of gas exchange in laminar oscillatory flow. *J. Fluid Mech.* 133: 245-254, 1983.
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33. Elad, D., Kamm, R.D., and Shapiro, A.H. Choking phenomena in a lung- like model. *J. Biomech. Engrg.* 109: 1-9, 1987.
34. Paloski, W.H., Slosberg, R.B., and Kamm, R.D. Effects of gas properties and waveform asymmetry on gas transport in a branching tube network. *J. Appl. Physiol.*, 62(3): 892-901, 1987.
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