

Registration Form

U.S. professors, postdocs and graduate students  
(See other side for NSF Fellowships).

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_

Zip Code: \_\_\_\_\_ Country: \_\_\_\_\_

E-mail: \_\_\_\_\_

Affiliation (will be printed on your name tag)

\_\_\_\_\_

Phone: (\_\_\_\_) \_\_\_\_\_

Institute Mission

- To identify and promote important areas of nanotechnology, and to create new areas of focus which will augment current nanotechnology research and development by universities, industries and government.
- To train future and practicing engineers, scientists and educators in the emerging areas of nanotechnology, nano-engineering, nano-mechanics, and nano-materials.
- To exchange new ideas, disseminate knowledge and provide valuable networking opportunities for researchers and leaders in the field.

Course Description

Nature has evolved and perfected systemic architectures including membrane proteins, signaling molecules, and genetic materials, that drive the processes of life. These elements coalesce and culminate towards an elegant coordination of sensors and actuators that make up a single cell. Advances in the development of modalities, both fundamental in nature and application-specific, to benefit the human condition will rely on the ability to precisely manipulate cellular components, and ultimately the cell itself to interrogate its internal functional mechanisms.

Conventional micro/nanofabrication techniques have formulated a framework upon which a spectrum of devices have been realized that enable unprecedented biological interrogation capabilities in several areas including 1) Sensing in the form of chip-based ELISA, electrochemical, and optical detection; 2) Processing in the form of micro/nanofluidics and hydrodynamic, electrokinetic, and dielectrophoretic mixing/manipulation; as well as 3) Bio-monitoring in the form of cellular electro-probing (micro/nanoelectrodes), mechano-transduction (e.g. cantilever-based), as well as smart Petri dish technology. This foundation will forge the blending of a myriad of advanced techniques to empower highly sophisticated,

fundamental bio-interrogation studies to better understand that mechanisms that drive cellular behavior. This enhanced knowledge will further catalyze the advent of unprecedented cell control capabilities for directed genotypic and phenotypic outcomes towards therapeutic relevance in the areas of neuroscience, cancer, stem cell biology, immunity, and beyond.

Program Outline

Each session is 3 hrs with breaks in between each topic.

**L:** (lecture) **P:** (practicum)

Monday 9:30-12:00pm

**L1:** Conventional Materials for Micro/Nanofabrication

**L2:** Introduction to Microfabrication Techniques

**L3:** Parylene as Foundation of Novel Devices

Monday 1:00-3:00pm

**L4:** Micro-HPLC and Cell Filtration Technology

**L5:** *In Vivo* Microfabricated Medical Devices

**P1:** Lab Tour 1-CMISE Core Lab Tour

Tuesday 9:30-12:00pm

**L6:** Introduction to Fluid Mechanics and Biology

**L7:** Smart Petri Dish Technology for Bio-Manipulation

**L8:** Chip-Based Biological Detection Technology

**L9:** Intelligent Control of Cellular States(an overview)

Tuesday 1:00-4:30pm

**L10:** Nanomolecular Manipulation and its Applications

**L11:** Mechanobiotechnology and its Medical Implications

**P2:** Lab Tours 2-UCLA Nanofabrication Facility

**P3:** Lab Tours 3-Chih-Ming Ho Laboratory

Wednesday 8:30-12:00pm

**L12:** Nanofabrication Modalities-Nanoimprintation

**L13:** Nanowires as Novel DNA Detection Technologies

**L14:** Neural Activity Measurement via Nanowire Sensors

**L15:** Directed Surface Functionalization

**P4:** Lab Tours 4-Yong Chen Laboratory

Wednesday 1:00-3:00pm

**L16:** Bio-Interrogation via Atomic Force Microscopy **L18:**

**L17:**Investigation of Distinguishable Membrane Properties  
Obtained Through AFM

**L18:** TCL1 as a Biological Rheostat: Cancer Regulation

**L19:** Introduction to Live Cell Surgery

**P5:** Lab Tours 5-Teitell Laboratory

Thursday 8:30-12:00pm

**L20:** Biological Performance of Materials

**L21:** Overview of Deposition Modalites (e.g. Langmuir-Blodgett, Self-Assembly, Layer-By-Layer)

Thursday 1:00-3:00pm

**L22:** Introduction to Block Copolymer Membrane Technology

**L23:** Copolymer Membranes as Matrices for Protein Binding

**L24:** Drug Trapping and Releasing Copolymeric Materials

**P6:** Lab Tours 6- School of Engineering Materials Characterization Core

Tentative Lab Tours:

Mechanical Engineering:

Engineering IV Cleanroom facilities

CMISE laboratory

School of Medicine:

Core Microscopy Facility

Henry Samueli School of Engineering:

Laboratory Tours (Chen, Ho)

Core Materials Characterization Facilities

Course Credit and Pre-requisites

The total number of contact hours for the four-day program is 21.5, and 2.2 CEUs. There are certain pre-requisites for each topic. In order to maximize the learning experience, we will provide complete course materials to students prior to the class. Pre-requisite material will be reviewed briefly at the beginning of each course.

Instructors

**Dr. Chih-Ming Ho** holds the Ben Rich-Lockheed Martin Chair Professor in School of Engineering . He is the Director of the Institute for Cell Mimetic Space Exploration (CMISE) with a goal of fusing bio-nano-information technologies, as well as the Center for Cell Control, a National Institutes of Health Nanomedicine Roadmap Center. After receiving his Ph.D. from The Johns Hopkins University, Dr. Ho started his career at the University of Southern California and rose to the rank of Full Professor. In 1991, he moved to the University of California , Los Angeles to lead the establishment of the micro-electro-mechanical -system (MEMS) field in UCLA and served as the founding Director of the Center for Micro Systems. To this day, the UCLA MEMS research has been recognized as one of the top three programs in the world. He served as UCLA Associate Vice Chancellor for Research from 2001 to 2005.

He is known for his contributions in bio-nano technology, micro/nano fluidics, and turbulence. He was ranked by ISI as one of the top 250 most cited researchers in all engineering category around the world. In 1997, Dr.

Ho was inducted as a member of the National Academy of Engineering. In the next year, he was elected as an Academician of Academia Sinica which honors scholars of Chinese origin with exceptional achievements in liberal arts and sciences. Dr. Ho holds five honorary professorships. He has published 260 papers and 10 patents. He presented over 100 keynote talks in international conferences. Dr. Ho was elected Fellow of the American Physical Society as well as American Institute of Aeronautics and Astronautics for his contributions in a wide spectrum of technical areas.

In addition to his academic accomplishments, he has made extensive contributions to the professional societies around the world. He has chaired the Division of Fluid Dynamics (DFD) in American Physical Society, which is the leading platform in the United States for scientists interested in fundamental fluid dynamics. He is on the advisory board for AIAA Journal. He is a member of the IEEE/ASME JMEMS coordinating Committee. He was an Associate Editor of the ASME Journal of Fluids Engineering and an Associate Editor of the AIAA Journal. He also has served as a Guest Editor for Annual Review of Fluid Dynamics.

On the international level, he has served on advisory panels to provide assistance to many countries and regions, China , France , United Kingdom , Korea , Israel , Taiwan , Hong Kong and Japan , on the developments of nano/micro technologies. Dr. Ho also has chaired or served on numerous organizing committees of international conferences on high technology topics.

**Dr. Yu-Chong Tai** has over 12 years of experience doing micromachines and/or Micro-electro-mechanical-system (MEMS) research. His research interests include MEMS technology, microsensors, microactuators, microstructure, MEMS systems, and MEMS science. To name a few, successfully developed MEMS devices in his lab include pressure sensors, shear-stress sensors, hot-wire anemometers, magnetic actuators, microphones, microvalves, micromotors, and so on. System-level MEMS research projects then include integrated M<sup>3</sup> (microelectronics + microsensors + microactuators) drag-reduction smart surface, flexible smart skin for the control unmanned aerial vehicles, and micro fluid delivery systems. He is also interested in MEMS sciences such as MEMS material (mechanical and thermal) properties, micro fluid mechanics, and micro/nano processing issues.

Dr. Tai built the Micromachining Laboratory at Caltech, which is an 8,000 sq. ft. facility completely designed for MEMS research. This facility has a clean-room lab (4,000 sq. ft), CAD lab, and a measurement/metrology lab. It is currently supporting more than 20 researchers (mainly graduates and postdocs)

with various MEMS research projects (<https://mems.caltech.edu>). Examples include micro scanning mirrors, neural chips, micro electromagnetic relays, field-emission tips, etc. For the last few years, he has extensively worked on MEMS devices for active fluid sensing and control. Successfully developed MEMS devices include flexible sensor skins, rubber-balloon actuators, etc. In addition, he also has research on integrated MEMS systems such as MEMS for delta-wing aerodynamic control, and MEMS-maneuvered unmanned aerial vehicle (UAV). Since seven years ago, he has initiated a major effort on microfluidics and labs-on-a-chip. He has built devices like micro channels, membrane filters, micro valves, pumps, and bioreactors for bio-medical applications. He has an extensive and collaborative research program with USC Medical School on retinal implants, including MEMS devices for eye applications. He also has a significant research effort on nanotechnology for artificial muscle applications.

**Dr. Yong Chen** is a joint Professor of California NanoSystems Institute, Mechanical and Aerospace Engineering, and Materials Science and Engineering at UCLA. His current research focuses on nanofabrication technologies, integrated nano device and circuit, and nanoscale biological and medical sensors. Before he joined UCLA, he worked as a Scientist, a Senior Scientist, and a Master Scientist in Quantum Science Research, in Hewlett-Packard Laboratories from 1996 to 2003. The research group led by him in HP demonstrated the world's highest density (40Gbits/inch<sup>2</sup>) electronic memory circuits in 2003 and the first nanoscale de/multiplexer for electric circuits. His thesis research focused on optoelectronic materials, especially on self-organized semiconductor quantum dots.

**Dr. Michael Teitell** received B.S. and M.S. degrees from the UCLA College Honors Program as a Departmental Scholar in Chemistry and Biochemistry in 1985. He earned combined M.D. and Ph.D. degrees in the UCLA Medical Scientist Training Program in 1993. His graduate and early post-doctoral studies were with Dr. Mitchell Kronenberg at UCLA in Molecular and Cellular Immunology. Dr. Teitell was a Resident and Clinical Instructor in Anatomic Pathology at Brigham and Women's Hospital and Harvard Medical School from 1993-1995. During this time he was a Research Associate with Dr. Richard Blumberg. From 1995-1997, Dr. Teitell was a Resident in Clinical Pathology at UCSF and a post-doctoral researcher with Dr. Joe Gray. From 1997-1999, he held a joint appointment at Children's Hospital of Los Angeles as a Pediatric Pathology Fellow and at UCLA as a Clinical Instructor in Pathology. He became an Assistant Professor in the UCLA Department of Pathology and Laboratory Medicine in 1999.

He was jointly appointed in the UCLA Department of Pediatrics in 2001 and was promoted to Associate Professor with tenure in 2004. He currently serves as Chief of the Division of Pediatric and Developmental Pathology, with board certification in anatomic, clinical and pediatric pathology.

Dr. Teitell has received several important honors and awards. Among these are the David Paul Kane Scholar Award of the Jonsson Cancer Center Foundation (2000-2001), the Lymphoma Research Foundation Junior Faculty Award (2001-2002), the FOCIS/Millennium Pharmaceuticals Young Investigator Award in Genomics Research (2001-2002), a Scholar Award from the Leukemia and Lymphoma Society (2003-2008), election to the American Society of Clinical Investigators (2004) and a Margaret E. Early Medical Research Trust Award (2005).

**Dr. Dean Ho** is currently an Assistant Professor in the Departments of Biomedical Engineering and Mechanical Engineering in the Robert R. McCormick School of Engineering and Applied Science, and Full Member of the Robert H. Lurie Comprehensive Cancer Center at the Feinberg School of Medicine of Northwestern University where he directs the Laboratory for Nanoscale Biotic-Abiotic Systems Engineering (N-BASE).

His research has covered emerging areas of bio-nano-technology and protein-functionalized materials. Dr. Ho has been among the first to demonstrate the coupling of protein function with a polymer film to fabricate nano energy conversion systems. This work is the subject of his recently published article in *Nanotechnology (Cover Article)* as well as a featured article in *Nanotechnology* that was downloaded over 1000 times which was among the top 10% of all downloaded Institute of Physics (IOP) publications. He has published over 40 peer-reviewed journal and conference papers in the areas of bio/chemical energetics, biotic-abiotic interfacing, as well as developing novel solar power sources.

Currently, Dr. Ho is investigating the fabrication of glucocorticoid-functionalized materials as anti-inflammatory coatings to enhance implant biocompatibility, as well as using nanowires and nanotubes as neuronal interrogative modalities. Dr. Ho's extensive research achievements have garnered news coverage in *Nature*, *MICRO/NANO*, as well as BBC Radio. Dr. Ho is currently an Associate Editor of the Journal of Nanotechnology Law and Business and a member of Sigma Xi. He was recently honored by the New Faces of Engineering National Award as a first runner up presented by IEEE.

### NSF Fellowships

NSF fellowships are available to professors, postdocs and Ph.D. candidates from US universities. The fellowship consists of full tuition plus a travel allowance if applicable. Please see web site for application forms. In addition, please submit a two-page vita in NSF format and a 200-word statement indicating why the short course will help your career by **April 1, 2007**.

### Registration

Mail in the completed registration form with check or money order by **May 1, 2007**.

Make check or money order payable to:

**Northwestern University**

**Send to:**

Northwestern University, Dept. of Mechanical Engineering,  
2145 Sheridan Rd., TECH B224, Evanston, IL 60208  
Attn: Wing Kam Liu

### Fees

The registration fee for the short course is: \$2,000.

**An additional \$200 fee will be added to late registrations received after June 1, 2007 Register by April 1, 2007 and receive a 20% discount.** The fee includes continental breakfast, coffee breaks, and lunch each day plus a Reception Dinner on Monday and a Banquet Dinner on Thursday, presentation materials, lecture notes and appropriate review papers.

### Location

The course will be held at the University of California, Los Angeles.

### Accommodations

A block of rooms has been reserved at special rates *inclusive of meals (breakfast, lunch, dinner)* based on double occupancy for short course attendees at the **UCLA De Neve Plaza Housing Facility**. Attendees should contact Dr. Dean Ho directly ([d-ho@northwestern.edu](mailto:d-ho@northwestern.edu), 847-467-0548) to make reservations, or checking the Institute website for more details. Requests for early arrival or extended stays will be accommodated based on room availability through [evillaver@ha.ucla.edu](mailto:evillaver@ha.ucla.edu). Early reservations are highly recommended. The meal-inclusive package rooms at the **special rate of \$160 will only be held until May 13, 2007**.

### Daily Schedule

The lectures start at 8:30 a.m. and end at 4:30 p.m. with a one-hour lunch break and breaks between each discussed topic.

**For additional information, contact:**

<http://tam.northwestern.edu/summerinstitute/Home.htm>  
email: [summerinstitute@mail.mech.northwestern.edu](mailto:summerinstitute@mail.mech.northwestern.edu)



## NSF Summer Institute on Nano Mechanics and Materials \*

**Co-sponsored by: ASME, the NASA URETI BIMat Center, NU Nanoscale Science and Engineering Center, Northwestern University, and the CSET, NSF IGERT on Virtual Tribology and AVS Science & Technology Society**

Professor Wing Kam Liu (Director)  
Professor Ted Belytschko (Co-Director)  
Professor Yip Wah Chung (Co-Director)  
Professor Q. Jane Wang (Co-Director)

Northwestern University, Robert R. McCormick School of Engineering and Applied Science, 2145 Sheridan Rd.  
Evanston, IL 60208

\*Funded by the Civil and Mechanical Systems Division, monitored and guided by Dr. Ken P. Chong.

## A Short Course on Micro/Nanotechnology and its Coalescence with Biology for Potential Medical Applications

### Instructors:

Chih-Ming Ho (UCLA)  
Yu-Chong Tai (Caltech)  
Dean Ho (Northwestern University)

### Guest Lecturers:

Mike Teitell (UCLA)  
Yong Chen (UCLA)

**July 16-19, 2007**