RESUME Hirotaka Sato

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Educational Background

March 2005 **Doctor of Engineering in Applied Chemistry**, Waseda University
Thesis title: *"A Study on the Electrochemical Fabrication Processes for Three-dimensional Microstructures and Their Application to Functional Devices"*

March 2002 **Master of Engineering in Applied Chemistry**, Waseda University

March 2000 **Bachelor of Engineering in Applied Chemistry**, Waseda University

Professional Experiences

February 2008 – Present

Postdoctoral Research Fellow

Department of Electrical Engineering and Computer Science, University of California, Berkeley, USA

January 2007 – January 2008

Postdoctoral Research Fellow

Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, USA.

April 2004 - January 2007

Research Associate

Department of Applied Chemistry, Waseda University, Tokyo, Japan

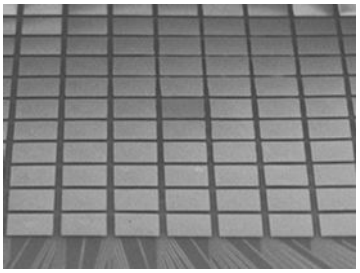
Current Interests and Research Activities

Fusion of insect and microsystem, Electrodeposition, Electroless deposition, Electrochemical Etching, Electrochemical Polishing, and Nanoparticles, MEMS, Nano/Micro-Fabrication Processes.

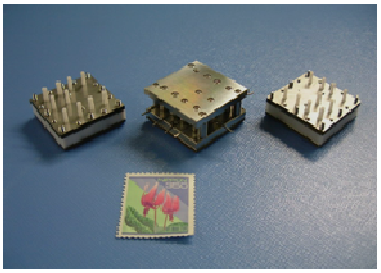
Created a **cyborg beetle** for its flight control. Achieved initiation, cessation, elevation control and left/right turns of the cyborg beetle flight. Studied MEMS processes, by using electrochemical methods, for fabricating multi-pixels of X-ray micro-sensors, magnetic thin films, metal nanoparticles, high aspect ratio structures, and 3-D micro-electrode arrays. Developed processes for **electrodeposition** and electrochemical polishing of Sn and Bi to form X-ray micro-sensors applied to the **X-ray imaging system** to be loaded on the next projected space satellite. Investigated effects of electroless deposition conditions on magnetic properties of CoNiP thin films, resulting in successful control of coercivity H_c and saturated magnetization Ms of the CoNiP thin film by adjusting the diffusion rates of the metal ions. Synthesized composite metal nanoparticles by means of electroless deposition with **micro-fluidic devices**. Developed an **electrochemical etching** process of Si wafer to form high-aspect-ratio pore arrays, and applied them as the template for **micro-glass-tube arrays** and metal micro-needle arrays. Fabricated **3-D micro-electrode arrays** for immunosensors by Ni and Cu electrodeposition and Au electroless deposition, and improved their fabrication conditions to obtain appropriate properties and smooth surfaces of the electrodeposited specimens.

Cyborg beetle

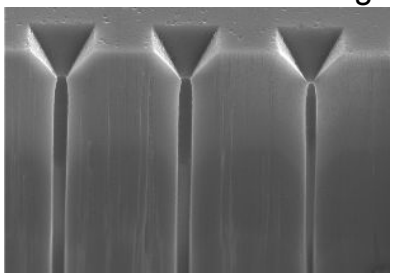
X-ray imaging system



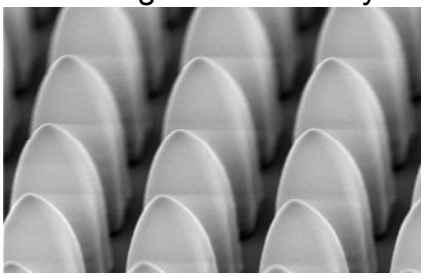
Micro-fluidic devices



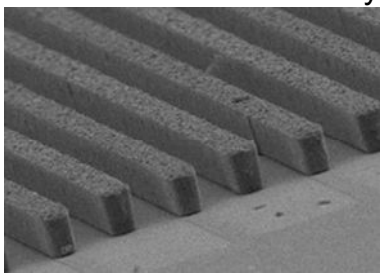
Electrochemical etching



Micro-glass-tube array



3-D micro-electrode array



Awards

1) UK-Japan Research Exchange Scholarship
Nanotechnology Research Network Center, MEXT Japan, 2006.

2) Poster Session Award, 1st prize
International Symposium on Electrochemical Processing of Tailored Materials, Oct., 2005.

3) Mizuno Memorial Award for Outstanding Doctoral Thesis
Waseda University, 2005.

4) Best Presentation Award
International Symposium on Electrochemical Micro and Nanosystem Technologies, Sep., 2004.

5) Poster Session Award, 2nd prize
International Symposium on Materials Processing for Nanostructured Device, Sep., 2001.

News Articles

1) "The Cyborg Animal Spies Hatching in the Lab", New Scientist, March 6, 2008.

2) "With Sensors for the Five Senses, Devices Will Get Closer to Human Beings", *Nikkei Electronics*, **972**, Feb. 25, 2008.

3) "University of Michigan Realized 'Cyborg Beetle', IC and a Battery Implanted", *Nikkei Electronics*, **970**, Jan. 28, 2008.

Journal Publications

1) 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).

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

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

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

5) 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).

6) 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).

7) 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).

8) 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).

9) 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).

10) 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).

11) T. Homma, H. Sato, K. Mori, T. Osaka, S. Shoji, "High aspect ratio nanovolume glass cell array fabricated by area-selective silicon electrochemical etching process", *Proc. IEEE MEMS*, 705-708 (2004).

12) 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).

13) 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)

14) 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).

15) 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).

16) 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).

17) 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).

Patents

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

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

Book

H. Sato, T. Homma, "Simultaneous formation of nanostructures", *Comprehensive Dictionary of Nanotechnology*, 400-409 (2003).

Presentations at International Conferences

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

2) "A cyborg beetle: insect flight control through an implantable, tetherless microsystem", MEMS 2008, Jan, 164-167, 2008. (Oral)

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

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

5) "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.

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

7) "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.

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

9) "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.

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

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

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

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

Experimental Skills

Preparation of nano/micro structured specimens (Wafer processing)

- 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 system to form photoresist masks and molds
- RIE and D-RIE for deep etching of Si wafers
- Sputtering, evaporation and CVD to prepare thin films
- CMP (Chemical Mechanical Polishing)to flatten surfaces

Manipulation and operation of specimens and micro-devices

- Micro sample-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

Simulation tool

- Coventor ware