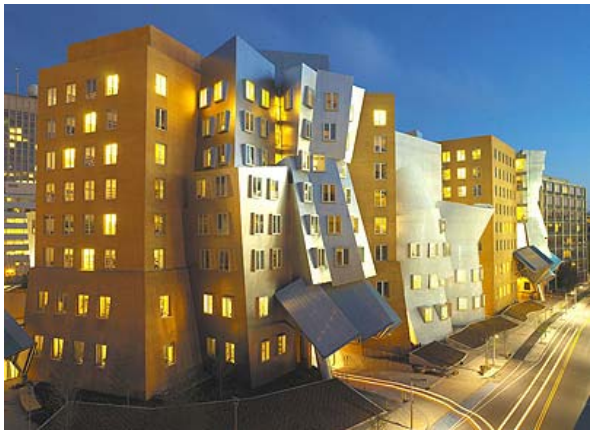
NSF Summer Institute Short Course on

Materiomics—Merging Biology and Engineering in Multiscale Structures and Materials

Location: Massachusetts Institute of Technology, LeMeridien Hotel (former Hotel@MIT)

Chair: Markus J. Buehler, Massachusetts Institute of Technology (mbuehler@MIT.EDU)

Dates: **May 30** (Wednesday) morning to **June 1** (Friday) evening, **2012**



Course Objectives: Theme-based introduction into emerging science at the interface of engineering and biology

This course will provide an introduction into the emerging science at the interface of engineering and biology, with a focus on the integration of multiscale modeling and experiment. Applying material design principles derived from biology—and specifically, the concept of developing diverse hierarchical structures composed of universal and simple design elements, used to derive sustainable and robust materials—is crucial for the next-generation engineering materials that are highly functional while satisfying multiple design constraints. This finds practical applications for example in regenerative medicine for *de novo* tissue growth, advanced carbon-based materials that are not only strong and tough, and self-learning material systems whose properties can be tailored by solely changing the structure without a need to introduce new building blocks.

This Summer Institute features experimental, computational and theoretical instructors from various areas of science, dealing with multiple length-scales, from nano to macro. Participants and instructors will engage in in-depth discussions on the frontiers, challenges, and opportunities in this emerging field referred to as materiomics. A unique feature of this short course is the participation of scientists from disparate fields that includes engineering mechanics, synthetic biology and architecture.

To make breakthroughs in this field, the introduction of dramatically new methods are critical, such as mathematical tools to understand and predict structure and hierarchies using geometric methods, folding of peptides, DNA, proteins or membranes or other structures, as well as the implementation of multiscale structures in diverse fields such as synthetic biology and architecture, which can be combined with new nanoscale engineering methods and chemistry. This Summer Institute will explore the application of these concepts towards the engineering design of materials from the bottom up and the application in high-impact areas of science and engineering.

Course Organization

The short course will feature three parts:

(I) Computational and theoretical methods
(II) Experimental methods
(III) Applications and case studies.

Lectures will be divided into 6 blocks of 3 mornings (8 am-12:30 pm, starts at 7:45 am the first day) and 3

afternoons (1:30 pm-6 pm, ends at 5 pm last day). Each hour is a 50 minute lecture and a 10 minute break. There will be a total of 22 sessions of 50 minutes each.

Course Description and Outline

(I) Computational and theoretical methods (8 sessions)

Covers basic computational and theoretical tools and how they can be integrated across the scales. Topics covered include:

- Computational materials science, computational chemistry, computational mechanics
- Molecular mechanics including quantum theory
- Category theory & computational and theoretical linguistics
- Architecture, design and materials

Speakers:

- **Mary Boyce**, MIT (micro/nano-mechanics of polymers and biomaterials, mechanics of naturally structured materials)
  http://meche.mit.edu/people/index.html?id=11
- **Markus Buehler**, MIT (molecular mechanics, multiscale modeling, theoretical and computational materiomics)
  http://web.mit.edu/mbuehler/www/
- **Wing Kam Liu**, Northwestern University (archetype-blending multiresolution modeling and mechanics and applications to materials design, drug delivery, and biotechnology)
  http://www.mech.northwestern.edu/web/people/faculty/liu_w/
- **Neri Oxman**, MIT (architecture and materials)
  http://www.media.mit.edu/people/neri

(II) Experimental methods (8 sessions)

Covers experimental methods, including synthesis and characterization.

- Multiscale experiment (TEM, AFM, OTs, tomography, etc.)
- *In vivo* and *in vitro* synthesis of materials and living organisms
- Peptide and protein engineering
- Molecular mechanics
- Disease characterization and treatment

Speakers:

- **Christine Ortiz**, MIT (experimental materials science of biological materials)
  http://web.mit.edu/cortiz/www/
  David Weitz, Harvard University (physics of soft matter, gels, self-assembly theory)
  http://www.physics.harvard.edu/people/facpages/weitz.html
- **David Kaplan**, Tufts University (biomaterials and silk-based biopolymers)
  http://ase.tufts.edu/terc/
- **Joyce Wong,** Boston University (biomedical materials engineering, regenerative medicine)
  http://www.bu.edu/bme/people/primary/wong/

(III) Applications and case studies (6 sessions)

Covers applications and case studies to demonstrate ongoing research and challenges.

- *De novo* design of structures and materials using self-assembly, hierarchical materials
- Synthetic biology (e.g. new life forms), design and engineering
- DNA nanotechnology
- Multiscale engineering of treatments (e.g. cancer nanotechnology)

Speakers:

- **Pamela Silver**, Harvard University (synthetic biology)
  http://silver.med.harvard.edu/

- **Joanna Aizenberg**, Harvard University and Wyss Institute (biomimetic materials, bionanoscience) http://www.seas.harvard.edu/aizenberg_lab/
- **William Shih**, Harvard University and Wyss Institute (DNA nanotechnology) http://wyss.harvard.edu/viewpage/127/william-shih

Fees

The registration fee for the short course is: $2,000. An additional $200 fee will be added to late registrations received after **May 1, 2012**. Register by **March 15, 2012** and receive a 20% discount. The fee includes coffee breaks, and lunches each day as well as all presentation materials, lecture notes and appropriate review papers.

NSF fellowships are available to faculty members, high-school science teachers, post-docs and Ph.D. candidates from the US. The fellowship consists of full registration fee plus an accommodation allowance. Download the application form from http://tam.northwestern.edu/summerinstitute/Home.htm. The deadline for fellowship application is **March 1, 2012**.

Location

The course will be held at the **LeMeridien Cambridge-MIT Hotel** (former Hotel@MIT).
http://www.starwoodhotels.com/lemeridien/property/overview/index.html?propertyID=3253

Street address: LeMeridien Cambridge-MIT Hotel, 20 Sidney Street, Cambridge, MA 02139, +1.617.577.0200

Accommodations

A block of rooms has been reserved at special rates for short course attendees at the **LeMeridien Cambridge-MIT** (former Hotel@MIT).

To make a reservation, please follow this link:
http://www.starwoodmeeting.com/StarGroupsWeb/res?id=1111173067&key=78B42

Alternatively, you can call the hotel and make a reservation under the code name “Materiomics”.
Phone number: +1.617.577.0200

The rooms at the **special rate of $179 will only be held until April 15, 2012.**

Registration

Registration form can done electronically at: http://tam.northwestern.edu/summerinstitute/Home.htm

Mail in the completed registration form with check or money order by **March 1, 2012**.
Make check or money order payable to:
Northwestern University
Send to: Northwestern University, Dept. of Materials Science and Engineering, 2220 N. Campus Drive, Evanston, Illinois, 60208
Attn: Yip-Wah Chung

For additional information, contact:

URL: http://tam.northwestern.edu/summerinstitute/Home.htm
E-mail: summerinstitute@mail.mech.northwestern.edu

NSF Summer Institute on Nanomechanics, Nanomaterials and Micro/Nanomanufacturing

Schedule (Wed May 30 - Friday June 1, 2012) – all lectures in the **Hunsaker ABC Room**

Time	Speaker	Topic
Wed, May 30, 2012	**Theoretical and computational methods**	
8:00-8:30 am	M. Buehler	Introductory remarks & logistics
8:30-9:00 am	NSF Program Manager M. Dunn (CMMI)	Overview
9:00-10:00 am	M. Boyce	Nano-/micromechanics of biopolymers
10:00-10:30 am	Coffee break	
10:30-11:30 am	M. Boyce	Mechanics of naturally structured materials
11:30-12:30 pm	M. Buehler	Molecular mechanics
12:30-1:30 pm	Lunch	
1:30-2:30 pm	W.K. Liu	Multiscale modeling I
2:30-3:30 pm	W.K. Liu	Multiscale modeling II
3:30-4:00 pm	Coffee break	
4:00-5:00 pm	D. Kaplan	Biomaterials I
5:00-6:00 pm	D. Kaplan	Biomaterials II
Dinner (on your own)		
Thur, May 31, 2012	**Experimental methods**	
8:00-9:00 am	C. Ortiz	Experimental nanomechanics I
9:00-10:00 am	C. Ortiz	Experimental nanomechanics II
10:00-10:30 am	Coffee break	
10:30-11:30 am	D. Weitz	Physics of soft matter I
11:30-12:30 pm	D. Weitz	Physics of soft matter II
12:30-1:30 pm	Lunch	
1:30-2:30 pm	J. Wong	Microfluidics and regenerative medicine I
2:30-3:30 pm	J. Wong	Microfluidics and regenerative medicine II
3:30-4:00 pm	Coffee break	
4:00-5:00 pm		
5:00-6:00 pm	N. Oxman	Architecture and materials I
Dinner (on your own)	N. Oxman	Architecture and materials II
Fri, June 1, 2012	**Case studies & applications**	
8:00-9:00 am	P. Silver	Synthetic biology I
9:00-10:00 am	P. Silver	Synthetic biology II
10:00-10:30 am	Coffee break	
10:30-11:30 am	J. Aizenberg	Hierarchical materials & self-assembly I
11:30-12:30 pm	J. Aizenberg	Hierarchical materials & self-assembly II
12:30-1:30 pm	Lunch	
1:30-2:30 pm	W. Shih	DNA nanotechnology I
2:30-3:30 pm	W. Shih	DNA nanotechnology II
3:30-4:00 pm	Coffee break	
4:00-5:00 pm	M. Buehler	Discussion, concluding remarks & wrap-up

Speaker bios (alphabetical order)

Joanna Aizenberg, Amy Smith Berylson Professor of Materials Science; Professor of Chemistry and Chemical Biology, Radcliffe Professor and the Director of the Kavli Institute for Bionano Science and Technology at Harvard University, pursues a broad range of research interests that include biomimetics, self-assembly, smart materials, crystal engineering, surface chemistry, nanofabrication, biomineralization, biomechanics and biooptics. She received the B.S. degree in Chemistry in 1981, the M.S. degree in Physical Chemistry in 1984 from Moscow State University, and the Ph.D. degree in Structural Biology from the Weizmann Institute of Science in 1996. Prior to her appointment at Harvard, Aizenberg was at Bell Labs/Lucent Technologies. She made several pioneering contributions, including the development of new biomimetic approaches for the synthesis of ordered mineral films with highly controlled shapes and orientations; and the discovery of unique optical systems formed by organisms (microlenses and optical fibers) that outshine their technological analogs. Currently she has extended her program to developing new, adaptive materials that respond to their environment. Aizenberg's selected awards include the Distinguished and Award Lectureships from the Northwestern University, U Kentucky, Dalhousie U, Molecular Foundry-LBNL, NYU, University of Minnesota, UCSB; the Fred Kavli Distinguished Lectureship in Nanoscience, Materials Research Society 2009; the Van't Hoff Award Lectureship, Dutch Royal Academy, 2009; The Ronald Breslow Award for the Achievement in Biomimetic Chemistry, ACS 2008; the Industrial Innovation Award, American Chemical Society 2007; Lucent Chairman's Award, 2005; New Investigator Award in Chemistry and Biology of Mineralized Tissues, 2001; Arthur K. Doolittle Award, American Chemical Society 1999; Award of the Max-Planck Society in Biology and Materials Science, 1995. Aizenberg is a AAAS Fellow; she has served at the Board of Directors of the Materials Research Society and at the Board on Physics and Astronomy of the National Academies. She is serving on the Advisory Board of Langmuir and Chemistry of Materials. E-mail: jaiz@seas.harvard.edu Lab URL: www.seas.harvard.edu/aizenberg_lab/

Mary C. Boyce is the Gail E. Kendall (1978) Professor and Department Head of Mechanical Engineering at the Massachusetts Institute of Technology. Professor Boyce earned her B.S. degree in Engineering Science and Mechanics from Virginia Tech; and her S.M. and Ph.D. degrees in Mechanical Engineering from the Massachusetts Institute of Technology. She joined the M.I.T. faculty in 1987. Professor Boyce teaches in the areas of mechanics and materials. Her research areas focus primarily on the mechanics of elastomers, polymers, polymeric-based micro- and nano-composite materials, lattice-structured materials, natural materials, and biological macromolecular networks, with emphasis on identifying connections among microstructure, deformation mechanisms, and mechanical properties. She has published over 100 journal papers in the field of mechanics and materials; and has mentored 36 SM Thesis students and 20 PhD students. Professor Boyce has been the recipient of several awards and honors recognizing her research and teaching efforts, including the MIT MacVicar Faculty Fellow, the Department of Mechanical Engineering Keenan Award for Teaching, the Spira Award for Teaching, the NSF Presidential Young Investigator Award, the ASME Applied Mechanics Young Investigator Award, Member-at-Large of the USNCTAM, Chair of the ASME Applied Mechanics Division, Fellow of the American Academy of Mechanics, Fellow of the ASME, and Fellow of the American Academy of Arts and Sciences. E-mail: mcboyce@mit.edu Lab URL: http://meche.mit.edu/people/index.html?id=11

Markus J. Buehler is an Associate Professor in the Department of Civil and Environmental Engineering at the Massachusetts Institute of Technology, where he directs the Laboratory for Atomistic and Molecular Mechanics (LAMM). Buehler's research focuses on bottom-up simulation of structural and mechanical properties of biological, bioinspired and synthetic materials across multiple scales, with a specific focus on materials failure from a nanoscale and molecular perspective. His work has identified the core principles that link atomistic-level chemical structures to functional scales by understanding how biological materials achieve superior mechanical properties through the formation of hierarchical structures, which has resulted in the development of biologically inspired materials. His research has demonstrated that the chemical composition of biological materials plays a minor role in achieving functional properties. Rather, the way components are connected at distinct length-scales defines what material properties can be achieved, how they can be altered, and how they fail in disease states and physiologically extreme conditions. Buehler has published more than 170 articles on computational materials science, nanotechnology and nanoscience, authored two monographs, and given several hundred invited, keynote and plenary talks. He was cited as one of the top engineers in the United States between the ages of 30-45 through invitation to the National Academy of Engineering-Frontiers in Engineering Symposium of the National Academy of Engineering. Buehler received the National Science Foundation CAREER award, the United States Air Force Young Investigator Award, the Navy Young Investigator Award, and the DARPA Young Faculty Award and his work was recognized by the Presidential Early Career Award for Scientists and Engineers (PECASE). He recently received the Harold E. Edgerton Faculty Achievement Award for exceptional distinction in teaching and in research or scholarship, the highest honor bestowed on young MIT faculty. Other major awards include the Materials Research Society Outstanding Young Investigator Award, the Society of Engineering Science Young Investigator Medal, the Thomas J.R. Hughes Young Investigator Award, the Sia Nemat-Nasser Medal, the Rossiter W. Raymond Memorial Award, the Stephen Brunauer Award, the Alfred Noble Prize, and the Leonardo da Vinci Award. Buehler serves as a member of the editorial board of several international journals including: BioNanoScience (as Editor-in-Chief), Roy. Soc. Interface, PLoS ONE, Int. J. Appl. Mech., Acta Mech. Sinica, J. Mech. Beh. Biomed. Mat., J. of Engrg. Mech., J. Nanomech. Micromech, and the J. Comp. and Theor. Nanosci. He is the founding chair of the Biomechanics Committee at the Engineering Mechanics Institute of ASCE, a member of the U.S. National Committee on Biomechanics, and participates actively in several committees at ASME. E-mail: mbuehler@MIT.EDU Lab URL: http://web.mit.edu/mbuehler/www/ and http://cee.mit.edu/buehler

David Kaplan holds an Endowed Chair, the Stern Family Professor of Engineering, at Tufts University. He is Professor & Chair of the Department of Biomedical Engineering and also holds faculty appointments in the School of Medicine, the School of Dental Medicine, Department of Chemistry and the Department of Chemical and Biological Engineering. His research focus is on biopolymer engineering to understand structure-function relationships, with emphasis on studies related to self-assembly, biomaterials engineering and functional tissue engineering. He has published over 400 papers and edited eight books. He directs the NIH P41 Tissue Engineering Resource Center (TERC) that involves Tufts University and Columbia University. He serves of the editorial boards of numerous journals and is Associate Editor for the journal Biomacromolecules. He has received a number of awards for teaching, was Elected Fellow American Institute of Medical and Biological Engineering and received the Columbus Discovery Medal and Society for Biomaterials Clemson Award for contributions to the literature. E-mail: David.Kaplan@tufts.edu URL: http://ase.tufts.edu/terc/ and http://engineering.tufts.edu/bme/people/kaplan/index.asp

Wing Kam Liu is Walter P. Murphy Professor of Mechanical Engineering at Northwestern University and Founding Chair of the ASME NanoEngineering Council. He received his B.S. from the University of Illinois at Chicago; his M.S. and Ph.D. both from Caltech. He is a world leader in multiscale simulation-based engineering and science and has applied a spectrum of atomistic, quantum, and continuum strategies towards the understanding of nanomaterial function and biological processes. He was the first to develop concurrent multiscale methods for materials design. These methods have been used to design new alloys and nano-composites. Recently, he has developed the 3D immersed electrokinetic molecular finite element method for modeling the microfluidic electrokinetic assembly of nano wires and filaments and bio-molecules. This transformative bio-nanotechnology has the potential to revolutionalize drug delivery system to achieve the desired therapeutic effects. Selected honors include the 2009 Dedicated Service Award, the Robert Henry Thurston Lecture Award, the Gustus L. Larson Memorial Award, the Pi Tau Sigma Gold Medal and the Melville Medal, (all from ASME); the John von Neumann Medal from US Association of Computational Mechanics (USACM); and the Computational Mechanics Awards of the International Association of Computational Mechanics (IACM) and the Japanese Society of Mechanical Engineers. Liu chaired the ASME Applied Mechanics Division and is past president of USACM. He is listed by the Institute for Scientific Information as one of the most highly cited researchers in engineering. He is the editor of two International Journals and honorary editor of two journals and has been a consultant for more than 20 organizations. Liu has written three books, the Finite Element book becomes a classical in the field and the Nano Mechanics and Materials book received a very favorable review by Nanotoday (Nov, 2006). E-mail: w-liu@northwestern.edu Lab URL: http://www.tam.northwestern.edu/wkl/liu.html

Christine Ortiz is the Dean for Graduate Education and a Professor of Materials Science and Engineering at the Massachusetts Institute of Technology. Professor Ortiz obtained her BS from Rensselaer Polytechnic Institute in Troy, NY, and her MS and PhD from Cornell University in Ithaca, NY, all in the field of materials science and engineering. After graduation, she was granted an NSF-NATO post-doctoral fellowship which she used to carry out research in the Department of Polymer Chemistry, University of Groningen, in the Netherlands. Dr. Ortiz's research program focuses on the ultrastructure and nanomechanics of structural biological materials (musculoskeletal and exoskeletal) with the primary goal being to quantify and understand new nanoscale mechanisms, phenomena, and design principles and how they determine function, quality, and pathology. Dr. Ortiz has over 140 scientific publications in more than 20 different academic journals. She has given more than 100 invited lectures, over 30 of which were international, taking place in 12 countries and at eight different Gordon Research Conferences. Dr. Ortiz has supervised a total of 60 students from eight different academic departments. She has received over 20 national and international honors, including most recently the National Security Science and Engineering Faculty Fellow Award; she was a Lady Davis Fellow and Visiting Professor at the Hebrew University of Jerusalem in Israel, where she received the Hadassah Appreciation Medal; the MIT Martin Luther King Jr. Leadership Award; a recognition award for “Outstanding Alumni” by the National Consortium for Graduate Degrees for Minorities in Engineering and Science; and the National Science Foundation Presidential Early Career Award for Scientists and Engineers, which was presented to her by President George W. Bush at the White House. She is also a fellow of the Department of Defense Science Study Group. Dr. Ortiz currently serves on the editorial boards of the journals Science, Marine Biotechnology, International Journal of Surface Science and Engineering, and Advanced Biomaterials. She has served as a review panelist for the National Science Foundation, the National Institutes of Health, the National Aeronautics and Space Administration, and the Department of Defense. Dr. Ortiz is the founding faculty director of the MIT International Science and Technology Initiatives (MISTI) Israel international exchange. She has served on over 25 institute and departmental committees including those that focus on faculty and administration searches, diversity, undergraduate and graduate education, international strategy, and commencement. Professor Ortiz has a strong commitment to teaching, mentoring, and increasing diversity at all educational levels. E-mail: cortiz@mit.edu Lab URL: http://web.mit.edu/cortiz/www/

Neri Oxman is an Architect and designer, and currently the Sony Corporation Career Development Professor and Assistant Professor of Media Arts and Sciences at the MIT Media Lab where she directs the Mediated Matter research group. Her group explores how digital design and fabrication technologies mediate between matter and environment to radically transform the design and construction of objects, buildings, and systems. Oxman's goal is to enhance the relationship between the built and the natural environment by employing design principles inspired by nature and implementing them in the invention of digital design technologies. Areas of application include product and architectural design as well as digital fabrication and construction. Oxman was named to the "top 20 most influential architects to shape our future" by ICON (2009) and was selected as one of the "100 most creative people" by FASTCOMPANY (2009). In 2008, she has been named "Revolutionary Mind" by SEED Magazine. Oxman received her PhD in Design Computation as a Presidential Fellow from MIT, where she developed the theory and practice of Material-based Design Computation. Prior to MIT, Oxman received her diploma from the Architectural Association (RIBA 2) after attending the Faculty of Architecture and Town Planning at the Technion Israel Institute of Technology and the Department of Medical Sciences at the Hebrew University in Jerusalem. Her work has been exhibited at MoMA (NYC) and is part of the museum's permanent collection. Recent work has been included in Centre Pompidou's permanent collection; other exhibitions include the Museum of Science (Boston, MA), FRAC Collection (Orleans, France), and the 2009 and 2010 Beijing Biennale. She received numerous awards including a Graham Foundation Carter Manny Award, the International Earth Award for Future-Crucial Design, a METROPOLIS Next Generation Award, and many others. E-mail: neri@mit.edu Lab URL: http://web.media.mit.edu/~neri/site/index.html and http://www.media.mit.edu/people/neri

William Shih is an Associate Professor in the Department of Biological Chemistry and Molecular Pharmacology at Harvard Medical School and the Department of Cancer Biology at the Dana-Farber Cancer Institute. In 2008, William received a New Innovator Award from the National Institutes of Health. William is overseeing an effort to apply Synthetic Biology approaches to the development of self-assembling DNA nanostructures and devices for use in biomedical applications. In addition to carrying genetic information, DNA is increasingly being explored for its use as a building material. This new process is called DNA origami because a long strand of DNA can be programmed to fold in on itself to create specific shapes, much as a single sheet of paper is folded to create a variety of designs in the traditional Japanese art. Using long biologically produced DNA strands to construct particles with precisely specified shapes, William is able to approximate a level of complexity that rivals that of the molecular machinery found in cells. To achieve structures of even greater complexity, his laboratory is pioneering methods for hierarchical assembly of these particles into three-dimensional networks with site-specific control over chemical functionalization and mechanical actuation. This work could lead to breakthroughs in manufacturing and medicine. For example, these incredibly tiny forms could be used as cogs in a machine for molecular manufacturing, optical reporters for bioimaging, and carriers for delivery of cancer drugs deep inside the body. Working in the Programmable Biomaterials Platform at the Wyss, William most recently created nanodevices made of DNA that self-assemble and can be programmed to move and change shape on demand. In contrast to existing nanotechnologies, these programmable nanodevices are highly suitable for medical applications because DNA is both biocompatible and biodegradable. E-mail: William.Shih@wyss.harvard.edu Lab URL: http://research4.dfci.harvard.edu/shih/SHIH_LAB/Home.html

	**Pamela Silver** received her BS in Chemistry and PhD in Biochemistry from the University of California where she was an NIH Pre-doctoral Fellow. She was a Postdoctoral Fellow at Harvard University where she was a Fellow of the American Cancer Society and The Medical Foundation. Subsequently, she was an Assistant Professor in Molecular Biology at Princeton University where she was an Established Investigator of the American Heart Association, a Scholar of the March of Dimes and an NSF Presidential Young Investigator. She moved to Harvard Medical School where she was a Professor in the Dept of Biological Chemistry and Molecular Pharmacology. She was named a Claudia Adams Barr Investigator and awarded the Mentoring Award for the PhD Program in Biological and Biomedical Sciences at Harvard Medical School. In 2004, she became one of the first members of the Department of Systems Biology at Harvard Medical School and the first Director of the Harvard University PhD Program in Systems Biology. In 2009, she became one of the founding members of the Harvard University Wyss Institute for Biologically Inspired Engineering. Her work was recognized by an Innovation Award at BIO2007 and has been funded by grants from the NIH, DOD, DOE, NSF, Novartis, Merck and The Keck Foundation. She currently holds an NIH MERIT award. She has served on numerous government and private advisory panels including the NIH Pioneer and Innovator Award Committees, the NAS/NRC Study on Network Science, the OSD/NA Biodefense Workshop, the Jane Coffin Childs Memorial Fund, the Novartis Oncology Program and the Institute of Synthetic Biology at Imperial College. She was recently appointed as a Fellow of the Radcliffe Institute. Her laboratory works in diverse areas of Systems and Synthetic Biology. The main focus areas include predictable design and re-programming of biological systems and designing sustainability. E-mail: pamela_silver@hms.harvard.edu Lab URL: http://silver.med.harvard.edu/
	**David A. Weitz** received his PhD in Physics from Harvard. He worked at Exxon Research and Engineering as a research physicist for nearly 18 years, and then became a Professor of Physics at the University of Pennsylvania. He moved to Harvard about 12 years ago, and is currently Professor of Physics and Applied Physics. He is also the director of Harvard's Materials Research Science and Engineering Center, and the co-director of the BASF Advance Research Initiative at Harvard. He heads a research group that investigates experimental soft matter physics. They focus on soft materials, biophysics and microfluidics. Several start-up companies have been formed based on the research in the group. Weitz is a member of the National Academy of Sciences. E-mail: weitz@seas.harvard.edu Lab URL: http://weitzlab.seas.harvard.edu/
	**Joyce Y. Wong** is an Associate Professor in Biomedical Engineering (BME) and a College of Engineering Distinguished Faculty Fellow at Boston University. She received her PhD training with Robert Langer (ScD) at MIT and postdoctoral training with Jacob Israelachvili (PhD) at UC-Santa Barbara as a NIH-NRSA postdoctoral fellow. Dr. Wong's research focuses on the development of biomaterials to probe how structure, material properties and composition of the cell-biomaterial interface affect fundamental cellular processes. Her current research interests include tissue engineering of small diameter blood vessels for pediatric vascular repair; development of targeted nano- and micro-particle contrast agents for multi-modal (magnetic resonance, ultrasound, and optical) detection of atherosclerotic and vulnerable plaque; and engineering biomimetic systems to study restenosis and cancer. Dr. Wong's research has been funded by NIH, NASA, DOE, and industry. Awards she has received include a NSF CAREER Award (2000), Clare Boothe Luce Assistant Professorship (1998-2003), Dupont Young Professor Award (2004). She was elected to the American Institute for Medical and Biological Engineering, AIMBE (2009), and received a Hartwell Individual Biomedical Research Award (Class of 2009). She was also selected for participation in the National Academy of Science Frontiers in Engineering (2001), National Academies Keck Futures Initiative Conference (2003), German-American Frontiers in Polymer Science (2003), and Japan-America Frontiers in Engineering (2004). Dr. Wong has served as Associate Director of the Center for Nanoscience and Nanobiotechnology (2006-2008) and Associate Chair for Graduate Studies (2006-2010) in Biomedical Engineering at Boston University. E-mail: jywong@bu.edu Lab URL: http://people.bu.edu/wonglab/people.html