Updated January 16th, 2010

Hirotaka Sato, Ph. D.

University of California, Berkeley
Electrical Engineering and Computer Science
407 Cory Hall, Berkeley, CA 94720, USA
(734) 709 - 0144, hirosato@berkeley.edu

Date of Birth	July 8th, 1977
Sex	Male
Citizenship	Japan

University of California, Berkeley, Electrical Engineering and Computer Science
February 2008 – Present Postdoctoral Research Fellow

University of Michigan, Electrical Engineering and Computer Science
January 2007 – January 2008 Postdoctoral Research Fellow

Waseda University, Tokyo, Japan, Applied Chemistry
April 2004 – January 2007 Research Scientist

Education

Ph.D., Chemistry, **Waseda University**, Tokyo

March 2005 Thesis title: *"A Study on the Electrochemical Fabrication Processes for Three-dimensional Microstructures and Their Application to Functional Devices"*
won a prize, Mizuno Memorial Award for Outstanding Doctoral Thesis

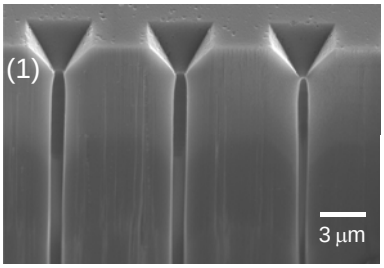
Master, Chemistry, **Waseda University**, Tokyo

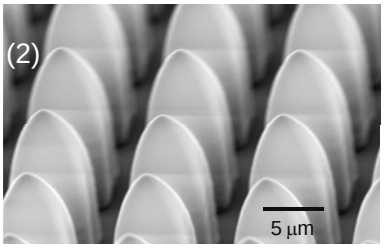
March 2002 Started electrochemical deposition and etching processes to form 3D micro/nano structures including

Bachelor, Chemistry, **Waseda University**, Tokyo

March 2000 Worked on electrochemical thin film fabrication for magnetic recording media. Developed nano film whose magnetic properties (coercivity, crystallinity) were gradually changed along the film thickness.

Research Interests and Activities



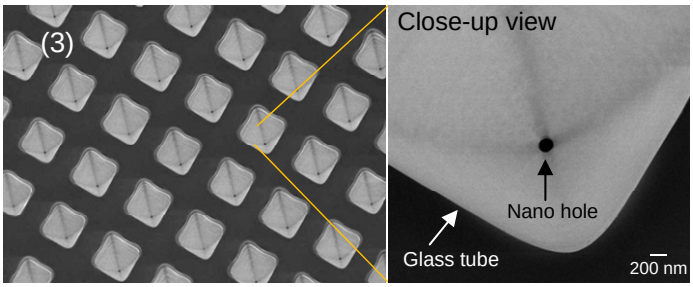


Nano/micro Fabrication

- Electrochemical deposition
- Electroless deposition
  (electroplating without external power source)
- Electrochemical etching
- Wet etching
- Conventional MEMS process
  (Photolithography, Deep Reactive Ion Etching, and etc.)

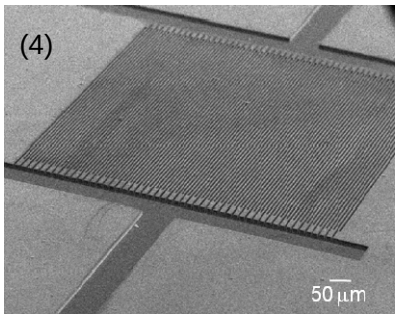
Nano/micro Structures

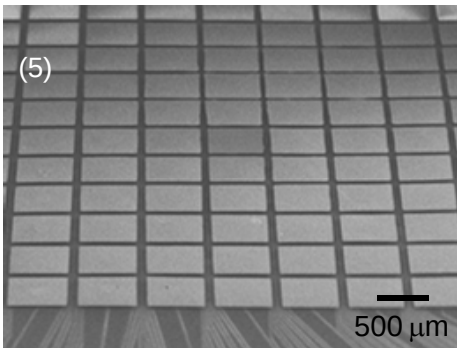
- Deep and straight pore array (photo 1)
- Pico little glass tube array (photo 2)
- Sharp needle array
- Nano hole (photo 3)
- 3D comb electrode array (photo 4)
- Free standing 3D mushroom (photo 5)

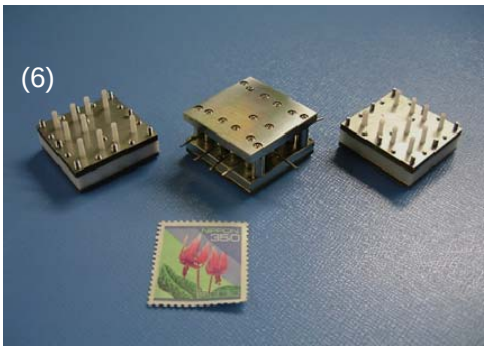


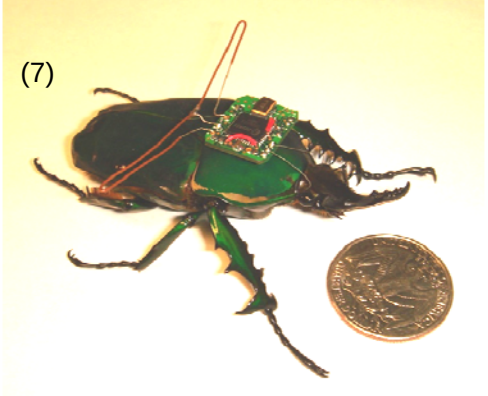
Systems and Applications

- Highly sensitive electrochemical immunosensor (photo 4)
- X-ray imaging system for artificial satellite telescope (photo 5)
- Nanoparticle synthesis mircro reactor (photo 6)
- Cyborg beetle (insect flight control system, photo 7)









Journal Publications (19 Journal Papers, all peer-reviewed)

1) H. Sato, T. Yamaguchi, T. Isobe, S. Shoji, T. Homma, "Electrochemical etching process to tune the diameter of arrayed deep pores by controlling carrier collection at a semiconductor-electrolyte interface", *Electrochem. Comm.*, accepted.

2) H. Sato, C. W. Berry, Y. Peeri, E. Baghoomian, B. E. Casey, G. Lavella, J. M. VandenBrooks, J. Harrison, M. M. Maharbiz, "Remote radio control of insect flight", *Front. Integr. Neurosci*., **3**, 1-11 (2009). **The Most Viewed Article 2009**

3) H. Sato, T. Yamaguchi, T. Isobe, T. Homma, S. Shoji, "Self-aligned formation of nano-holes to arrayed micro glass tubes", *Electrochimica Acta*, **53**, 200-204 (2007).

4) H. Sato, "Micro/nano fabrication processes based on electrochemical methods", *J. Nano Sci. Tech.*, **5**, 65-68 (2007). **Invited Paper**

5) H. Sato, T. Homma, "Fabrication of magnetic nanodot arrays for patterned magnetic recording media", *J. Nanosci. Nanotech.*, **7**, 225-231 (2007). **Review Paper**

6) H. Sato, T. Homma, "Fabrication of high-aspect-ratio arrayed structures using Si electrochemical etching", *Sci. Tech. of Adv. Mater.*, 7, 468-474 (2006).

7) H. Sato, T. Homma, K. Mori, T. Osaka, S. Shoji, "Picoliter volume glass tube array fabricated by Si electrochemical etching process", *Electrochim. Acta*, **51**, 844-848 (2005).

8) H. Sato, T. Homma, H. Kudo, T. Izumi, T. Osaka, S. Shoji, "Three-dimensional microfabrication process using Bi electrodeposition for a highly sensitive X-ray imaging sensor", *J. Electroanal. Chem.*, **584**, 28-33 (2005).

9) H. Sato, T. Homma, K. Mori, T. Osaka, S. Shoji, "Electrochemical formation process of Si macropore and metal filling for high aspect ratio metal microstructure using single electrolyte system", *Electrochemistry*, **73**, 275-278 (2005).

10) H. Sato, Y. Ohinata, T. Homma, T. Osaka, "Preparation of composite metal nanoparticles by electroless-deposition process using microchannel type reactor", *J. Surf. Finish. Soc. Jpn.*, **55**, 966-967 (2004).

11) H. Sato, H. Kobayashi, H. Kudo, T. Izumi, T. Homma, T. Osaka, S. Shoji, Y. Ishisaki, R. Fujimoto, K. Mitsuda, "Development of Bi electrodeposition process for fabricating microabsorber array for high sensitive X-ray imaging sensor", *Electrochemistry*, **72**, 424-426 (2004).

12) T. Homma, H. Sato, K. Mori, T. Osaka, S. Shoji, "Area-selective formation of macropore array by anisotropic electrochemical etching on an n-Si(100) surface in aqueous HF solution", *J. Phys. Chem. B*, **109**, 5724-5727 (2005).

13) T. Homma, H. Sato, H. Kobayashi, T. Arakawa, H. Kudo, T. Osaka, S. Shoji, Y. Ishisaki, T. Oshima, N. Iyomoto, R. Fujimoto, K. Mitsuda, "Sn electrodeposition process for fabricating microabsorber arrays for an X-ray microcalorimeter", *J. Electroanal. Chem.*, **559**, 143-148 (2003).

14) T. Arakawa, H. Kudo, H. Sato, H. Kobayashi, T. Izumi, S. Ohtsuka, K. Mori, S. Shoji, T. Osaka, T. Homma, K. Mitsuda, N. Yamasaki, R. Fujimoto, N. Iyomoto, Y. Ishisaki, U. Morita, T. Koga, K. Shinozaki, K. Sato, N. Takai, T. Ohashi, Y. Kuroda, M. Onishi, M. Goto, F. Beppu, "Fabrication of

multi-pixel TES microcalorimeters with an electrodeposited Sn absorber and Bi absorber", *Nucl. Instrum. Methods Phys. Res., Sect. A*, **520**, 456-459 (2004).

15) N. Honda, M. Inaba, T. Katagiri, S. Shoji, H. Sato, T. Homma, T. Osaka, M. Saito, J. Mizuno, Y. Wada, "High efficiency electrochemical immuno sensors using 3D comb electrodes", *Biosens. Bioelectron.*, **20**, 2306-2309 (2005).

16) H. Kudo, T. Nakamura, T. Arakawa, S. Ohtsuka, T. Izumi, S. Shoji, H. Sato, H. Kobayashi, K. Mori, T. Homma, T. Osaka, K. Mitsuda, N. Y. Yamasaki, R. Fujimoto, N. Iyomoto, T. Oshima, K. Futamoto, Y. Takei, T. Ichitsubo, T. Fujimori, Y. Ishisaki, U. Morita, T. Koga, K. Sato, T. Ohashi, Y. Kuroda, M. Onishi, K. Otake, F. Beppu, "Prototype of the high sensitive X-ray microcalorimeter for X-ray imaging", *Sens. Actuators, A*, **114**, 171-175 (2004).

17) H. Kudo, T. Arakawa, S. Ohtsuka, T. Izumi, S. Shoji, H. Sato, H. Kobayashi, K. Mori, T. Homma, T. Osaka, N. Iyomoto, R. Fujimoto, K. Mitsuda, N. Y. Yamasaki, T. Oshima, K. Futamoto, Y. Takei, T. Ichitsubo, T. Fujimori, Y. Ishisaki, U. Morita, T. Koga, K. Shinozaki, K. Sato, T. Ohashi, Y. Kuroda, M. Onishi, K. Otake, F. Beppu, "High sensitive X-ray microcalorimeter using Bi-Au microabsorber for imaging applications", *Jpn. J. Appl. Phys., Part 1*, **43**, 1190-1195 (2004).

18) R. Fujimoto, K. Mitsuda, N. Y. Yamasaki, N. Iyomoto, T. Oshima, Y. Takei, K. Futamoto, T. Ichitsubo, T. Fujimori, K. Yoshida, Y. Ishisaki, U. Morita, T. Koga, K. Shinozaki, K. Sato, N. Takai, T. Ohashi, H. Kudo, H. Sato, T. Arakawa, H. Kobayashi, T. Izumi, S. Ohtsuka, K. Mori, S. Shoji, T. Osaka, T. Homma, Y. Kuroda, M. Onishi, M. Goto, F. Beppu, T. Tanaka, T. Morooka, S. Nakayama, K. Chinone, "TES microcalorimeter development for future Japanese X-ray astronomy missions", *Nucl. Instrum. Methods Phys. Res., Sect. A*, **520**, 431-434 (2004).

19) Y. Ishisaki, U. Morita, T. Koga, K. Shinozaki, K. Sato, N. Takai, T. Ohashi, T. Arakawa, H. Kudo, H. Sato, H. Kobayashi, T. Izumi, S. Ohtsuka, K. Mori, S. Shoji, T. Osaka, T. Homma, K. Mitsuda, N. Y. Yamasaki, R. Fujimoto, N. Iyomoto, T. Oshima, K. Futamoto, Y. Takei, T. Ichitsubo, T. Fujimori, K. Yoshida, Y. Kuroda, M. Onishi, M. Goto, F. Beppu, "Performance analyse's of TES microcalorimeters with mushroom shaped X-ray absorbers made of Sn or Bi", *Nucl. Instrum. Methods Phys. Res., Sect. A*, **520**, 452-455 (2004).

Honors and Awards

1) Frontiers in Neuroscience, The most viewed paper since the journal was established

2) TIME Magazine, The 50 Best Inventions of 2009

3) MIT Technology Review, Top 10 emerging technologies 2009 (TR10) 'Biological Machines'

4) Selected top technologies (Cyborg beetle display), Tech Museum, University of California, Berkeley.

5) UK-Japan Research Exchange Scholarship

Nanotechnology Research Network Center, MEXT Japan, 2006.

6) Poster Session Award, 1st prize

International Symposium on Electrochemical Processing of Tailored Materials, Oct., 2005.

7) Mizuno Memorial Award for Outstanding Doctoral Thesis

Waseda University, 2005.

8) Best Presentation Award

International Symposium on Electrochemical Micro and Nanosystem Technologies, Sep., 2004.

9) Poster Session Award, 2nd prize

International Symposium on Materials Processing for Nanostructured Device, Sep., 2001.

10) Best Presentation Award

Waseda and Keio Universities Applied Chemistry Workshop, August, 2002.

Press Releases

1) MIT Technology Review, Top 10 emerging technologies (TR10) 'Biological Machines', March 2009.

2) New Scientist, 'Free-flying cyborg insects steered from a distance', October, 2009.

3) BBC NEWS, 'Remote controlled bugs buzz off', October, 2009.

4) Discover Magazine, 'Beetle Borgs', May 2009.

5) New Scientist, 'The Cyborg Animal Spies Hatching in the Lab', March, 2008.

Patents

1) H. Sato, M. M. Maharbiz, C. W. Berry, B. E. Casey, G. Lavella, 'Control system for insect flight', WO/2009/088614.

2) T. Homma, S. Shoji, T. Osaka, H. Sato, "Microreactor and its fabrication process", 2005-207901, Aug. 4, 2005.

3) N. Honda, S. Shoji, T. Homma, H. Sato, "Fabrication of micro-electrode and measurement of electrolyte with it", 2004-93406, March 25, 2004.

Book Chapters

1) H. Sato, D. Cohen, M. M. Maharbiz, "Building interfaces to developing cells and organisms: from cyborg beetles to synthetic biology," in Integrated Microsystems: Mechanical, Photonic and Biological Interfaces, CRC Press (2010).

2) H. Sato, T. Homma, "Fabrication of Nanostructure", *Comprehensive Dictionary of Nanotechnology*, Kogyo Chosakai Publishing Inc., 400-409 (2003).

Presentations at International Conferences

1) Invited Talk "Cyborg Beetle: Remote radio control of insect flight", CMOS Emerging Technologies, May, 2010.

2) Invited Talk "Remote radio control of insect flight", International Symposium on Microchemistry and Microsystems (ISMM2009), November, 2009.

3) Invited Talk "Cyborg Beetle: Neural Stimulation for Insect Flight Control & Implanted BioFuel Cell", BSAC Tokyo Technology Symposium, November, 2009.

4) Invited Talk "Remote radio control of insect flight", BSAC Tokyo Technology Symposium, December, 2008.

5) Invited Talk "Development of electrochemical etching process for size-controllable pore-formation into Si wafer", UK-Japan Collaboration Day, Sep., 2006.

6) Invited Talk "MEMS and Electrochemical Processing", The 48th Material Tailoring Conference, July, 2006.

7) Talk / Late News "Flight control of 10 gram insects by implanted neural stimulators", Hilton Head 2008, June, 2008.

8) Talk "A cyborg beetle: insect flight control through an implantable, tetherless microsystem", MEMS 2008, Jan, 2008.

9) Talk "Electroless deposition process for synthesis of composite metal nanoparticles using micro-fluidic device", The 5th Asian Conference on Electrochemistry, May, 2005.

10) Talk "Single Batch Process for Area-Selective Formation of Si Micropore Array and Metal Filling", 206th The Electrochemical Society ,Oct., 2004.

11) Talk "Fabrication of microabsorber array for X-ray microcalorimeter by Sn electrodeposition", The 200th The Electrochemical Society, Sep., 2001.

12) Poster / Late News "Three-dimensional tracking of microsystem-controlled free-flying insects", Microtechnologies in Medicine and Biology (MMB), April, 2009.

13) Poster "Radio-controlled cyborg beetles: a radio-frequency system for insect neural flight control", MEMS 2009, Jan., 2009.

14) Poster "Size-controllable formation of pore array into Si wafer using electrochemical etching", The 57th International Society of Electrochemistry, Aug., 2006.

15) Poster "Formation process of micro-glass-tube array for fluid device based upon Si electrochemical etching and thermal oxidation", The 4th International Symposium on Electrochemical Processing of Tailored Materials, Oct., 2005.

16) Poster "Three-dimensional electrodeposition process for fabrication of arrayed high sensitive X-ray microsensors", The 56th International Society of Electrochemistry, Sep., 2005.

17) Poster "Formation of 256 pixels of X-ray microcalorimeters applying three-dimensional electrodeposition process for arrayed X-ray absorbers", The 11th International Workshop on Low Temperature Detectors, Aug., 2005.

18) Poster "Development of a microreactor with nanovolume glass tube array fabricated by area-selective Si electrochemical etching process", The 5th International Symposium on Electrochemical Micro and Nanosystem Technologies, Sep., 2004.

19) Poster "Fabrication of the array of high sensitive X-ray microdetectors by electrochemical micromachining process", International Symposium on Materials Processing for Nanostructured Devices, May, 2003.

20) Poster "Modification of Si anodization process for area selective formation of high aspect ratio micropore array", The 53rd International Society of Electrochemistry, Sep., 2002.

21) Poster “Application of Sn electrodeposition process to fabricate X-ray microcalorimeter”, International Symposium on Materials Processing for Nanostructured Devices, Sep., 2001.

Funding

Research and Development Grant, Electro-Mechanic Technology Advancing Foundation

“

Teaching Experience

Seminar, Biomedical Micro/Nano Mechatronics Laboratory, Nogoya University, 13th Nov. 2009

“Remote Radio Control of Insect Flight”

Seminar, Research Institute for Nanodevice and Bio Systems, Hiroshima Universiy, 11th Nov. 2009

“Remote Radio Control of Insect Flight”

Seminar, Biomechanics, University of California Berkeley, 18th Sep. 2009

“Remote Radio Control of Insect Flight”

Seminar, Lawrence Hall of Science Nano Science Summer Camp, 6th August 2008

“Insect Flight Control”

Applied Chemistry Department, Waseda University (2004 – 2006)

- Lectured at physical chemistry class (over 30 students each class)
- Lectured at physical chemistry experiment class (over 30 students each class)

Science Partnership Program, Tokyo Gakugei University Senior High School (Nov., 2004)

- Teaching assistant at physical chemistry experiment class (over 50 students)

Current/Past Advisors and Collaborators

- University of California, Berkeley, USA
  - Prof. Michel M. Maharbiz (EECS)
  - Prof. Pieter Abbeel (EECS)
  - Prof. Shuichi Shoji (EECS)
  - Prof. Tetsuya Osaka (Chem)
- Waseda University, Japan
  - Prof. Takayuki Homma (Chem)
- Cornell University, USA
  - Prof. Amit Lal (EECS)
- University of Michigan, USA

Prof. Yogesh B. Gianchandani (EECS)

Prof. Khalil Najafi (EECS)

Prof. Kensall Wise (EECS)

- Arizona State University, USA

  Prof. Jon Harrison (Bio)

- JAXA (Japan Aerospace Exploration Agency)

  Prof. Kazuhisa Mitsuda (Physics)

  Prof. Yamazaki Noriko (Physics)

- Tokyo Metropolitan University, Japan

  Prof. Yoshitaka Ishisaki (Physics)

- University of Newcastle Upon Tyne, UK

  Prof. Sudipta Roy (Chem)

- Tel Aviv University, Israel

  Prof. Yosi Shacham-Diamand (EECS)

- Seiko Epson Corporation, Japan

References

Professor Michel M. Maharbiz

Department of Electrical Engineering and Computer Science, College of Engineering

646 Sutardja Dai Hall, University of California Berkeley

Berkeley, CA 94720-1764 **maharbiz@eecs.berkeley.edu**

Professor Pieter Abbeel

Department of Electrical Engineering and Computer Science, College of Engineering

704 Sutardja Dai Hall, University of California Berkeley

Berkeley, CA 94720-1764. **pabbeel@cs.berkeley.edu**

Professor Takayuki Homma

Department of Applied Chemistry, Waseda University, 3-4-1 Okubo, Shinjuku-ku, Tokyo 169-8555, Japan. +81-3-5286-3209 **homma@mse.waseda.ac.jp**

Professor Shuichi Shoji

Department of Electrical Engineering and Bioscience, Waseda University, 3-4-1, Okubo, Shinjuku-ku, Tokyo 169-8555, Japan. +81-3-5286-3384 **shojis@waseda.jp**

Professor Yosi Shacham-Diamand

Department of Physical Electronics School of Electrical Engineering, Tel Aviv University, Ramat Aviv, Tel Aviv 69978, Israel. +972-3-6408064 **yosish@eng.tau.ac.il**

Experimental Skills

Fabrication of nano/micro structures

- Electrodeposition of various metals and alloys (Au, Ag, Co, Cu, Fe, Ni, Pd and etc.)
- Electroless-deposition of various metals and alloys (Au, Co, Cu, Ni, Pd and etc.)
- Electrochemical etching, electrochemical polishing and chemical etching of Si and various metals
- Photolithography to form photoresist masks and 3D molds
- RIE and D-RIE for deep etching of Si wafers
- Sputtering, evaporation and CVD to form thin films

- CMP (Chemical Mechanical Polishing) to flatten surfaces
- Nano indentation by diamond tip AFM

Manipulation and operation of specimens and micro-devices

- Pico litter sampling-manipulator to inject liquid specimens into micro-channels and micro-tubes
- Flow control systems equipped with optical microscopes, CCD cameras and syringe pumps for micro-fluidic devices
- Potentiostat/Galvanostat systems and function generators to operate electrochemical detection devices

Observation of specimens

- TEM and SEM to observe nano/micro-structures
- FIB to prepare cross-sections of specimens for SEM and TEM observation
- AFM and MFM to measure surface morphologies and magnetic states

Evaluation and analysis of specimens

- VSM (Vibration Sample Magnetometer) to measure magnetic properties
- XRD to analyze crystal structures
- UV-Vis, IR, and Raman spectrometers to analyze molecular states in aqueous solutions
- EPMA (Electron Probe Micro-Analysis) for elemental analysis
- High speed camera operation

Simulation tool

- Coventor ware