

# Dr. Motofumi Suzuki

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## Personal Information

Born: May 5, 1963

## Education

### 1998 PhD (Doctor of Engineering)

Kyoto University, Kyoto, JAPAN

Dissertation: Studies on the Giant Magnetoresistance in Magnetic Superlattices.

### 1988 Master of Engineering

Graduate School of Engineering, Kyoto University, Kyoto, JAPAN

Dissertation: Surface Structure of SnTe(001) and PbSe/SnTe(001) Studied by RBS/Channeling of MeV He<sup>+</sup> Ions.

### 1986 Bachelor of Engineering

Faculty of Engineering, Kyoto University, Kyoto, JAPAN

Dissertation: Epitaxial Growth of Sputtered Ni Films on Alkali Halides.

## Awards and Honors

- Award of the Journal of Vacuum Society of Japan, 2012
- Best Oral Presentation at The Nanostructured Thin Films V conference in SPIE Optics+Photonics 2012, 2012
- MMS Award, Tanaka Precious Metals, 2006
- MMS Award, Tanaka Precious Metals, 2005
- International Metallographic Contest, CLASS 4: Electron Microscopy - Scanning, Honorable Mention, International Metallographic Society, 2002.
- 52nd Metallographic Contest of The Japan Institute of Metals, 3rd place. 2002.
- Seven papers have been selected in AIP's Virtual Journal of Nanoscale Science & Technology.

## Professional Experience

2016

Assistant Dean of Graduate School of Engineering, Professor at Department of Micro Engineering, Kyoto University, Kyoto, JAPAN.

2015

Chair of Department of Micro Engineering, Professor at Department of Micro Engineering, Graduate School of Engineering, Kyoto University, Kyoto, JAPAN.

2013-

Professor at Department of Micro Engineering, Graduate School of Engineering, Kyoto University, Kyoto, JAPAN.

2002-2013

Associate Professor at Department of Micro Engineering (transfer due to reorganization, 2005).  
Associate Professor at Department of Engineering Physics and Mechanics, Graduate School of Engineering, Kyoto University, Kyoto, JAPAN.

- Generation and control of thermoplasmonic Marangoni flows.
- Growth on nanowires by high temperature glancing angle deposition.
- Development of spectrally-selective infra red thermal emitters.
- Development of low reflectivity wire-grid polarizers.
- Development of aligned nanorod arrays of noble metals and their applications to thin film polarizers, tunable plasmonic sensors and thermoplasmonics.
- Investigations on initial stage of thin film growth of semiconducting silicides.
- Development of rugate filters for optical communications.
- Surface and interface analysis by using high resolution Rutherford backscattering spectroscopy.
- Investigations of ion beam interaction with solid surfaces.

1988-2002

Researcher, TOYOTA Central Research and Development Laboratories, Inc., Nagakute, Aichi 480-1192, JAPAN.

- Development of integrated nanostructured thin films by dynamic oblique deposition.
- Development of 3D thin film growth simulator VFiGS.
- Development of thin-film waveplates of oblique columnar thin films for optical pickup.
- Investigations on surface and interface properties of organic LED.
- Investigations on the giant magnetoresistance of metallic superlattices and their application to sensors.
- Development of angular selective coatings containing metal nanoparticles.

## Teaching Experience

- 2014- Quantum Physics I
- 2011-2013 CME seminar for PhD students for 3rd grade students.
- 2003-2012 Exercise of Machine Design I for 3rd grade students.
- 2002- Solid State Physics I & II for graduate students.

- 2002- Applied Electromagnetism for 3rd grade students.
- 2002- Exercise on Engineering Science II for 3ed grade students.

## Professional Activities

### Activities in scientific societies

- 2016- Vice chair of Kansai Branch of Surface Science Society Japan.
- 2015- Chair of Functional Thin Film Division of The Vacuum Society of Japan.
- 2013-2016 Member of Board of Directors, Chair of Public Relations Division of The Vacuum Society of Japan.
- 2009- Member of Board of Directors of The 141th Committee on Microbeam Analysis of Japan Society for the Promotion of Science.
- 2009-2012 Committee member of Public Relations Division of The Vacuum Society of Japan.
- 2006-2008 Committee member of Kansai branch of The Vacuum Society of Japan.
- 2004-2014 Committee member of Kansai branch of The Surface Science Society of Japan.
- 2002- Committee member of the professional group of "Semiconducting Silicides and Related Materials" in The Japan Society of Applied Physics.

### Editor

- 2012- Journal of Nanophotonics; Associated Editor
- 2013 Physica Status Solidi C: Guest Editor
- 2010-2011 Thin Solid Films: Guest Editor
- 2010-2011 Trans. MRS-J: Guest Editor

### Reviewer

Journal of Applied Physics, Japanese Journal of Applied Physics, Journal of Vacuum Science & Technology A, Applied Surface Science, Journal of Colloid and Interface Science, Vacuum, Journal of Nanophotonics, e-Journal of Surface Science and Nanotechnology, Recent Patents on Nanotechnology, Materials Research Society Symposium Proceedings, Proceedings of SPIE, Analyst, Journal of Biomedical Optics Report, Crystal Growth & Design, Physica B, Optics Letters, etc.

### Activities in international conferences

- 30th International Microprocesses and Nanotechnology Conference (MNC 2017), November 6-9, 2017, Jeju, Korea, Organizing Committee Member.
- The 8th International Symposium on Surface Science (ISSS-8), Oct. 22 (sun) to 26 (thu), 2017, Tsukuba, Japan, Program Committee Member.
- 29th International Microprocesses and Nanotechnology Conference (MNC 2016), November 8-11, 2016, Kyoto, Japan, Steering Chair.
- SPIE Optics + Photonics 2016, 28 August-1 September 2016, San Diego, California, USA: Conference "NANOSTRUCTURED THIN FILMS IX", Conference chair.
- 28th International Microprocesses and Nanotechnology Conference (MNC 2015), November 10-13, 2015, Toyama, Japan, Steering Vice Chair.

- The 10th International Symposium on Atomic Level Characterizations for New Materials and Devices ' 15, 25-30 November 2015, Matsue, Japan, Chair of publication committee.
- 228th ECS meeting, October 11-15, 2015, Phoenix, AZ, USA: "Session H01: Low-Dimensional Nanoscale Electronic and Photonic Devices 8," Lead organizer.
- SPIE Optics + Photonics 2015, 9 - 14 August 2015, San Diego, California, USA: Conference " NANOSTRUCTURED THIN FILMS VIII" , Conference chair.
- The 7th International Symposium on Surface Science, November 2-7, 2014, Matsue, Japan, Steering Committee Vice-Chair.
- 226th ECS and SMEQ Joint International Meeting, October 5- 10, 2014, CANCUN, Mexico: "Session Q4: Low-Dimensional Nanoscale Electronic and Photonic Devices 7," Organizer.
- SPIE Optics + Photonics 2014, 17 - 22 August 2014, San Diego, California, USA: Conference " NANOSTRUCTURED THIN FILMS VII" , Conference chair.
- International conference and summer school on advanced silicide technology 2014, July 19-21, 2014, Tokyo University of Science, Katsushika Campus, Tokyo, Japan, Program Committee & Publishing Committee.
- The 9th International Symposium on Atomic Level Characterizations for New Materials and Devices ' 13, 2-6 December 2013, Kona, Hawaii, Secretariat.
- 224th ECS meeting, October 27-November 1, 2013, San Francisco, CA, USA: Session E5 "Low-Dimensional Nanoscale Electronic and Photonic Devices 6," Lead organizer.
- SPIE Optics + Photonics 2013, 25 - 30 August 2013, San Diego, California, USA: Conference " NANOSTRUCTURED THIN FILMS VI" , Conference chair.
- Asia-Pacific Conference on Semiconducting Silicides 2013, 27 - 29 July 2013, Tsukuba: Chair of publication committee.
- Pacific RIM Meeting on Electrochemical and Solid-State Science (PRiME 2012), October 7-12, 2012, Honolulu, Hawaii, USA: Session E7 "Low-Dimensional Nanoscale Electronic and Photonic Devices 5" , Co-organizer.
- 25th International Conference on Atomic Collisions in Solids, October 21-25, 2012 Kyoto, Japan, Steering committee.
- SPIE Optics + Photonics 2012, 12 - 17 August 2012, San Diego, California, USA: Conference " NANOSTRUCTURED THIN FILMS V" , Program committee.
- 2012 7th Annual IEEE International Conference on Nano/Micro Engineered and Molecular Systems, March 5 - 8, 2012, Kyoto University, Program committee.
- The 21st Symposium of MRS-J, 19-21 December 2011, Yokohama, Japan: International Session D, Co-organizer.
- IUMRS-ICA 2011, 19-22 September 2011, Taipei, Taiwan: Session E1 "Oxide /nitride for electronic applications" , Co-organizer.
- IUMRS-ICA 2011, 19-22 September 2011, Taipei, Taiwan: Session E3 "Optoelectronic /Photonic Related Materials" , Co-organizer.
- SPIE Optics + Photonics 2011\*, 21 - 25 August 2011, San Diego, California, USA: Conference " NANOSTRUCTURED THIN FILMS IV" , Program committee.

- The 8th International Symposium on Atomic Level Characterizations for New Materials and Devices '11, 22-27 May 2011, Seoul, Korea, Secretariat.
- The 20th Symposium of MRS-J, 20-22 December 2010, Yokohama, Japan: International Session E, Co-organizer.
- 218th ECS meeting, 10-15 October 2010, Las Vegas, Nevada, USA: Session E7 "Low-Dimensional Nanoscale Electronic and Photonic Devices 4" , Co-organizer.
- SPIE Optics + Photonics 2010, 1 - 5 August 2010, San Diego, California, USA: Conference "NANOSTRUCTURED THIN FILMS III" , Program committee.
- Asia-Pacific Conference on Semiconducting Silicides 2010, 24 - 26 July 2010, Tsukuba: Publication committee, and Steering committee.
- The 5th International Workshop on High-Resolution Depth Profiling, 15-19 November 2009, Kyoto: Steering committee.
- SPIE Optics + Photonics 2009, 2 - 6 August 2009, San Diego, California, USA: Conference "NANOSTRUCTURED THIN FILMS II" , Program committee.
- SPIE Optics + Photonics 2008, 10 - 14 August 2008, San Diego, California, USA: Conference "NANOSTRUCTURED THIN FILMS I" , Program committee.
- 4th Vacuum and Surface Sciences Conference of Asia and Australia (VASSCAA-4), October 28-31, 2008, Matsue: Vice-chair of steering committee.
- SPIE Optics + Photonics 2007, 26 - 30 August 2007, San Diego, California, USA: Conference "Nanocoatings" , Program committee.
- Asia-Pacific Conference on Semiconducting Silicides, 29 - 31 July 2006, Kyoto: Chair of steering committee.

### Memberships

The Japan Society of Applied Physics, The Vacuum Society of Japan, The Surface Science Society of Japan, The Physical Society of Japan, The Japan Society of Mechanical Engineers

AVS, SPIE, The Electrochemical Society, IOP

## List of publications

### Original papers

- [1] K. Namura, K. Nakajima, K. Kimura, and M. Suzuki, "Sheathless particle focusing in a microfluidic chamber by using the thermoplasmonic Marangoni effect," *Appl. Phys. Lett.* 108 (7), 071603 (2016).
- [2] K. Namura, K. Nakajima, K. Kimura, and M. Suzuki, "Microfluidic control on nanoplasmonic thin films using Marangoni effect," *Journal of Nanophotonics* 10 (3), 033006-033006 (2016).
- [3] K. Jr-Jian, K. Namura, J. R. D. Retamal, H. Chih-Hsiang, H. Minamitake, W. Tzu-Chiao, T. Dung-Sheng, L. Chun-Ho, M. Suzuki, and H. Jr-Hau, "Surface-Controlled Metal Oxide Resistive Memory," *Electron Device Letters, IEEE* 36 (12), 1307-1309 (2015).
- [4] K. Namura, K. Nakajima, K. Kimura, and M. Suzuki, "Photothermally controlled Marangoni flow around a micro bubble," *Appl. Phys. Lett.* **106** (4), 043101 (2015).

- [5] H. Saito, K. Namura, M. Suzuki, and H. Kurata, "Dispersion relations for coupled surface plasmon-polariton modes excited in multilayer structures," *Microscopy* **63** (1), 85-93 (2014).
- [6] G. Recio-Sanchez, K. Namura, M. Suzuki, and R. Martin-Palma, "Nanostructured copper/porous silicon hybrid systems as efficient sound-emitting devices," *Nanoscale Research Letters* **9** (1), 487 (2014).
- [7] K. Namura, K. Nakajima, K. Kimura, and M. Suzuki, "Enhancement of photoacoustic emission from self-supported plasmonic multilayers," *J. Appl. Phys.* **116** (2), 024310-024311 (2014).
- [8] K. Nakajima, K. Nagano, M. Suzuki, K. Narumi, Y. Saitoh, K. Hirata, and K. Kimura, "Transmission secondary ion mass spectrometry using 5 MeV C-60(+) ions," *Appl. Phys. Lett.* **104** (11), 114103 (2014).
- [9] K. Nakajima, Y. Morita, T. Kitayama, M. Suzuki, K. Narumi, Y. Saitoh, M. Tsujimoto, S. Isoda, Y. Fujii, and K. Kimura, "Sputtering of SiN films by 540 keV C<sub>60</sub><sup>2+</sup> ions observed using high-resolution Rutherford backscattering spectroscopy," *Nucl. Instr. and Methods B* **332**, 117-121 (2014).
- [10] K. Nakajima, M. Miyashita, M. Suzuki, and K. Kimura, "Surface sensitivity of secondary ion mass spectroscopy in the electronic sputtering regime," *Nucl. Instr. and Methods B* **332**, 373-376 (2014).
- [11] N. Koike, K. Sasaki, T. Yamada, N. Hanashima, A. Takada, and M. Suzuki, "Optical properties and microstructures of inorganic wave plates prepared by serial bideposition," *Journal of Nanophotonics* **8** (1), 083991-083991 (2014).
- [12] Y. Fujii, K. Nakajima, M. Suzuki, and K. Kimura, "Surface and interface roughness estimations by X-ray reflectivity and RBS measurements," *Surface and Interface Analysis* **46** (12-13), 1208-1211 (2014).
- [13] M. Suzuki, H. Minamitake, R. Kita, K. Hamachi, H. Hara, K. Nakajima, K. Kimura, C.-W. Hsu, and L.-J. Chou, "Growth of Nanowires by High-Temperature Glancing Angle Deposition," *Japanese Journal of Applied Physics* **52**, 110116 (2013).
- [14] K. Namura, M. Suzuki, K. Nakajima, and K. Kimura, "Highly localized photothermal conversion in two-dimensional Au nanoparticle arrays," *J. Appl. Phys.* **114** (7), 074308-074304 (2013).
- [15] Y. Morita, K. Nakajima, M. Suzuki, K. Narumi, Y. Saitoh, N. Ishikawa, K. Hojou, M. Tsujimoto, S. Isoda, and K. Kimura, "Surface effect on ion track formation in amorphous Si<sub>3</sub>N<sub>4</sub> films," *Nucl. Instr. and Methods B* **315** (0), 142-145 (2013).
- [16] S.-Y. Li, K. Namura, M. Suzuki, G. A. Niklasson, and C. G. Granqvist, "Thermochromic VO<sub>2</sub> nanorods made by sputter deposition: Growth conditions and optical modeling," *J. Appl. Phys.* **114** (3), 033516-033511 (2013).
- [17] K. Namura, M. Suzuki, K. Nakajima, and K. Kimura, "Photoacoustic emission from Au nanoparticles arrayed on thermal insulation layer," *Opt. Express* **21** (7), 8689-8700 (2013).
- [18] M. Suzuki, "Practical applications of thin films nanostructured by shadowing growth," *Journal of Nanophotonics* **7**, 073598 (073510 pages) (2013).
- [19] M. Suzuki, Y. Kaneko, K. Nakajima, and K. Kimura, "Fabrication of periodic arrays of silicide nanopillars by using self-assembled polystyrene nanosphere template and oblique deposition technique," *physica status solidi (c)* **10** (12), 1866-1869 (2013).

- [20] W. Li, K. Nakane, M. Suzuki, and H. Tatsuoka, "Synthesis of Mg<sub>2</sub>Si nanorod arrays by the heat treatment of Si nanorod arrays under Mg vapor," *physica status solidi (c)* **10** (12), 1796-1799 (2013).
- [21] K. Nakajima, Y. Morita, M. Suzuki, K. Narumi, Y. Saitoh, N. Ishikawa, K. Hojou, M. Tsujimoto, S. Isoda, and K. Kimura, "Direct observation of fine structure in ion tracks in amorphous Si<sub>3</sub>N<sub>4</sub> by TEM," *Nucl. Instr. and Methods B* **291** (0), 12-16 (2012).
- [22] Y.-J. Jen, M. Suzuki, Y.-H. Wang, and M.-J. Lin, "Near-Field Simulation of Obliquely Deposited SERS Substrates," *J. Appl. Phys.* **112** (12), 113111 (113116pages) (2012).
- [23] H. Hashimoto, S. Fujita, K. Nakajima, M. Suzuki, K. Sasakawa, and K. Kimura, "Improvement of sensitivity in high-resolution ERDA," *Nucl. Instr. and Methods B* **273**, 241-244 (2012).
- [24] K. Nakajima, S. Oshima, M. Suzuki, and K. Kimura, "Surface structures of equimolar mixtures of imidazolium-based ionic liquids using high-resolution Rutherford backscattering spectroscopy," *Surf. Sci.* **606** (21, 22), 1693-1699 (2012).
- [25] K. Sasakawa, K. Nakajima, M. Suzuki, and K. Kimura, "Effect of multiple scattering on high-resolution Rutherford backscattering spectroscopy," *Nucl. Instr. and Methods B* **285**, 1-5 (2012).
- [26] M. Suzuki, K. Hamachi, H. Hara, K. Nakajima, K. Kimura, C.-W. Hsu, and L.-J. Chou, "Vapor-liquid-solid growth of Ge nanowhiskers enhanced by high-temperature glancing angle deposition," *Appl. Phys. Lett.* **99** (22), 223107 (223103 pages) (2011).
- [27] K. Namura, M. Suzuki, K. Nakajima, and K. Kimura, "Heat-generating property of a local plasmon resonator under illumination," *Opt. Lett.* **36** (18), 3533-3535 (2011).
- [28] M. Suzuki, A. Takada, T. Yamada, T. Hayasaka, K. Sasaki, E. Takahashi, and S. Kumagai, "Low-reflectivity wire-grid polarizers multilayered by the glancing-angle-deposition technique," *Journal of Nanophotonics* **5**, 011501 (011509 pages) (2011).
- [29] M. Suzuki, A. Takada, T. Yamada, T. Hayasaka, K. Sasaki, E. Takahashi, and S. Kumagai, "Antireflection coatings with FeSi<sub>2</sub> layer: Application to low-reflectivity wire grid polarizers," *Thin Solid Films* **519** (24), 8485-8489 (2011).
- [30] A. Takada, K. Sasaki, E. Takahashi, N. Hanashima, T. Yamada, and M. Suzuki, "Low-reflective Wire-grid Polarizers with an Absorptive Layer Formed by Glancing Angle Deposition," *映像情報メディア学会誌* **65** (10), 1440-1445 (2011).
- [31] Y. Kaneko, M. Suzuki, K. Nakajima, K. Kimura, K. Akiyama, K. Harutsugu, H. Wakabayashi, and T. Makino, "Antireflection coatings with FeSi<sub>2</sub> layer: Application to spectrally selective infrared emitter," *Physics Procedia* **11**, 71-74 (2011).
- [32] H. Hashimoto, K. Nakajima, M. Suzuki, K. Sasakawa, and K. Kimura, "Improvement of sensitivity in high-resolution Rutherford backscattering spectroscopy," *Review of Scientific Instruments* **82** (6), 063301 (063305 pages) (2011).
- [33] Y. Morita, K. Nakajima, M. Suzuki, K. Narumi, Y. Saitoh, W. Vandervorst, and K. Kimura, "Cluster effect on projected range of 30keV C<sub>60</sub><sup>+</sup> in silicon," *Nucl. Instr. and Methods B* **269**, 2080-2083 (2011).
- [34] M. Sakata, K. Nakajima, M. Suzuki, and K. Kimura, "Grazing scattering of 1-2 MeV HeH(+) ions from KCl(0 0 1): Effect of surface track potential," *Nucl. Instr. and Methods B* **269** (9), 795-798 (2011).

- [35] M. Suzuki, R. Kita, H. Hara, K. Hamachi, K. Nagai, K. Nakajima, and K. Kimura, "Growth of Metal Nanowhiskers on Patterned Substrate by High Temperature Glancing Angle Deposition," *Journal of The Electrochemical Society* **157** (2), K34-K38 (2010).
- [36] M. Suzuki, A. Takada, T. Yamada, T. Hayasaka, K. Sasaki, E. Takahashi, and S. Kumagai, "Low-reflective wire-grid polarizers with absorptive interference overlayers," *Nanotechnology* **21** (17), 175604 (175606 pages) (2010).
- [37] H. Hashimoto, A. Ohno, K. Nakajima, M. Suzuki, H. Tsuji, and K. Kimura, "Surface characterization of imidazolium ionic liquids by high-resolution Rutherford backscattering spectroscopy and X-ray photoelectron spectroscopy," *Surf. Sci.* **604** (3-4), 464-469 (2010).
- [38] K. Nakajima, A. Ohno, H. Hashimoto, M. Suzuki, and K. Kimura, "Observation of surface structure of 1-alkyl-3-methylimidazolium bis(trifluoromethanesulfonyl)imide using high-resolution Rutherford backscattering spectroscopy," *Journal of Chemical Physics* **133** (4), 044702 (044707pages) (2010).
- [39] K. Nakajima, M. Sakata, M. Suzuki, and K. Kimura, "Direct evidence of the surface track potential," *Phys. Rev. A* **82** (2), 022901 (022904 pages) (2010).
- [40] M. Suzuki, Y. Imai, H. Tokunaga, K. Nakajima, K. Kimura, T. Fukuoka, and Y. Mori, "Tailoring coupling of light to local plasmons by using Ag nanorods/structured dielectric/mirror sandwiches," *Journal of Nanophotonics* **3** (1), 031502 (031512 pages) (2009).
- [41] T. Sumigawa, T. Sueda, Y. Futamura, M. Suzuki, and T. Kitamura, "Effect of interface layer consisting of nanosprings on stress field near interface edge," *Engineering Fracture Mechanics* **76** (9), 1336-1344 (2009).
- [42] K. Nakajima, A. Ohno, M. Suzuki, and K. Kimura, "Surface structure of an ionic liquid with high-resolution Rutherford backscattering spectroscopy," *Nucl. Instr. and Methods B* **267** (4), 605-609 (2009).
- [43] A. Ohno, H. Hashimoto, K. Nakajima, M. Suzuki, and K. Kimura, "Observation of surface structure of 1-butyl-3-methylimidazolium hexafluorophosphate using high-resolution Rutherford backscattering spectroscopy," *The Journal of Chemical Physics* **130** (20), 204705 (204705 pages) (2009).
- [44] M. Suzuki, W. Maekita, Y. Wada, K. Nagai, K. Nakajima, K. Kimura, T. Fukuoka, and Y. Mori, "Ag nanorod arrays tailored for surface-enhanced Raman imaging in the near-infrared region," *Nanotechnology* **19** (26), 265304 (265307 pages) (2008).
- [45] T. Sumigawa, H. Hirakata, M. Takemura, S. Matsumoto, M. Suzuki, and T. Kitamura, "Disappearance of stress singularity at interface edge due to nanostructured thin film," *Engineering Fracture Mechanics* **75** (10), 3073-3083 (2008).
- [46] K. Nakajima, A. Ohno, M. Suzuki, and K. Kimura, "Observation of Molecular Ordering at the Surface of Trimethylpropylammonium Bis (trifluoromethanesulfonyl) imide Using High-Resolution Rutherford Backscattering Spectroscopy," *Langmuir* **24** (9), 4482-4484 (2008).
- [47] M. Suzuki, K. Kinoshita, S. Jomori, H. Harada, K. Nakajima, and K. Kimura, "Subsurface structures in initial stage of FeSi<sub>2</sub> growth studied by high-resolution Rutherford backscattering spectroscopy," *Thin Solid Films* **515** (22), 8281-8284 (2007).
- [48] M. Suzuki, K. Nagai, S. Kinoshita, K. Nakajima, K. Kimura, T. Okano, and K. Sasakawa, "Morphological evolution of Al whiskers grown by high temperature glancing angle deposition," *J. Vac. Sci. Technol. A* **25**, 1098-1102 (2007).



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- [50] A. Amassian, K. Kaminska, M. Suzuki, L. Martinu, and K. Robbie, "Onset of shadowing-dominated growth in glancing angle deposition," *Appl. Phys. Lett.* **91** (17), 173114 (173113 pages) (2007).
- [51] H. Harada, S. Jomori, M. Suzuki, K. Kinoshita, K. Nakajima, and K. Kimura, "Effect of oblique-angle deposition on early stage of Fe-Si growth," *Thin Solid Films* **515** (22), 8277-8280 (2007).
- [52] H. Hirakata, S. Matsumoto, M. Takemura, M. Suzuki, and T. Kitamura, "Anisotropic deformation of thin films comprised of helical nanosprings," *International Journal of Solids and Structures* **44** (11-12), 4030-4038 (2007).
- [53] T. Matsushita, K. Nakajima, M. Suzuki, and K. Kimura, "Energy loss of slow  $C_{60}^+$  ions during grazing scattering from a KCl(001) surface," *Phys. Rev. A* **76** (3), 032903 (032907 pages) (2007).
- [54] K. Nakajima, A. Fujiyoshi, Z. Ming, M. Suzuki, and K. Kimura, "In situ observation of oxygen gettering by titanium overlayer on  $HfO_2/SiO_2/Si$  using high-resolution Rutherford backscattering spectroscopy," *J. Appl. Phys.* **102** (6), 064507 (064503 pages) (2007).
- [55] K. Nakajima, S. Yamasaki, M. Suzuki, and K. Kimura, "Secondary ion emission from a KCl(001) surface by grazing-angle incidence of swift heavy ions," *Nucl. Instr. and Methods B* **256** (1), 524-527 (2007).
- [56] S. Tamehiro, T. Matsushita, K. Nakajima, M. Suzuki, and K. Kimura, "Neutralization of slow  $C_{60}^+$  ions in front of KCl(001) surface," *Nucl. Instr. and Methods B* **256** (1), 16-20 (2007).
- [57] M. Zhao, K. Nakajima, M. Suzuki, K. Kimura, M. Uematsu, K. Torii, S. Kamiyama, Y. Nara, H. Watanabe, K. Shiraishi, T. Chikyow, and K. Yamada, "Isotopic labeling study of the oxygen diffusion in  $HfO_2/SiO_2/Si$ ," *Appl. Phys. Lett.* **90** (13), 133510 (133513 pages) (2007).
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- [60] T. Hattori, H. Nohira, K. Azuma, K. W. Sakai, K. Nakajima, M. Suzuki, K. Kimura, Y. Sugita, E. Ikenaga, K. Kobayashi, Y. Takata, H. Kondo, and S. Zaima, "Study of the gate insulator/silicon interface utilizing soft and hard X-ray photoelectron spectroscopy at Spring-8," *International Journal of High Speed Electronics and Systems* **16** (1), 353-364 (2006).
- [61] S. Hosoi, K. Nakajima, M. Suzuki, K. Kimura, Y. Shimizu, S. Fukatsu, K. M. Itoh, M. Uematsu, H. Kageshima, and K. Shiraishi, "Observation of Si emission during thermal oxidation of Si(001) with high-resolution RBS," *Nucl. Instr. and Methods B* **249**, 390-393 (2006).
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#### Invited lectures

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# Interfacial Mechanics for Micro and Nanomechanical Systems Engineered by Photothermal Heating

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## ABSTRACT

With decreasing size of mechanical systems, surface force becomes dominant over body force. Thus, it is important to engineer the surface forces to actuate micro- and nano-scale elements. Especially, the forces acting on solid-solid, solid-liquid and liquid-gas interfaces are expected to be power sources for micro and nanomechanical systems. Because such interfacial forces may depend on temperature and/or temperature gradient at interfaces, various types of micro and nanoheaters are developed. Among them, photothermal heating is the most possible candidate for the power to actuate micro and nanomechanical systems because of its flexibility, quick response and localization. In this presentation, we propose two types of actuation using the photothermal actuation.

The first topic is the thermal nanobimorph realized by high and low temperature glancing angle deposition. First, we prepared Cu nanowires by our original high temperature glancing angle deposition technique[1, 2]. On a side surface of the Cu nanowires, we deposited SiO<sub>2</sub> up to a thickness of a few nm at room temperature. As a result, we have successfully prepared biomaterial nanowires. When we irradiate a nanowire with a laser beam of wavelength of 785 nm, the nanowire deforms quickly, because its heat capacity, which depends on its volume, is quite small. Such thermal nanobimorphs can be applied to artificial nanoflagella and nanocilia.

The second topic is microfluidic flow induced by thermoplasmonic Marangoni force[3-5]. Recently, we have successfully control the microfluidic flows around a micro bubble. By using the photothermal conversion on a Au nanoisland film immersed in water, a micro bubble is created. When we irradiate the vicinity of the microbubble with the laser, the liquid-gas interface is locally heated and the steep temperature gradient is induced at the liquid-gas interface. As the result, the rapid flow is induced around the bubble. The flow pattern can be controlled by the position of the laser irradiation and its power. Therefore, the thermoplasmonic Marangoni flow will be the engine for microfluidic devices.

## KEYWORDS

Thermoplasmonics, Photothermal heating, Marangoni force, Hetero structured nanowire

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