

# CHIEH CHANG, Ph.D.

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## AREAS OF INTERESTS

Renewable energy (Biofuel, energy harvester, and solar cells); Microfluidics; Nanomaterials synthesis and assembly; Nanomaterials for sensing and actuation; MEMS design, fabrication, packaging, and testing; Piezoelectricity.

Press coverage of my Ph.D. research can be found here: <http://www.ocf.berkeley.edu/~cyl/news.html>

## EDUCATION

08/2005 – 12/2009 **Ph.D.** in Mechanical Engineering (MEMS/NANO), **University of California, Berkeley, CA**

Minors: Electrical Engineering and Bioengineering

Ph.D. thesis: “Direct-Write Piezoelectric Nanogenerator by Near-Field Electrospinning”

Research advisor: Prof. Liwei Lin

09/2001 – 07/2003 **M.S.** in Power Mechanical Engineering, **National Tsing Hua University, Hsinchu, Taiwan**

Master thesis: “Novel Lobster Antennules-Like Micro-Actuators for the Manipulation of Biology Objects”

Research advisor: Prof. Cheng-Hsien Liu

09/1997 – 06/2001 **B.S.** in Power Mechanical Engineering, **National Tsing Hua University, Hsinchu, Taiwan**

## SKILLS

Nano fabrication	Electrospinning of nanofibers, Vapor–liquid–solid (VLS) growth of carbon nanotubes and nanowires.
Micro fabrication	Soft lithography (single and multilayer PDMS chip), Wet bench, Photolithography, Double-sided aligner, Chemical vapor deposition (PECVD, LPCVD), Sputter, Evaporator, Reactive ion etching (RIE), XeF <sub>2</sub> etching, Electron cyclotron resonance (ECR) etching, Metal dry etching, Wire bonding.
Biological techniques	Cell-free expression system, Transformation ( <i>E.coli</i> ), Plasmid DNA assembly, Fluorescence/confocal spectroscopy.
Characterization	Scanning electron microscopy (SEM), X-ray diffractometer (XRD), Focused ion beam (FIB), Atomic force microscope (AFM), I-V measurement, Impedance measurement, Small current/charge (pA/pC range) measurement, Laser doppler vibrometer, Surface profiler, Thin film thickness and stress measurement.
Software	AutoCAD, COMSOL, L-Edit, MATLAB, CoventorWare, CFDRC, Supreme, Max plus II

## WORKING EXPERIENCE

02/2010 – present **JBEI Postdoctoral Fellow**, Sandia National Laboratories, Livermore, CA

- Perform research in application of microfluidics to chemical and biochemical analysis relevant to bioenergy research.
- Develop microfluidic devices for high throughput combinatorial DNA assembly, enzyme assays and microscale platforms for analysis of biomass constituents.
- Integrate chips with optical, mechanical and electrical components and develop interface techniques and hardware for implementation.

09/2009 – 12/2009 **Consultant** (Part-time), Samsung Electro-Mechanics Co., Ltd.

- Optimized the structure design and fabrication process of a 6-axis MEMS inertial sensor to improve the resolution, bandwidth and sensitivity, and to lower noise level and cross talk.
- Performed both theoretical and finite element analysis to model the dynamics and electromechanical coupling of the system.

08/2005 – 08/2009 **Graduate Student Researcher**, Berkeley Sensor & Actuator Center, Berkeley, CA

- Near-Field Electrospinning (NFES)
  - Initiator and leader of nanofiber team in laboratory.
  - Developed NFES process that revolutionizes the capability of conventional electrospinning, including drawing intricate nanofiber patterns with precise nanofiber placement.
  - Spearheaded the application of nanofiber for tissue engineering and one-dimensional optical waveguide.
- Direct-Write Piezoelectric Polymeric Nanogenerator
  - Conceived the idea, fabricated the device, and designed the whole experiment.
  - Evaluated the performance of nanogenerators with comprehensive electrical and mechanical tests.
  - Helped generate proposal and received a three-year \$350,000 grant from the National Science Foundation.
- Plastically Self-Aligned Micromirrors
  - Designed and tested angular vertical comb-drive torsional microactuators providing versatility for the potential applications in Optical MEMS.

05/2008 – 08/2009 **Graduate Student Researcher**, Micro/Nano Fluidics Fundamentals Focus (MF3) Center, Irvine, CA

- IgG and glucose detection in a serum/plasma blood separation microfluidic platform
  - Designed and fabricated nanochannels with fluidic tests.
  - Integrated the electrospun nanofibers as reference electrodes of bio-sensors for enhanced sensitivity.

10/2005 – 01/2007 **Graduate Student Researcher**, Berkeley Nanosciences and Nanoengineering Institute, Berkeley, CA

- Local Synthesis of Carbon Nanotubes/Silicon Nanowires on Microbridges (COINS project)
  - Investigated the thermal properties of fabricated carbon nanotubes.

10/2003 – 05/2005	<b>Liaison Officer</b> (Second Lieutenant), Army of Taiwan (Compulsory military service)
01/2003 – 06/2003	<b>Research Assistant</b> , Nano Technology Program in University System of Taiwan, Taiwan <ul style="list-style-type: none"> <li>● The Development of Lobster Antennules-like Trapping Actuators Microarray and Optical Tweezers for the Studies of Tissue Engineering and Structure Biology <ul style="list-style-type: none"> <li>- Helped generate proposal and received a three-year \$900,000 grant from the National Science Council in Taiwan for this project.</li> <li>- Developed micro-actuators that mimic the capturing function of lobster's tiny hairs on its antennules.</li> <li>- Performed comprehensive materials and device characterization.</li> <li>- Demonstrated the functionality via the micro-object manipulation in liquid environment.</li> </ul> </li> </ul>
10/2001 – 06/2002	<b>Research Assistant</b> , National Nano Device Laboratories, Hsinchu, Taiwan <ul style="list-style-type: none"> <li>● Dry Etching of High Aspect Ratio Microstructures <ul style="list-style-type: none"> <li>- Designed various microstructures to evaluate the optimal fabrication parameters for ECR dry etching.</li> <li>- Fabricated microneedle arrays with novel one-mask process for neural probe application.</li> </ul> </li> </ul>
07/2001 – 09/2001	<b>Summer Intern</b> , Institute of BioAgricultural Science, Academia Sinica, Taipei, Taiwan <ul style="list-style-type: none"> <li>● Learned molecular biology technology and adapted assays to microfluidic format for BioMEMS applications.</li> </ul>

## TEACHING EXPERIENCE

Summer 2008	<b>Graduate Mentor</b> for Undergraduate Interns of COINS project, UC Berkeley, CA <ul style="list-style-type: none"> <li>● Project: Continuous Near-field Electrospinning for Tissue Engineering</li> </ul>
Fall 2007	<b>Graduate Student Instructor</b> , Mechanical Engineering, UC Berkeley, CA <ul style="list-style-type: none"> <li>● Course: ME 119 – Introduction to MEMS</li> </ul>
Summer 2006	<b>Graduate Mentor</b> for Undergraduate Interns of SUPERB program, UC Berkeley, CA <ul style="list-style-type: none"> <li>● Project: Nanochannels via Near-field Electrospinning</li> </ul>
Spring 2003	<b>Teaching Assistant</b> , Power Mechanical Engineering, National Tsing Hua University, Hsinchu, Taiwan <ul style="list-style-type: none"> <li>● Course: PME3304 – Experimental Measurements of Systems</li> </ul>
Fall 2001	<b>Teaching Assistant</b> , Power Mechanical Engineering, National Tsing Hua University, Hsinchu, Taiwan <ul style="list-style-type: none"> <li>● Course: PME3207 – Feedback Control System</li> </ul>

## JOURNAL PUBLICATIONS

1. Chieh Chang, Van H. Tran, Yiin-Kuen Fuh, Liwei Lin, “**Power generation using electrospun PVDF nanofibers,**” *Applied Physics Letters*, in preparation.
2. Juan Pu, Xiaojun Yan, Yadong Jiang, Chieh Chang, Liwei Lin, “**Piezoelectric Actuation of Direct-Write Electrospun Nanofibers,**” *Sensors and Actuators - A: Physical*, Vol. 164, pp. 131-136, 2010.
3. Chieh Chang, Van H. Tran, Junbo Wang, Yiin-Kuen Fuh, Liwei Lin, “**Direct-Write Piezoelectric Polymeric Nanogenerator with High Energy Conversion Efficiency,**” *Nano Letters*, Vol. 10, No. 2, pp. 726-731, 2010.  
(Featured in News Focus of *Science*, Vol. 328, no. 5976, pp. 304 – 305, 2010.)  
(Press coverage by Los Angeles Times, KRON4 TV, RSC Chemistry World, and various public media.)
4. Chieh Chang, Kevin Limkrajassiri, Liwei Lin, “**Continuous Near-Field Electrospinning for Large Area Deposition of Orderly Nanofiber Patterns,**” *Applied Physics Letters*, Vol. 93, 123111, 2008.  
(Selected paper by *The Virtual Journal of Nanoscience and Nanotechnology*, Vol. 18, Iss. 14, October 6, 2008).
5. Daoheng Sun, Chieh Chang, Sha Li, Liwei Lin, “**Near-Field Electrospinning,**” *Nano Letters*, Vol. 6, No. 4, pp. 839-842, 2006.  
(Reported by UC Berkeley News and various public media.)
6. Cheng-Hsiang Liu, Chia-Fang Chiang, Chieh Chang, Cheng-Hsien Liu, “**A Lobster-Sniffing Inspired Actuator for Manipulation of Micro-objects via Controlling Local Fluid,**” *Sensors and Actuators A: Physical*, Vol. 130-131, pp. 545-552, 2006.
7. Chieh Chang, Chia-Fang Chiang, Cheng-Hsiang Liu, Cheng-Hsien Liu, “**A Lobster-Sniffing-Inspired Method for Micro-Objects Manipulation Using Electrostatic Micro-Actuators,**” *Journal of Micromechanics and Microengineering*, Vol. 15, No. 4, pp. 812-821, 2005.

## SELECT PRESENTATION/CONFERENCE PROCEEDINGS

1. Rajiv Bharadwaj, Aarthi Chandrasekaran, April Wong, Chieh Chang, Zhiwei Chen, Supratim Datta, Joshua Park, Blake Simmons, Paul Adams, Anup Singh, “**Microfluidic high-throughput assays for biomass-to-biofuels conversion,**” *The 33rd Symposium on Biotechnology for Fuels and Chemicals*, Seattle, WA, May 2-5, 2011.
2. Juan Pu, Yadong Jiang, Xiaojun Yan, Chieh Chang, Liwei Lin, “**Piezoelectric Actuation of A Single Electrospun PVDF Micro/Nanofiber,**” *The 23rd IEEE International Conference on Micro Electro Mechanical Systems (MEMS 2010)*, pp. 1163-1166, Hong Kong, Jan. 24-28, 2010.
3. Chieh Chang, “**Near-Field Electrospinning and Its Application for Direct-Write Piezoelectric Nanogenerator,**” Sandia National Laboratories seminar at Joint BioEnergy Institute, Emeryville, CA, Oct. 30, 2009.
4. Chieh Chang, Yiin-Kuen Fuh, Liwei Lin, “**A Direct-Write Piezoelectric PVDF Nanogenerator,**” *The 15th International Conference on Solid-State Sensors, Actuators and Microsystems (Transducers '09)*, pp. 1485-1488, Denver, CO, June 21-25, 2009.
5. Chieh Chang, Liwei Lin, “**A Direct-Write Piezoelectric PVDF Nanogenerator via Near-Field Electrospinning,**” Berkeley Sensor & Actuator Center IAB meeting, Berkeley, CA, Mar. 12, 2009.
6. Chieh Chang, Yiin-Kuen Fuh, Bernd Kamasi, Adrienne Higa, Sang-Hoon Lee, Liwei Lin, “**Near-Field Electrospinning Applications,**” Micro/Nano Fluidics Fundamentals Focus (MF3) Center workshop, Miami, FL, Jan. 12, 2008.

7. Sang Hoon Lee, Kevin Limkrailassiri, Yuan Gao, Chieh Chang, Liwei Lin, “**Chip-to-Chip Fluidic Connectors via Near-Field Electrospinning**,” *The 20th IEEE International Conference on Micro Electro Mechanical Systems (MEMS 2007)*, pp. 61-64, Kobe, Japan, Jan. 21-25, 2007.
8. Chieh Chang, “**Near-Field Electrospinning**,” Department of Power Mechanical Engineering seminar, National Tsing Hua University, Hsinchu, Taiwan, Dec. 26, 2006.
9. Chieh Chang, Liwei Lin, “**Near-Field Electrospinning**,” NSF Site Visit, Center of Integrated Nanomechanical Systems (COINS), Berkeley, CA, June 15-16, 2006.
10. Chieh Chang, Liwei Lin, “**Near-Field Electrospinning**,” Berkeley Nanotechnology Forum 2006, Berkeley, CA, April 15, 2006.
11. Chia-Fang Chiang, Cheng-Hsiang Liu, Chieh Chang, Cheng-Hsien Liu, “**A Lobster-Sniffing-Inspired Actuator for Manipulation of Micro-Objects via Controlling Local Fluid**,” *The 13th International Conference on Solid-State Sensors, Actuators and Microsystems (Transducers '05)*, pp. 348-351, Seoul, Korea, June 5-9, 2005.
12. Chia-Fang Chiang, Cheng-Hsiang Liu, Chien-Chang Lee, Ting-Chen Shih, Kuang-Han Chu, Tang-Yan Lo, Tsan-I Chen, Yi-Hsun Chiu, Shu-Jen Chen, Wen-Hao Lin, Chieh Chang, Cheng-Hsien Liu, “**Micro Mechanical Devices Based on MPMC Process**,” *The 7th Nano Engineering and Micro System Technology Workshop*, Hsinchu, Taiwan, June 11, 2003.
13. Yu-Sheng Yang, Wen-Hao Lin, Chieh Chang, Yuan-Yi Yeh, Ching-Chen Tu, Chen-Ta Ho, Guo-Hau fann Jiang, Te-Ling Wu, Hsin-Yu Wu, Kun-Han Yang, Cheng-Hsien Liu, “**MEMS Designs and Microfabrication Results Using MPMC Process**,” *The 6th Nano Engineering and Micro System Technology Workshop*, Hsinchu, Taiwan, April 18, 2002.

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#### PATENTS/INVENTION DISCLOSURE

1. Chieh Chang, Liwei Lin, Yiin-Kuen Fuh, “**A Direct-Write Piezoelectric PVDF Nanogenerator**,” University of California, Berkeley, Invention disclosure number: 19241.
2. Daoheng Sun, Liwei Lin, Chieh Chang, “**Controllable Deposition of Polymeric Nanofibers and Nanotubes Using Electrospinning Technology**,” University of California, Berkeley, Invention disclosure number: 17655.
3. Long Hsu, Cheng-Hsien Liu, Hwan-You Chang, Hwei-Ling Peng, Chieh Chang, “**Actuator Wording Based On Principle Of Fluidic Reynolds Number And Manufacturing Method Thereof And Operating Method Thereof**,” *ROC Patent*, I266742, August 1, 2005.

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#### SCIENTIFIC & PROFESSIONAL ACTIVITIES

Journal paper reviewer for

*Nano Letters, Lab on a Chip, Langmuir, Advanced Functional Materials, Macromolecule, The Journal of Physical Chemistry, Polymer, Sensors and Actuators A: Physical, IEEE Transactions on Nanotechnology, Polymers for Advanced Technologies, Sensors*

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#### AWARDS & HONORS

- Graduate Division Fellowship, UC Berkeley, fall 2006 & fall 2007.
- Direct admission to master's program (excellent performance in coursework), National Tsing Hua University, Dec. 2000.
- Cathay Life Scholarship & Shin Kong Life Scholarship, 1999 - 2001.