
# Conference Program

# Digest

## The Fourth International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale

## 3M-NANO 2014

**Taipei, Taiwan**

**27 – 31 October 2014**

**Organized by:**

**Industrial Technology Research Institute, Taiwan**

**Academia Sinica, Taiwan**

**University of Oldenburg, Germany**

**National Taiwan University, Taipei, Taiwan**

**Changchun University of Science and Technology, China**

**OFFIS, Oldenburg, Germany**

**Sponsored by:**

**National Natural Science Foundation of China**

**Ministry of Science and Technology of the People's Republic of China**

**Research Executive Agency (REA), European Commission**

**Jilin Provincial Science & Technology Department, China**

**IEEE Nanotechnology Council (technically sponsored)**

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**Tampere University of Technology, Finland**

**University of Bedfordshire, UK**

# Greetings

On behalf of the organizing committee, it is our great pleasure and honor to welcome you in Taipei at 3M-NANO 2014 conference!

3M-NANO is an annual International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale, held for the fourth time in Taipei. 3M-NANO covers advanced technologies for handling and fabrication on the nanoscale. The ultimate ambition of this conference series is to bridge the gap between nanosciences and engineering sciences, aiming at emerging market and technology opportunities. The advanced technologies for manipulation, manufacturing and measurement on the nanoscale promise novel revolutionary products and methods in numerous areas of application. Scientists working in different research fields are invited to discuss theories, technologies and applications related to manipulation, manufacturing and measurement on the nanoscale. 3M-NANO 2014 is proud to offer an excellent technical program containing 24 keynote talks on major conference topics delivered by distinguished researchers and around 150 presentations in parallel technical program.

Sergej Fatikow
3M-NANO, Founding Chair

Shuo-Hung Chang
3M-NANO 2014, General Chair

Zuobin Wang
3M-NANO, Founding Chair

A major goal of the 3M-NANO conference is to support a sustainable development of the nanohandling research community and to encourage long-term partnerships and collaborative research activities. To underline this dedication and to provide a get-together

forum for all the participants, 3M-NANO 2014 has organized several exciting social events during and after the conference.

We would like to express our most sincere appreciation to all of our sponsoring organizations and all the individuals who have contributed to this conference. Our special thanks go to our colleagues in various conference committees and the volunteers who worked very hard to ensure the success of 3M-NANO 2014. Last but definitely not least, we thank all the conference participants for their support and contribution. We do hope that 3M-NANO 2014 will be the next successful step in this series of annual conferences and give home to rapidly growing nanohandling research community.

We wish you a successful conference and enjoyable stay in Taipei!

# Table of Content

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| | |
|---|---|
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# Conference Information

## Venue and Accommodation

### Venue

3M-NANO 2014 is held at Academia Sinica in Taipei City, which is the most preeminent academic institution in Taiwan. It was founded in 1928 to promote and to undertake scholarly research in sciences and humanities. It supports research activities in a wide variety of disciplines, ranging from mathematical and physical sciences, life sciences, to humanities and social sciences.

Website: http://www.sinica.edu.tw/main_e.shtml

Address: Public Affairs Committee of H.S.S. Building, Academia Sinica
128 Academia Road, Section 2, Nankang, Taipei 115, Taiwan.

Phone: +886-2-2652-5200

Fax: +886-2-2782-6672

The venues of 3M-NANO 2014 are Humanities and Social Sciences Center on 28 October and Research Center for Applied Sciences (Multidisciplinary Science and Technology Research Building) on 29-30 October.


1 Main Entrance
2 Institute of Biomedical Sciences
3 Environment, Health and Safety Management Division
4 Institute of Cellular and Organismic Biology
4 Biodiversity Research Center
5 Institute of Molecular Biology
6 Institute of Biological Chemistry
6 Life Science Library
7 National Laboratory Animal Center, NLAC
8 Interdisciplinary Research Building for Science and Technology
9 Mini-forest restoration area
10 Central Office of Administration
11 Biodiversity Research Center
11 Biodiversity Research Museum
12 Institute of Plant and Microbial Biology
13 Research Center for Information Technology Innovation
13 IRDR-International Centre of Excellence (IRDR-ICoE)
14 Tsai Yuan-Pei Memorial Hall
15 Institute of Statistical Science
16 Post office, garage, grocery store and Hi-Life convenient store
17 Ecopond
18 Genomics Research Center
19 Agricultural Technology Building
19 Agricultural Biotechnology Research Center (Agricultural Technology Building 1st-2nd Floor and 5-7th Floor)
19 Institute of Plant and Microbial Biology (Agricultural Technology Building 1st-4th Floor)
20 Center of Academic Activities (Bookstore, auditorium, conference rooms, guest rooms, breastfeeding room, Chinese and Western restaurants, coffee shop)
21 Institute of Chinese Literature and Philosophy
22 Institute of Earth Sciences
23 Gymnasium (Breastfeeding room)
24 Humanities and Social Sciences Building (HSSB)
24 Joint Library of Humanities and Social Sciences (1st-2nd Floor HSSB)
24 Institute of Linguistics (5-7th Floor of South Wing, HSSB)
24 Institute of Sociology (8-10th Floor of South Wing, HSSB)

* The Institute of Mathematics, Institute of Atomic and Molecular Sciences, Institute of Astronomy and Astrophysics and some buildings belonging to the Institute of Biological Chemistry are located on the National Taiwan University campus.

24 Research Center for Applied Sciences (11th Floor of South Wing, HSSB)
24 Research Center for Environmental Changes (11th Floor of South Wing, HSSB)
24 Institute of Political Science (5-6th Floor of North Wing, HSSB)
24 Institute of Taiwan History (7-8th Floor of North Wing, HSSB)
24 Institutum Iurisprudentiae (9-10th Floor of North Wing, HSSB)
25 Research Center for Environmental Changes (Laboratories)
26 Plant Molecular Breeding Greenhouse
27 Greenhouse Building
27 Biodiversity Research Center
28 Research Center for Environmental Changes (under construction)
30 Institute of Chemistry
31 Research Center for Humanities and Social Sciences
32 Institute of Information Science
33 Institute of Physics

33 Research Center for Applied Sciences (Laboratories)
33 Wu Ta-You Memorial Hall
34 Hu Shih Memorial Hall
35 Institute of Modern History
36 Institute of European and American Studies
37 Institute of History and Philology
37 Museum of the Institute of History and Philology
38 Fu Ssu-nien Library
39 Institute of Economics
40 Institute of Ethnology
40 Museum of the Institute of Ethnology
41 Lingnan Fine Arts Museum (Jin Mei Building)
42 Archive Building, Institute of Modern History
43 Taiwan Archaeological Studies Building
50 Academia Sinica Dormitory Buildings
51 Temporary Parking
60 TIGP Teaching and Administration Building (TA Building)
60 Administrative office for TIGP, Degree Program, and Foreigners Services (2nd-3rd Floor of TA Building)
60 Kindergarten (1st Floor of TA Building)

Directions
- By Bus: Buses 205, 212, 270, 276, 306, 620, 645, 679, Blue 25, minibus 1, minibus 5, and minibus 12 all go to Academia Sinica.
- By Train: Take bus 205, 212, 276, 306, 679, minibus 5 or minibus 12 to Academia Sinica at Nankang Train Station.
- By MRT: 1. Take the Bannan Line to Nankang Station (Exit 2). Then take bus 212, 270 or Blue 25 to Academia Sinica.
2. Take the Bannan Line to the Nangang Exhibition Center (Exit 2). Then take bus 205, 212, 276, 306, 620, 645, 679, minibus 1, minibus 5 or minibus 12 to Academia Sinica.

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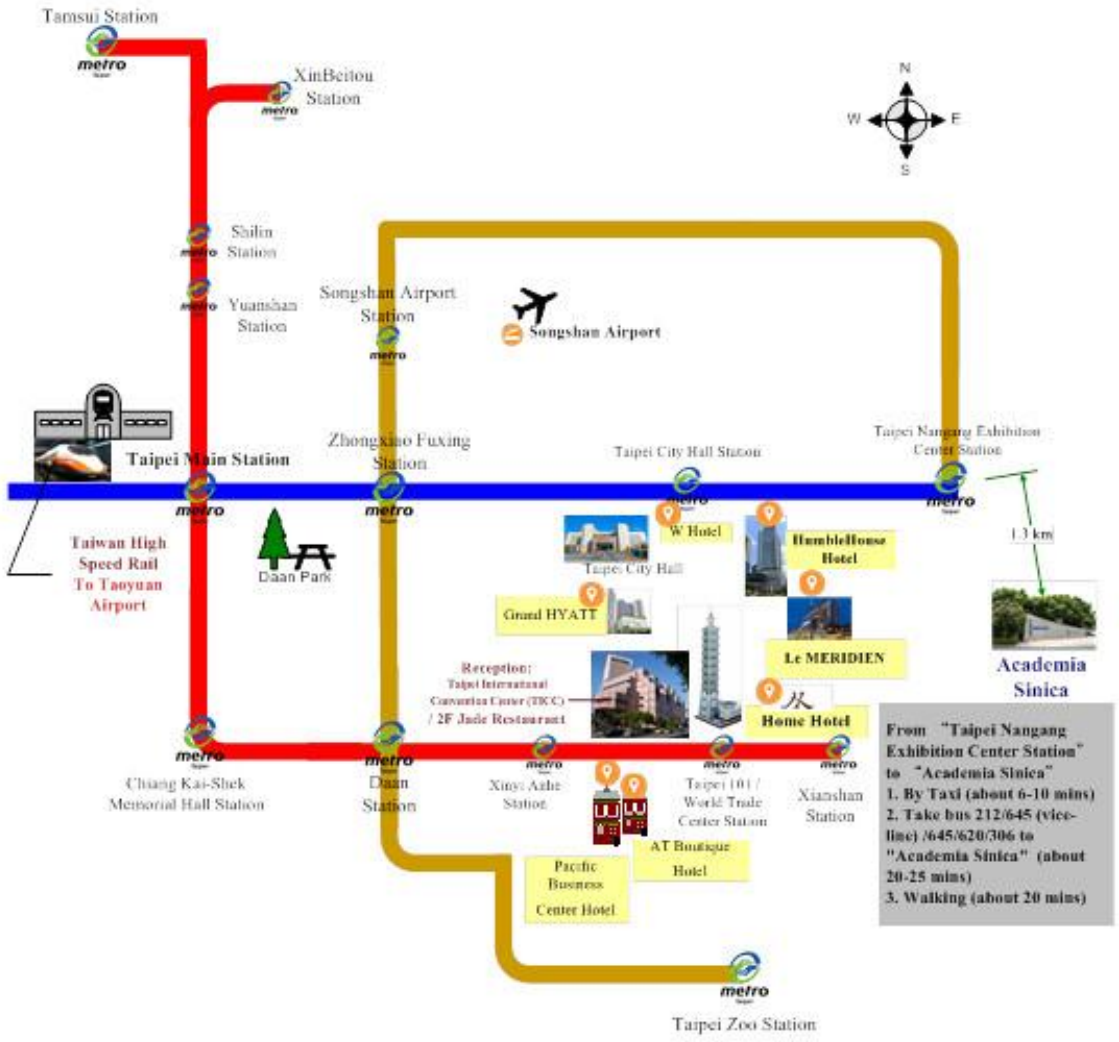
# Accommodation

## Hotel, Welcome Reception and MRT station locations

**MRT Routes from Hotels to airports and conference venue**




Complimentary shuttle buses from Humble House and Pacific Business Hotel to the conference venue and back to the hotels/banquet will be arranged:

## Departure Time of the shuttle buses:

| | | |
|---|---|---|
| **28 October:** | **07:30** | **(from the hotels to the venue)** |
| | **20:00** | **(from the venue to the hotels)** |
| **29 October:** | **07:30** | **(from the hotels to the venue)** |
| | **20:00** | **(from the venue to the hotels)** |
| **30 October:** | **07:30** | **(from the hotels to the venue)** |
| | **18:15** | **(from the venue to the banquet)** |

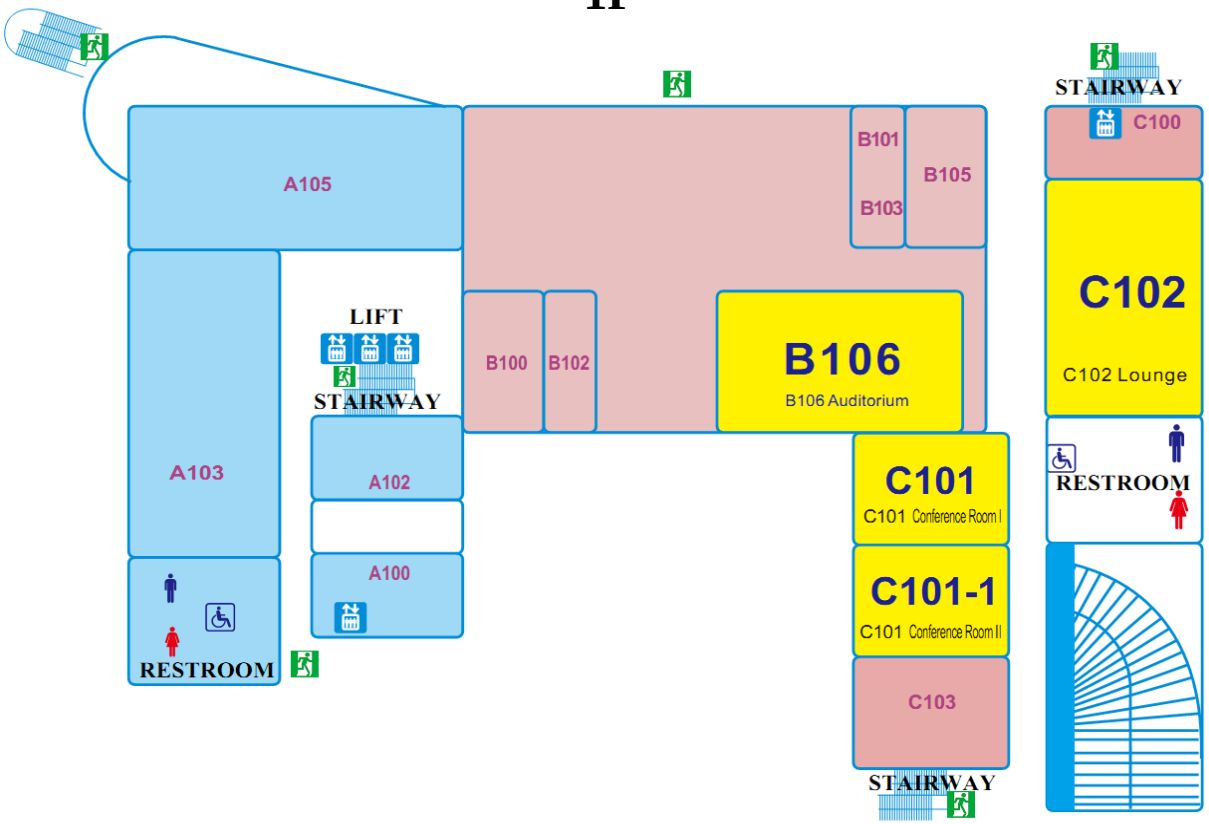
# Floor Maps of Conference Rooms

## Humanities and Social Sciences Building (HSSB)
## 28 October 2014

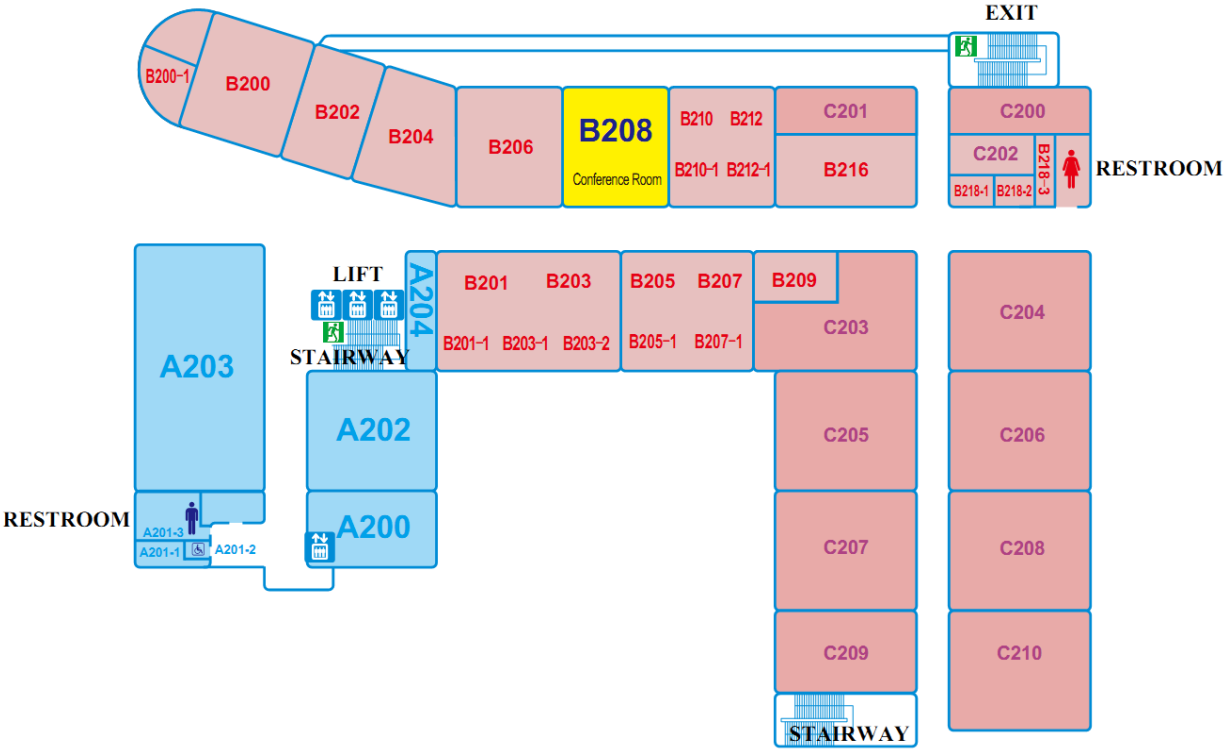
### 4F

# Multidisciplinary Science and Technology Research Building
# 29-30 October 2014

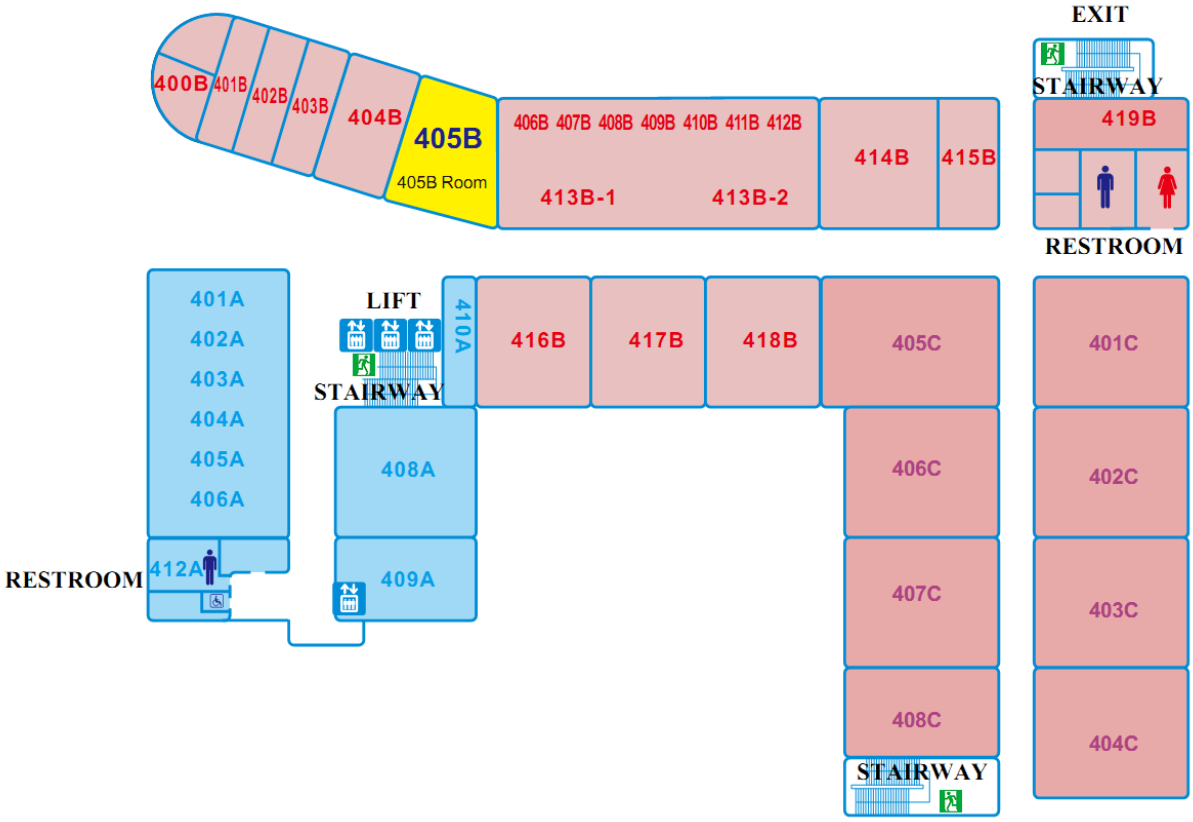
## 1F




## 2F



# 4F


EXIT
STAIRWAY
400B
401B
402B
403B
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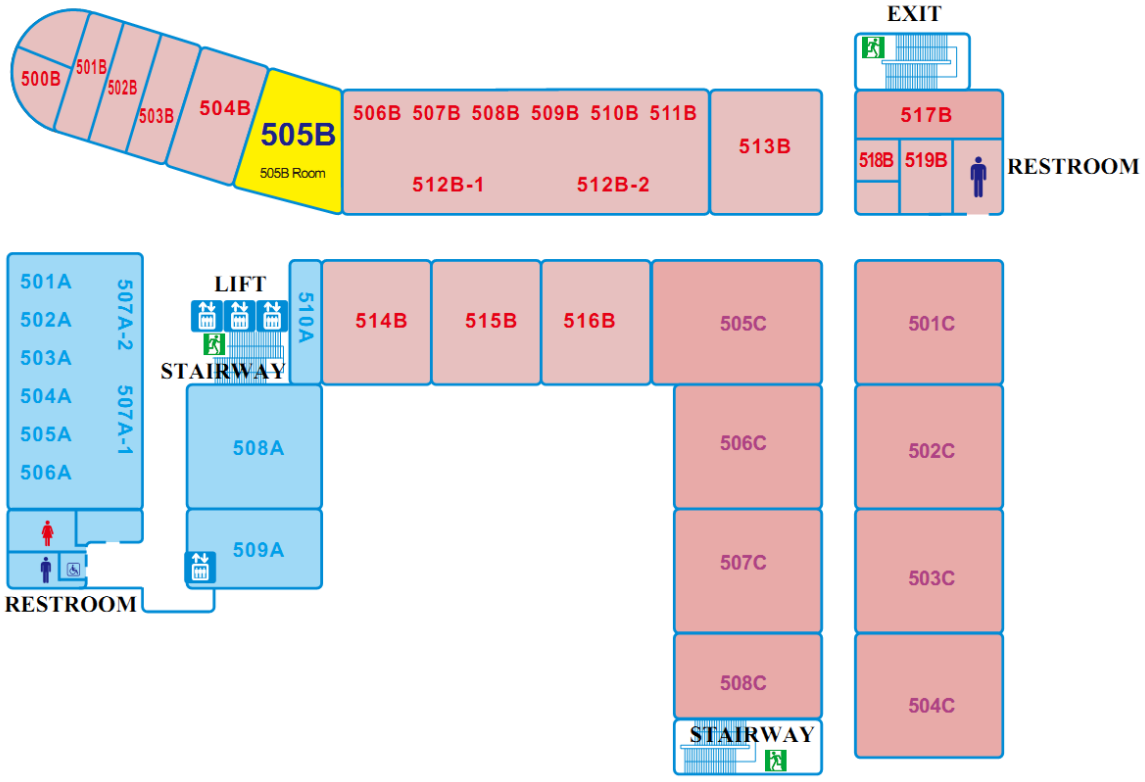
405B
405B Room
406B 407B 408B 409B 410B 411B 412B
413B-1
413B-2
414B
415B
419B
RESTROOM
401A
402A
403A
404A
405A
406A
412A
RESTROOM
LIFT
STAIRWAY
410A
416B
417B
418B
405C
406C
407C
408C
STAIRWAY
408A
409A
401C
402C
403C
404C

# 5F


EXIT
500B
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518B
519B
RESTROOM
501A
502A
503A
504A
505A
506A
507A-2
507A-1
RESTROOM
LIFT
STAIRWAY
510A
514B
515B
516B
505C
506C
507C
508C
STAIRWAY
508A
509A
501C
502C
503C
504C

# 3M-NANO 2014
# Program at a Glance

| **Monday, 27 October 2014, Jade restaurant, 2F: 17:00–21:00** | |
|---|---|
| Registration and Welcome reception | |
| **Tuesday, 28 October 2014: 08:00–18:20** | |
| 08:00—08:40 | Opening ceremony |
| 08:40—10:00 | Keynote reports |
| 10:00—10:20 | Break |
| 10:20—13:00 | Keynote reports |
| 13:00—14:00 | Lunch |
| 14:00—16:00 | Keynote reports |
| 16:00—16:20 | Break |
| 16:20—18:20 | Keynote reports |
| 18:20—20:00 | Conference dinner |
| **Wednesday, 29 October 2014: 08:00–18:20** | |
| 08:00—10:00 | Parallel technical sessions |
| 10:00—10:20 | Break |
| 10:20—13:00 | Topical Workshop on 2D Materials<br>(4 Keynote reports) |

| | |
|---|---|
| 13:00—14:00 | Lunch |
| 14:00—16:00 | Parallel technical sessions |
| 16:00—16:20 | Break |
| 16:20—18:20 | Keynote reports |
| 18:20—20:00 | Conference dinner |
| **Thursday, 30 October 2014: 08:00–18:00** | |
| 08:00—10:00 | Parallel technical sessions |
| 10:00—10:20 | Break |
| 10:20—13:00 | Keynote reports |
| 13:00—14:00 | Lunch |
| 14:00—16:00 | Parallel technical sessions |
| 16:00—16:20 | Break |
| 16:20—17:00 | Keynote report |
| 17:00—18:00 | Closing ceremony |
| 18:00—20:00 | Farewell banquet |
| **Friday, 31 October 2014: 08:00–17:30** | |
| Sightseeing tour | |

# Schedule of the Keynote Reports

## Tuesday, 28 October 2014, International Conference Hall

## Humanities and Social Sciences Building

| Time | Topic | Speaker |
|---|---|---|
| **Session Chair:** Sergej Fatikow | | |
| 08:40 – 09:20 | Manipulation of a Bio Nano Complex System for Personalized Medicine | Chih-Ming Ho |
| 09:20 – 10:00 | Biomedical Imaging Systems for Early Detection of Disease | Dae-Gab Gweon |
| **Session Chair:** Hong-Bo Sun | | |
| 10:20 – 11:00 | Row-column Addressed Capacitive Micromachined Ultrasonic Imaging System | John Yeow |
| 11:00 – 11:40 | Biologically Inspired Hybrid Robotic Systems for Nanomedicine | MinJun Kim |
| 11:40 – 12:20 | Ultimate Ring Resonator for Atomic Force Microscopy: A Possible Way for Biosensing | Lionel Buchaillot |
| 12:20 –13:00 | Multiparametric Imaging of Nanomaterials by Dynamic Quantitative Nanomechanical Mapping | Mingdong Dong |
| **Session Chair:** Evangelos S. Eleftheriou | | |
| 14:00 – 14:40 | Bessel Beam Machining and Light-field Metrology | Chih-kung Lee |
| 14:40 – 15:20 | Non-Vector Space Control for Nano Manipulations | Ning Xi |
| 15:20 – 16:00 | Nano-Measurement by Transient Spectroscopies: Open the Blackbox of Optoelectronic Dynamics | Hong-Bo Sun |

| | | |
|---|---|---|
| **Session Chair:** Pei-Kuen Wei | | |
| 16:20 – 17:00 | Nanostructure Conducting Polymer for Energy-Related Applications | Chih Wei Chu |
| 17:00 – 17:40 | Key Enabling Technologies for Scanning Probe Microscopy | Evangelos S. Eleftheriou |
| 17:40 – 18:20 | Nanopositioning and Nanomeasuring Machine for Measurement, Manufacturing and Manipulation on the Nanoscale | Eberhard Manske |

## Wednesday, 29 October 2014, Room B106 Auditorium (1st floor) Multidisciplinary Science and Technology Research Building

| Time | Topic | Speaker |
|---|---|---|
| **Topical Workshop: "Emerging 2D Materials for Nanotechnology"** **Workshop Chair:** Peter Bøggild | | |
| 10:20 – 11:00 | The Atomic Structure of Low-dimensional Materials Determined from In-situ Low-voltage Aberration-corrected TEM Experiments | Ute Kaiser |
| 11:00 – 11:40 | Defects in Two-dimensional Materials | Arkady Krasheninnikov |
| 11:40 – 12:20 | Properties and Application of Graphene Based Materials | Rahul Raveendran Nair |
| 12:20 – 13:00 | Epitaxial Graphene on SiC: Gateless Patterning, Efficient Switches and a Concept for Digital Circuits | Heiko Weber |
| **Session Chair:** Ute Kaiser | | |
| 16:20 – 17:00 | 2D or not 2D: Electrical Continuity of Graphene and How to Measure It | Peter Bøggild |
| 17:00 – 17:40 | CMOS MEMS: A Key Technology Towards the “More Than Moore” Era | Weileun Fang |
| 17:40 – 18:20 | Miniaturized Systems for Pharmaceutical and Medical Applications | Andreas Dietzel |

# Thursday, 30 October 2014, Room B106 Auditorium (1st floor)

# Multidisciplinary Science and Technology Research Building

| Time | Topic | Speaker |
|---|---|---|
| **Session Chair:** Chih-Ming Ho | | |
| 10:20 – 11:00 | Metrology for 3D Interconnect Processes | Yi-sha Ku |
| 11:00 – 11:40 | Nanometrology Using<br>Scanning Probe Microscopy Methods | Teodor Pawel Gotszalk |
| 11:40 – 12:20 | Analysis and Design of<br>the Precision Compliant Mechanisms | Xianmin Zhang |
| 12:20 – 13:00 | Micro/nanorobotic Handling and Characterization of<br>Microscale Biological Objects | Pasi Kallio |
| **Session Chair:** Pasi Kallio | | |
| 16:20 – 17:00 | Fabrication and Applications of Nanostructures for<br>Highly Efficient Light Extraction | Pei-Kuen Wei |

# Keynote Speakers

(in alphabetical order)

## 2D or not 2D: Electrical Continuity of Graphene and How to Measure It

**Peter Bøggild**

Professor
DTU Nanotech
Department of Micro-and Nanotechnology
Technical University of Denmark
E-mail: Peter.Boggild@nanotech.dtu.dk

**Abstract:** For nearly all applications of large-area graphene, the presence of cracks, rips, holes and tears is unacceptable. In this work, several non-destructive, large-area characterization techniques, including micro four-point probe and Terahertz time-domain spectroscopic conductance mapping, as well as gigapixel quantitative optical microscopy are for the first time combined to study the electrical continuity of chemical vapor deposited graphene on length scales from 100 nm to 100 um. We investigate how catalyst crystallinity, domain size distribution, growth parameters as well as the transfer process, affect the chance of making truly two-dimensional graphene.

## Ultimate Ring Resonator for Atomic Force Microscopy: A Possible Way for Biosensing

**Lionel Buchaillot**

Professor
University of Lille Nord de France, Director
The Institute of Electronics, Microelectronics and Nanotechnology – IEMN, France
E-mail: lionel.buchaillot@iemn.univ-lille1.fr

**Abstract:** Since its discovery, atomic force microscopy (AFM) has paved the way for new research experiments in physics allowing multi physics probing combined with ultimate imaging at the atomic scale. Microlevers tapered by metal or active materials have allowed unprecedented experiments leading to original electrical, mechanical and magnetic measurements, among others. It has been now more than 10 years since biologists started paying attention to this wonderful instrument. At the early stage, they were satisfied by the AFM characteristics, but now, they expect better performances not only in air, but in liquid medium as well. In order to comply with these requirements, we designed a ring resonator featuring interesting data for biosensing, e.g. the ability to operate the probe at very high frequency compare to standard AFM levers.

## Nanostructure Conducting Polymer for Energy-Related Applications


**Chih Wei Chu**

Associate Research Fellow
Research Center for Applied Sciences, Academia Sinica
Associate Professor
Department of Photonics, National Chiao-Tung University
E-mail: gchu@gate.sinica.edu.tw



**Abstract:** Conjugated organic materials, possessing electrical and optical properties similar to metals and inorganic semiconductors, are capable of bringing new opportunities because of their soft nature, and thus allowing high flexibility. Poly (3, 4-ethylenedioxythiophene): Polystyrene sulfonate (PEDOT: PSS) and Poly (3,4-ethylenedioxythiophene) (PEDOT) have been investigated most often because of their reasonable electric conductivity, low oxidation potentials, biocompatibility, and environmental stability at high temperature. In this presentation, I will introduce different facile approaches to enhance conductivity of PEDOT: PSS and fabricate nanostructure PEDOT films as well as their energy-related applications.


## Miniaturized Systems for Pharmaceutical and Medical Applications


**Andreas Dietzel**

Professor
Institute of Microtechnology
Braunschweig University of Technology, Germany
E-mail: a.dietzel@tu-braunschweig.de



**Abstract:** Micro-/Nanotechnologies offer many advantages over conventional systems in particular in the field of health care applications. Several examples such as point of care sensors including elements of fluid manipulation and sensing within a single chip, mechanically flexible microsystems that allow more comfortable adaption to the shape of the human body to be used for monitoring, and systems for the processing and formulation of nano-particulate pharmaceuticals for the small scale production of individualized medicine will be discussed.

## Multiparametric Imaging of Nanomaterials by Dynamic Quantitative Nanomechanical Mapping


**Mingdong Dong**

Assoc. Professor
Head, Bio-SPM Lab
Interdisciplinary Nanoscience Center (iNANO)
Aarhus University, Denmark
E-mail: dong@inano.au.dk



**Abstract:** Force spectroscopy is a powerful method to measure physical properties of materials. Recently progress has been made in the characterization of nanomechanical properties using Dynamic Quantitative Nanomechanical Mapping (DQNM). DQNM has the ability to recover the tip–sample force waveforms which provide high-speed force–distance curves and allow specific material properties to be measured with high spatial resolution. This talk will review the recently developed experimental technique and its applications in quantitative imaging of biological molecules and nano materials.


## Key Enabling Technologies for Scanning Probe Microscopy


**Evangelos S. Eleftheriou**

PhD, IBM Fellow
Head, Storage Technologies Department
IBM Zurich Research Laboratory, Switzerland
E-mail: ele@zurich.ibm.com



**Abstract:** Manipulation and interrogation at the nanometer scale with a scanning probe microscope (SPM) necessitate high-resolution sensing and positioning systems with atomic-scale accuracy. This talk will review recent progress in cantilever-deflection sensing for atomic force microscopy (AFM) using nonoptical means, including schemes suitable for multi-resolution imaging. A second focus will be a key enabling technology for SPM, namely, nanopositioning, and discuss four technology elements that are vital for high-speed nanopositioning: (1) a magnetoresistance-based high-bandwidth and low-noise nanoscale sensing scheme, (2) dual-stage nanopositioners, (3) noise-resilient feedback controllers using hybrid control, and (4) optimized scan trajectories.

## CMOS MEMS: A Key Technology Towards the "More Than Moore" Era


**Weileun Fang**

Distinguished Professor
Head, Micro Device Laboratory
Power Mech. Eng. Dept. and NEMS Institute
National Tsing Hua University
Hsinchu, Taiwan
E-mail: fang@pme.nthu.edu.tw



**Abstract:** The mature CMOS fabrication processes are available in many IC foundries. It is cost-effective to leverage the existing CMOS fabrication technologies to implement MEMS devices. On the other hand, the MEMS devices could also add values to the IC industry as the Moore's law reaching its limit. The CMOS MEMS could play a key role to bridge the gap between the CMOS and MEMS technologies. The CMOS MEMS also offers the advantage of monolithic integration of ICs and micro mechanical components. This talk introduces the approach to implement and integrate various MEMS transducers by leveraging standard CMOS processes. Note that other process platforms (e.g. poly-Si, CNT, glass, metal, etc.) are also of importance for different MEMS applications. In future, these process platforms could enhance the variety and performance of on-chip devices as moving towards the "More than Moore" era.


## Nanometrology Using Scanning Probe Microscopy Methods


**Teodor Pawel Gotszalk**

Professor
Head, Nanometrology Lab
Faculty of Microsystem Electronics and Photonics
Wroclaw University of Technology, Poland
E-mail: teodor.gotszalk@pwr.wroc.pl



**Abstract:** Scanning probe microscopy (SPM) belongs to the high resolution methods for imaging of micro- and nanostructures. This technology has been used successfully in the university and industry research laboratories for over two decades. Despite progress in this field a lot of effort must be done in order to enable quantitave (in other words metrological) surface investigations. In this presentation latest results on metrological applications of the SPM related methods will be presented.

## Biomedical Imaging Systems for Early Detection of Disease


**Dae-Gab Gweon**

Professor
Head, Nano-Opto-Mechatronics Laboratory
Division of Mechanical Engineering
Korea Advanced Institute of Science and Technology (KAIST),
South Korea
E-mail: dggweon@kaist.ac.kr



**Abstract:** In this presentation, the imaging principles and applications of 4 biomedical imaging systems, confocal microscope, two-photon microscope, FLIM (fluorescence Lifetime Imaging Microscope) and spectral imaging microscope, will be introduced. The highlight of the presentation is a multimodal microscope which is the combination of the above four modalities. The diagnostic accuracy and capability can be much increased by using this multimodal microscope. For improving the accessibility of the multimodal microscope in diagnostic process, a multimodal endomicroscope was also developed in our laboratory and will be introduced in this presentation.


## Manipulation of a Bio Nano Complex System for Personalized Medicine


**Chih-Ming Ho**

Ben Rich-Lockheed Martin Professor
UCLA Distinguished Professor
Henry Samueli School of Engineering and Applied Science
University of California, Los Angeles, USA
Member of the US National Academy of Engineering
Academician of Academia Sinica, Taiwan
E-mail: chihming@seas.ucla.edu



**Abstract:** With a newly developed feedback system control (FSC.X) technique, we can rapidly optimize the drug-dose combination for manipulating the aberrant nano components in the complex system of a specific patient. In this case, we will be able to prescribe the personalized drug for a patient, rather than just base on the disease being diagnosed.

## The Atomic Structure of Low-dimensional Materials Determined from In-situ Low-voltage Aberration-corrected TEM Experiments


**Ute Kaiser**

Professor
Head, Electron Microscopy Group of Materials Science
University of Ulm, Germany
E-mail: ute.kaiser@uni-ulm.de



**Abstract:** We report in this lecture on the atomic structure and the electronic properties of graphene and other 2D materials as well as functionalized carbon nanotubes obtained by analytical aberration-corrected transmission electron microscopy at voltages below their knock-on damage thresholds. We outline challenges, current possibilities and future prospects.


## Micro/nanorobotic Handling and Characterization of Microscale Biological Objects


**Pasi Kallio**

Professor
Micro- and Nanosystems Research Lab
Department of Automation Science and Engineering
Tampere University of Technology, Finland
IEEE Finland Section Chair
E-mail: pasi.kallio@tut.fi



**Abstract:** This talk will discuss recent developments in micro/nanorobotic and microfluidic technologies in the handling and characterization of microscale biological objects. The talk will address challenges in stem cell research and opportunities provided by micro/nanorobotic and microfluidic technologies. It will also discuss issues in autonomous characterization of natural fibers, such as individual wood fibers.

## Biologically Inspired Hybrid Robotic Systems for Nanomedicine

**MinJun Kim**

Professor
Director,
Biological Actuation, Sensing and Transport Laboratory
Department of Mechanical Engineering and Mechanics
Drexel University, Philadelphia, USA
E-mail: mkim@coe.drexel.edu

**Abstract:** The use of biological nanostructures in engineered systems represents a critical step toward understanding both how the biological world has evolved at the nanoscale as well as how scientists and engineers can mimic and improve on nature using modern fabrication and assembly. Two topics are treated within this talk. First, we will discuss the practical integration of biomolecular motors to actuate microscale transporters for cell manipulation. The ability to integrate multiple levels of functionality with a control hierarchy will be highlighted to show the realization of miniaturized biomedical robots. Second, this talk will be focused on a biomimetic drug delivery system with active propulsion.

## Defects in Two-dimensional Materials

**Arkady Krasheninnikov**

Assoc. Professor
Materials Physics Division, University of Helsinki
Department of Applied Physics, Aalto University
Helsinki, Finland
E-mail: arkady.krasheninnikov@aalto.fi

**Abstract:** Two-dimensional (2D) materials like graphene, h-BN, and transition metal dichalcogenides have recently received lots of attention due to their unique properties. All these materials have defects, which naturally affect their characteristics. Moreover, defects can deliberately be introduced to tailor the properties of the system. In my talk, I will present the results of our first-principles theoretical studies of defects in 2D systems, compare them to the experimental transmission electron microscopy data, and discuss how defect and impurities can be used to engineer the electronic structure of 2D materials.

## Metrology for 3D Interconnect Processes


**Yi-sha Ku**

Senior Principal Researcher
Project leader, Semiconductor Metrology
Industrial Technology Research Institute, Taiwan
Professor, Institute of Photonics Technology
National Tsing Hua University, Taiwan
E-mail: yku@itri.org.tw



**Abstract:** The 2013 ITRS expands on the new urgency for Metrology for 3D Interconnects to include wafer alignment, interface bonding, and through silicon vias (TSV). The main challenges for 3D metrology involve measuring high aspect ratio TSV, and the opaque nature of silicon wafer materials that limit conventional optical microscopy techniques. This talk presents a 3D IC metrology development status on the basis of what we have known from 3D Interconnect manufacturing process at ITRI. The main topics covered here are HAR TSV depth/profile measurement, thinned wafer thickness/bow/warpage measurement and metal film thickness measurement.


## Bessel Beam Machining and Light-field Metrology


**Chih-kung Lee**

Distinguished Professor
Head, Wireless Nano-Bio MEMS Lab
Institute of Applied Mechanics
Dept of Engineering Science & Ocean Engineering
National Taiwan University, Taipei, Taiwan
E-mail: cklee@ntumems.net



**Abstract:** Optical based micromachining has been gaining popularity due to its flexibility and ease of use. However, traditional optical systems are affected by a diffraction limit where the focal spot size is limited by an incident wavelength and numerical aperture of the system. In order to shrink the focal spot, one approach has been to increase the numerical aperture of the lens. A lens with a larger NA can reduce the spot size but also simultaneously reduces the depth-of-focus (DOF) which increases the difficulty in system alignment. By extending the non-diffracting beam demonstrated in 1987 by Durnin, termed a Bessel beam due to its 10 to 100 times depth-of-focus when compared to that of traditional Gaussian beams, we have channeled our efforts towards adopting finite-difference time-domain (FDTD) simulation and experimentation to facilitate Bessel beam micromachining techniques. Precision metrology based on furthering the light-field techniques which can improve several traditional measurement techniques will also be examined.

## Nanopositioning and Nanomeasuring Machine for Measurement, Manufacturing and Manipulation on the Nanoscale

**Eberhard Manske**

Professor
Chair, Dept. of Precision Metrology
Inst. of Process Measurement and Sensor Technology
Ilmenau University of Technology, Germany
Email: eberhard.manske@tu-ilmenau.de

**Abstract:** Today, nanopositioning and nanomeasuring technology provides high-precision measurement and positioning of objects across different scales, from sub-nanometres up to several centimetres. Continuing rapid progress in some key fabrication technologies structures are reaching atomic dimensions and are becoming more and more complex. The Nanopositioning and Nanomeasuring Machine, developed at the Technische Universität Ilmenau, has got a measuring range of 25 mm x 25 mm x 5 mm, 0.02 nanometer resolution. This machine is suitable not only to measure with an outstanding nanometer accuracy but also to manipulate and to fabricate on the nanoscale.

## Properties and Application of Graphene Based Materials

**Rahul Raveendran Nair**

Leverhulme Fellow
Condensed Matter Physics (Geim Lab)
School of Physics and Astronomy
University of Manchester, UK
E-mail: Rahul.Raveendran-Nair@manchester.ac.uk

**Abstract:** In my talk, I will mainly discuss the novel properties and potential applications of various graphene based materials. Especially, I will focus on the membrane properties and applications. Graphene-based materials can have well-defined nanometer pores and can exhibit low frictional water flow inside them, making their properties of interest for filtration and separation.

## Nano-Measurement by Transient Spectroscopies: Open the Blackbox of Optoelectronic Dynamics

**Hong-Bo Sun**

Professor and Dean
College of Electronic Science and Engineering
Jilin University, China
E-mail: hbsun@jlu.edu.cn

**Abstract:** Low-dimensional quantum systems from conventional semiconductor nanocrystals to, nano-graphene and carbon nanodots exhibit significantly different optoelectronic properties compared with bulk materials. The origin of some unusual phenomena remains unknown, which is making a major obstacle for their broad device applications. In this talk, we will introduce typical ultrafast spectroscopic technologies such as single-photon counting, pump probe, and fluorescent upconversion transient absorption, and their applications on revealing optoelectronic and electro-optical conversion dynamics of the nano-scaled materials.

## Epitaxial Graphene on SiC: Gateless Patterning, Efficient Switches and a Concept for Digital Circuits

**Heiko Weber**

Professor
Chair, Applied Physics
Institute of Condensed Matter Physics
University of Erlangen-Nuremberg, Germany
E-mail: heiko.weber@physik.uni-erlangen.de

**Abstract:** I will present recent progress obtained with the material system epitaxial graphene on SiC (0001). In solid state electronics, functionality is related to material contrast. In that spirit, we introduce a lateral patterning of the charge density in the graphene layer by locally varying intercalation. Further, we employ the substrate SiC as a semiconductor, which can be used as semiconducting transistor channel. By combining these two material contrasts, we achieve a system which allows the design of switches with high on/off ratio as well as the definition of logical and analog circuits. A variety of functionalities is presented.

## Fabrication and Applications of Nanostructures for Highly Efficient Light Extraction

**Pei-Kuen Wei**

Associate Director and Research Fellow
Research Center for Applied Sciences (RCAS),
Academia Sinica, Taiwan
Professor
Institute of Biophotonics,
National YangMing University, Taiwan
E-mail: pkwei@sinica.edu.tw

**Abstract:** Green energy devices, such as LEDs and solar cells, suffer from low external quantum efficiency due to the limited light extraction. We designed and fabricated different shapes and dimensions of nanostructures on the devices by using nanoimprint and nanosphere lithography. For the OLEDs, the nanopillers surface with the nanomech silver anode resulted in an extraction efficiency enhancement up to 2.7 times. For the OPVs, 35% enhancement of power conversion efficiency was achieved.

## Non-Vector Space Control for Nano Manipulations

**Ning Xi**

MSU Distinguished Professor and John D. Ryder Professor
Dept. of Electrical and Computer Engineering
Director, Robotics and Automation Laboratory
Michigan State University, USA
E-mail: ningxi@cityu.edu.hk

**Abstract:** Nano meter positioning accuracy has been a major bottle neck in manufacturing automation in semiconductor industries. In addition, nano meter scale motion control capability will enable a direct sensing and manipulation at a molecular level, e.g. for drug discovery and disease diagnostics and treatments. In this talk a new motion control theory, i.e. non-vector space control, will be introduced. The dynamics associated with the motion control will be described in a non-vector space mathematical framework. This non-vector space dynamics model enables the development of the compressive feedback method that can overcome the major difficulties with high accuracy motion control including sensor noise and system calibration. The applications of the non-vector space motion control method will also be discussed, in particular nano manufacturing and biomedical systems.

## Row-column Addressed Capacitive Micromachined Ultrasonic Imaging System

**John Yeow**

Professor
Canada Research Chair in Micro/Nanodevices
Dept. of Systems Design Engineering
University of Waterloo, Canada
E-mail: jyeow@uwaterloo.ca

**Abstract:** This talk will focus on the design and experimental results of a row-colum field-programmable gate array (FPGA)-based real-time ultrasound imaging system that uses 1D and 2D phased-array capacitive micromachined ultrasonic transducers (CMUTs) fabricated using a fusion bonding process. A novel row-column addressing scheme will be introduced to simplify the circuitry design as well as minimize the overall footprint of the CMUT device.

## Analysis and Design of the Precision Compliant Mechanisms

**Xianmin Zhang**

Dean and Chair Professor
School of Mechanical and Automotive Engineering
South China University of Technology
Guangzhou, China
E-mail: zhangxm@scut.edu.cn

**Abstract:** Compliant mechanisms have been recognized as the most suitable mechanisms for accomplishing high-precision tasks in the field of micro/nano manipulation. This talk will present some typical analysis and design methods for compliant mechanisms.

# Technical Program

(ss: Technical Special Session)

## Wednesday, 29 October 2014, 08:00–10:00

## Multidisciplinary Science and Technology Research Building

| No. | Room | Session |
|---|---|---|
| 01 | B106 | AFM and SEM |
| 02 | C101-1 | Nanobubbles and gasesconfined in a small space (ss) |
| 03 | C102 | Nano sensing (ss) |
| 04 | B208 | Small-scale manipulation using contact and non-contact techniques (ss） |
| 05 | 405B | Holographic femtosecond laser nanofabrication and its applications (ss) |
| 06 | 505B | Applications of micro-/nanorobotic systems and microfluidic channels (ss) |

## Wednesday, 29 October 2014, 14:00–16:00

## Multidisciplinary Science and Technology Research Building

| No. | Room | Session |
|---|---|---|
| 07 | B106 | Microwave to optical spectroscopy and imaging at nanoscale (ss) |
| 08 | C101-1 | Nanometrology and nanocharacterization |
| 09 | C102 | ECROBOT |
| 10 | B208 | Nanomaterials and applications |
| 11 | 405B | Graphene, nanowires, nanotubes and nanoparticles |
| 12 | 505B | Femtosecond laser nanofabrication (ss) |

## Thursday, 30 October 2014, 08:00–10:00

## Multidisciplinary Science and Technology Research Building

| No. | Room | Session |
|---|---|---|
| 13 | B106 | Precision engineering |
| 14 | C101-1 | Microsystems for biological and medical applications (ss) |
| 15 | C102 | Probe induced dielectrophoresis for 3D manipulation of nanoparticles based on AFM (ss) |
| 16 | B208 | Nanophotonics and photonic crystals |
| 17 | 405B | Design and fabrication of micronano mechanisms devices/micronano mechanism design and control (ss) |
| 18 | 505B | Micro-nanotechnology for energy harvesting (ss) |

## Thursday, 30 October 2014, 14:00–16:00

## Multidisciplinary Science and Technology Research Building

| No. | Room | Session |
|---|---|---|
| 19 | B106 | New developments of the compliant mechanisms (ss) |
| 20 | C101-1 | Micronano technology used in aerospace (ss) |
| 21 | C102 | Nanomaterials synthesis, characterization & applications (ss) |
| 22 | B208 | ECNANOMAN |
| 23 | 405B | Nanomanipulation, nanofabrication and systems |
| 24 | 505B | BioRA |

**Technical Session 01**
**AFM and SEM**
B106
08:00–10:00 Wednesday, 29 October
Chair: Ivan Štich, Second Chair: Wei-Tse Chang

## 01-1 08:00–08:20

### Improving Scanning Speed of the AFMs with Inversion-based Feedforward Control

Mei-Ju Yang, Chun-Xia Li, Guo-Ying Gu and Li-Min Zhu
State Key Laboratory of Mechanical System and Vibration,
School of Mechanical Engineering, Shanghai Jiao Tong University, China

- An inversion-based feedforward control is proposed to improving scanning speed of AFM
- A direct inverse P-I model is used to compensate the hysteresis effect
- A zero magnitude error tracking controller is used to suppress the vibration dynamics
- Scanning experiments are conducted on AFM system to verify the proposed controller.

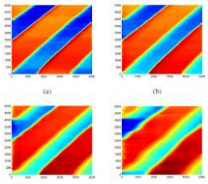


Figure: Scanned images with the inversion-based controlled AFM

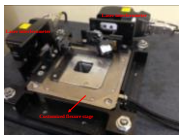
Notes

## 01-2 08:20–08:40

### Development of a Metrological Atomic Force Microscope Based on the Commercial Product

Po-Er Hsu*, Bo-Ching He, Yen-Song Chen and Chung-Chi Tang
Center for Measurement Standards
Industrial Technology Research Institute, Taiwan

- This paper presents the on-going metrological AFM development project.
- The metrological AFM is conducted with two laser interferometers and a flexure stage.
- The vibration noise should have an obvious influence to measurement results in steady state.
- The positioning of the flexure stage is at high repeatability.
- The metrological AFM will be used to be the primary standards of the pitch and grating pitch.



Nanopositioning and scanning platform of the metrological AFM

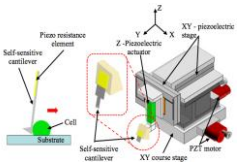
Notes

## 01-3 08:40–09:00

### Nanomanipulation for Measurement of Single Cell Shear Force Using a Self-sensitive Cantilever

Shigetaka HASHIMOTO, Futoshi IWATA
Department of mechanical engineering, Graduate school of engineering, Shizuoka University Hamamatsu, Japan

- Manipulation for detaching a single cell from a substrate
- Quantitative measurement of the shear force of the detaching cell using a self-sensitive cantilever
- Capability of detection of the slight shear force difference under different conditions




Schematic diagram of AFM manipulator

Notes

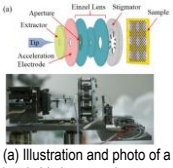
**Technical Session 01**
**AFM and SEM**
B106
08:00–10:00 Wednesday, 29 October
Chair: Ivan Štich, Second Chair: Wei-Tse Chang

## 01-4 09:00–09:20

### A Low-keV Electron Microscope Based on a Single-atom Emitter

W.T. Chang, C.Y. Lin, W.H. Hsu and I.S. Hwang
Institute of Physics, Academia Sinica, Taiwan R.O.C.

- Imaging of low-atomic-number materials, such as biological and organic materials, is a challenge for current electron microscopes (> 10 keV) because of low imaging contrast and high radiation damage.
- We propose a low-keV (500 eV~5000 eV) electron microscope based on a single-atom emitter. In this electron energy range, samples within 3 nm thickness can be imaged using coherent diffractive imaging.
- This new instrument may allow determination of the atomic structures of thin objects, such as graphene, carbon nanotubes, DNA molecules, and protein molecules.




(a) Illustration and photo of a low-keV electron microscope

(b) The diffraction pattern of a CVD graphene sample

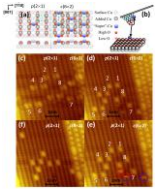
Notes

## 01-5 09:20–09:40

### Atomic Manipulation with Dynamic AFM

J. Bamidele, L. Kantorovich
Physics Department, King's College London, London, U.K.
R. Turanský, I. Štich
Institute of Physics, Slovak Academy of Sciences, Bratislava, Slovakia
Y. Sugawara
Department of Applied Physics,Osaka University, Osaka, Japan

- **NC-AFM vertical manipulation** of super-Cu atoms on $p(2 \times 1)$ Cu(110):O surface; letter X written (f)
- **no image contrast change** observed after each manipulation even
- **4-state model** constructed
- **slow-scale tip dynamics** described by novel **theory**: **DFT** energy barriers with **Kinetic Monte Carlo**



Notes

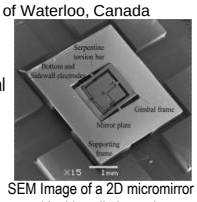
## 01-6 09:40–10:00

### High Performance Closed-loop Control of a 2D MEMS Micromirror with Sidewall Electrodes for a Laser Scanning Microscope System

Hui Chen and WeiJie Sun
Automation Science and Engineering,South China University of Technology,China
ZhenDong Sun
Key Lab of Systems & Control, Chinese Academy of Sciences, China
Albert Chen and John T W Yeow
Systems Design Engineering, University of Waterloo, Canada

Bullet points: micromirror; adaptive sliding mode control; 2D image; Laser scanning microscope.

- This paper presents the design and experimental implementation of a closed-loop controlled 2D micromirror-based laser scanning microscope system based on NI field-programmable gate array hardware, 2D image of the scanned target are obtained.




SEM Image of a 2D micromirror with sidewall electrodes

Notes

## Technical Special Session 02
## Nanobubbles and gases confined in a small space

C101-1

08:00–10:00 Wednesday, 29 October

Organizer: Ing-Shouh Hwang

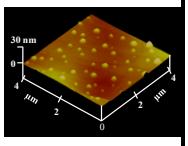
Second Chair: S. E. Donnelly

### 02-1 08:00–08:20

**Lifetime of Surface Nanobubbles and Surface Nanodroplets**

Detlef Lohse
Physics of Fluids group, University of Twente, Netherlands

- Surface nanobubbles are nanoscopic gaseous domains on immersed substrates which can survive for days.
- Their existence seems paradoxical, as an estimate based on the large Laplace pressure of such a small bubble suggests that they should dissolved in microseconds.
- We present numerical simulations and a theory that the limited gas diffusion through the water in the far field, the cooperative effect of nanobubble clusters, and the pinned contact line of the nanobubbles lead to the very slow dissolution rate. We also compare the situation to the dissolution of surface nanodroplets.




Surface nanobubbles on HOPG, visualized by AFM. Courtesy of Xuehua Zhang, Melbourne

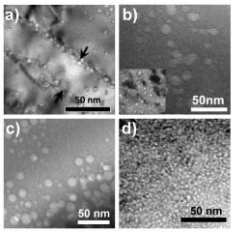
Notes

### 02-2 08:20–08:40

**Nanobubbles in Ion-implanted Solids**

S. E. Donnelly
School of Computing and Engineering
University of Huddersfield
Huddersfield, UK

- Review of current understanding of inert gas nanobubbles in solids in order to permit parallels and contrasts to be made nanobubbles at solid/liquid interfaces;
- Discussion of equilibrium and overpresssurized bubbles;
- Examples of different bubble morphologies including platelets and bubble superlattices.




He nanobubbles in:
a) W, b) SiO2, c) SON68 glass; d)SiC.

Notes

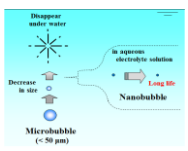
### 02-3 08:40–09:00

**Bulk Nanobubbles: Temporarily Stabilized Microbubble Residue Leading to Generation of Free Radicals at Extinction**

Masayoshi Takahashi
National Institute of Advanced Industrial Science and Technology (AIST)
Japan

We successfully produced bulk nanobubbles.

- Microbubbles become smaller and eventually disappear under water because of their long stagnation and excellent gas dissolution.
- Nanobubbles are generated as temporarily stabilized microbubble residues in electrolyte aqueous solution owing to the condensed ionic cloud around the shrunk gas-water interface.
- The addition of DMPO and HCl might restart the collapsing process and ESR signals (DMPO-OH) were obtained at the extinction of bubbles.




Nanobubbles are generated as the temporarily stabilized figures of the collapsing microbubbles because of the suppression of the dissolution of the gases

Notes

## Technical Special Session 02
## Nanobubbles and gases confined in a small space

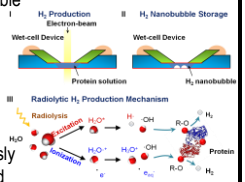
C101-1
08:00–10:00 Wednesday, 29 October
Organizer: Ing-Shouh Hwang
Second Chair: S. E. Donnelly

### 02-4 08:00–08:20

**Wet-cell TEM Investigation of Radiolytic Hydrogen Nano-bubble in Liquid-environmental**

Shih-Yi Liu, Fu-Rong Chen and Fan-Gang Tseng
Department of Engineering and System Science, National Tsing Hua University, Taiwan

- In-situ visualize local area hydrogen nano-bubble formation
- Energy consumption and reaction mechanism analysis of hydrogen nano-bubble
- Long-lived nano-bubble in Wet-cell device
- Competitive hydrogen storage density
- Propose the potential method for simultaneously satisfying nano-scale hydrogen production and storage




Concept of $H_2$ nano-bubble generation and production

Notes

### 02-5 08:20–08:40

**Stability of Surface Nanobubbles**

Xuehua Zhang
Department of Chemical and Biomolecular Engineering, University of Melbourne, Australia

- The lifetime of surface nanobubbles can be hours or even days.
- It is unknown how surface nanobubbles respond to a large temperature increase.
- We present the stability of nanobubbles at close-to-boiling temperatures and their persistence after the bulk water has receded from the surface. Our results suggest that pinning plays a crucial role in nanobubble stability.


Surface nanobubbles can sustain the temperature close to boiling point (PRL 112, 144503 (2014)

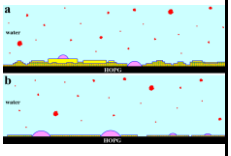
Notes

### 02-6 08:40–09:00

**Evidence of Epitaxial Growth of Molecular Layers of Gas at a Hydrophobic-Water Interface**

Yi-Hsien Lu, Chih-Wen Yang, and Ing-Shouh Hwang
Institute of Physics, Academia Sinica, Nankang, Taipei, Taiwan

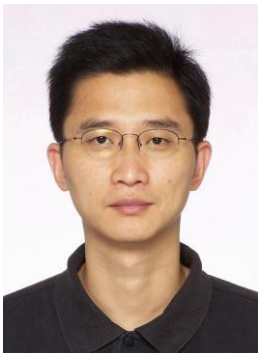
- A water/graphite interface is investigated with high-sensitivity atomic force microscopy.
- We show evidence of epitaxial molecular layers of gas at the interface.
- Interfacial nanobubbles are liquid-like gas agglomerates at the HOPG-water.
- Micropancakes comprise disordered dense gas layers on top of ordered epitaxial layers.
- The interfacial structures of gas at hydrophobic-water interfaces are thermodynamically stable.




Schematic of the structures at the HOPG-water interface when water is supersaturated with oxygen (a) and nitrogen (b).

Notes

**Technical Special Session 03**
**Nano sensing**
C102
08:00–10:00 Wednesday, 29 October
Organizer: Tie Li,
Second Chair: Quan Zhou



## 03-1 08:00–08:20

**Characterization of Nano-coated Micro- and Nanostructures by Pushing**

Ville Liimatainen, Janne Venäläinen, Mikko Koverola, Quan Zhou
Dept. Electrical Eng. and Automation, Aalto University, Finland
Jussi Lyytinen, Ville Rontu, Maria Berdova,
Jari Koskinen, Sami Franssila
Dept. Materials Science and Eng., Aalto University, Finland

- Mechanical properties of micro- and nanostructures obtained by measuring normal and lateral forces during pushing
- Methodology is based on micro- and nanorobotics
- Application to thin films, microfibers, and microparts
- Exploring new applications for micro- and nanorobotics in mechanical characterization

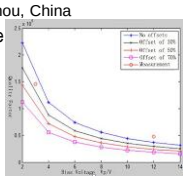
Notes

## 03-2 08:20–08:40

**The Effects of Offset on Quality Factor of MEMS Wine-Glass Resonator**

Linxi Dong and Jinyan Bao
The Key Laboratory of RF Circuits and System of Ministry of Education, Hangzhou Dianzi University, Hangzhou, China
Ying Pan
Hangzhou Dianzi University, Hangzhou, China

- The offset of the resonator disk has an impact on the system performance
- The computing equation of the quality factor was derived by establishing the disk-electrode modal
- Using the equation to calculate the quality factor of different offset situations
- The offset of the disk cannot be ignored when designing the MEMS wine-glass resonator



Quality factor versus the offset of the disk

Notes

## 03-3 08:40–09:00

**Mesoporous $TiO_2$ Microspheres Based Resistive-type Ammonia Sensor at Room Temperature**

Li, Xiaogan1; Chen, Ning; Lin, Shiwei; Wang, Jing;
1 School of Electronic Science & Technology, Dalian Univ. Tech. Dalian China
2 Department of Materials Science & Engineering, Hainan Univ. , Hainan, China

- Pure mesoporous $TiO_2$ based chemoresistive gas sensors showed response to several organic volatile compounds (VOCs) under the UV illumination in the humid air at room temperature.
- With NiO, the NiO-wrapped mesoporous $TiO_2$ based sensor showed good sensitivity to different concentrations of ammonia from 10 ppm to 100 ppm whereas almost no response to other VOCs indicating an excellent selectivity to detect ammonia in presence of above VOCs.

Notes

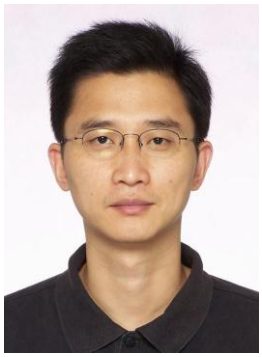
## Technical Special Session 03
## Nano sensing

C102

08:00–10:00 Wednesday, 29 October

Organizer: Tie Li,

Second Chair: Quan Zhou

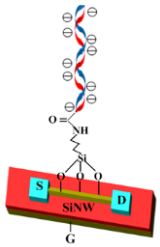


### 03-4 09:00–09:20

**High Performance Biosensor Based on CMOS-Compatible Silicon Nanowires**

Anran Gao, Pengfei Dai, Na Lu, Tie Li, Yuelin Wang
Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China

- The SiNWs were fabricated with CMOS compatibility and low cost methods
- Fundamental factors related to device sensitivity were studied to further make clear the overall effect on sensing sensitivity
- The optimized SiNW-FET nanosensor revealed ultrahigh sensitivity for DNA detection with a limit of 0.1 fM and high specificity for SNP
- By further combining with RCA, the SNR of >20 for 1 fM DNA detection was achieved, implying a detectionfloor of 50 aM



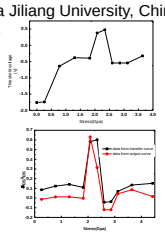

Notes

### 03-5 09:20–09:40

**Electronic Property of TFT Under High Mechanical Stress**

Huiquan Wang and Zhonghe Jin
Micro-Satellite Research Center, Zhejiang University, China
Tieying Ma
College of Optical and Electronic Technology, China Jiliang University, China

- Thin film FET (TFT) has been fabricated at end of a cantilever beam. Gpa mechanical stress has been applied to the TFT through a probe.
- Electrical property of TFT under mechanical stress has been studied. $\Delta I_{DS}/I_{DS}$ under mechanical stress is about -31.35%. The device stopped work when 273K temperature and 1.75 Gpa mechanical stress applied. A “mutation point” has been observed at the output curve when 2.4V $V_{DS}$ applied.



Threshold voltage (upper) and $\Delta I_{ds}/I_{ds}$ () VS mechanical stress

Notes

## Technical Special Session 04
## Small-scale manipulation using contact and non-contact techniques

B208

08:00–10:00 Wednesday, 29 October

Organizer: Li Zhang

Second Chair: Yih-Fan Chen

### 04-1 08:00–08:20

**Scalable Assembly and Integration of Ultrathin Metallic Nanowires with Various Applications**

Hongti Zhang and Yang Lu*
Department of Mechanical and Biomedical Engineering,
City University of Hong Kong, Hong Kong, P.R. China

- Ultrathin metallic nanowires and their applications in future nano-electronics and NEMS
- Mechanical and physical properties of ultrathi Au nanowires
- Scalable assembly of ultrathin nanowires by mechanical approaches
- Cold welding-assisted ultrathin Au nanowire integration and quality examination

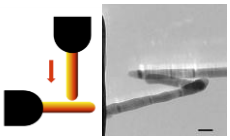


Fig. 1 Ultrathin gold nanowires manipulated and integrated by Cold Welding technique
(Y. Lu et al. *Nature Nanotech.* 2010)

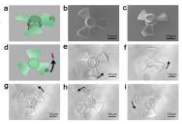
Notes

### 04-2 08:20–08:40

**Remotely Controllable Micro-Nanomachines by Two-Photon Polymerization**

Hong Xia and Hong-Bo Sun
State Key Laboratory on Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, P. R. China
Department Name, University Name, Country

- Smart micro-nanomachines with micromanipulation feature have been fabricated from two-photo polymerization.
- Micrometer-sized spring and turbine was successfully created for magnetic force remote control.
- By using an external magnet, micro-machines could be easily manipulated to perform desired task.
- The combination of photopolymerizable resin and laser processing technology would make a breakthrough in nanotechnology.



Remote control of the micro-turbine by magnetic force.

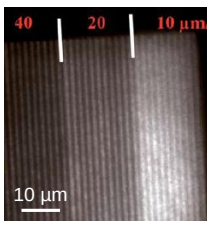
Notes

### 04-3 08:40–09:00

**FluidFM for Nanoparticle Lithography in Liquid Environment**

Tomaso Zambelli
Laboratory of Biosensors and Bioelectronics, ETH Zurich, Switzerland

- FluidFM technology as lithography tool in liquid;
- Influence of the applied pressure on the patterning mechanism of polystyrene nanoparticles;
- Mesoscopic metallic interconnections depositing Au nanoparticles;
- Local polymer replacement for neuron patterning and in situ neurite guidance.




Notes

## Technical Special Session 04
## Small-scale manipulation using contact and non-contact techniques

B208

08:00–10:00 Wednesday, 29 October

Organizer: Li Zhang

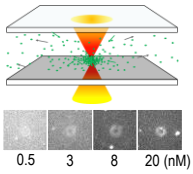
Second Chair: Yih-Fan Chen

### 04-4 09:00–09:20

**Accumulation and Detection of Biomolecules Using Optical Thermophoresis**

Yih-Fan Chen
Institute of Biophotonics, National Yang-Ming University, Taiwan
Li-Hsien Yu
Department of Biomedical Engieering, National Cheng Kung University, Taiwan

- Accumulate biomolecules and nanoparticles under a laser-induced temperature gradient using thermophoresis
- Quantify DNA and proteins in serum-containing buffers based on the level of thermophoretic accumulation
- Simple setup – Do not need micro- and nanofabrication, buffer-exchange, pumps, tubing, and micro-channels.





0.5 3 8 20 (nM)

The accumulation of fluorescent dyes by thermophoresis depends on the concentration of the target molecules.

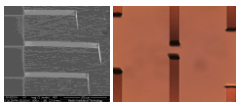
Notes

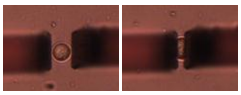
### 04-5 09:20–09:40

**Measuring Viscoelastic Properties of the Living Cell with a Probe Nanotweezer**

Hui Xie[1], Hao Wang[1], Feng Yang[1], and Lining Sun[1,2]
[1] The State Key Lab of Robotics and Systems, Harbin Institute of technology, China
[2] Robotics and Microsystems Center, Soochow University, China

- Living cell mechanical properties have been measured by employing probe nanotweezer
- The nanotweezer consists of two microassembled AFM probes
- The nanotweezer has potential to measure the cell mechanical properties by compressing, relaxing and shear modes.
- Cell mechanics, including creep, stress-relaxation, hysteresis and the complex Young's modulus can be measured





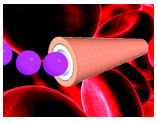
Notes

### 04-6 09:40–10:00

**Functional Self-propelled Micro- and Nanorobots and Nanomotors**

Martin Pumera
Division of Chemistry and Biological Chemistry, Nanyang Technological University, Singapore

- Sense-and-Act self propelled autonomous devices.
- Able to sense chemical, using chemotaxis to approach it and than to decontaminate the environment.
- Magnetotaxis for navigation.
- Simple electrochemical and roll up technology for the fabrication of the devices.



Nanomotor moving among red blood cells.

Pumera, **J. Am. Chem. Soc.** 2014, 136, 2719
Pumera, **Chem. Commun.** 2012, 48, 10090.

Notes

## Technical Special Session 05
## Holographic femtosecond laser nanofabrication and its applications

405B

08:00–10:00 Wednesday, 29 October

Organizer: Yoshio Hayasaki

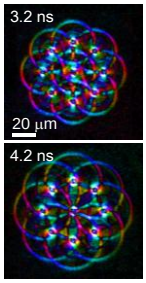
Second Chair: Satoshi Hasegawa

### 05-1 08:00–08:20

**Transient stress and Temperature Modulation Inside Transparent Solids by a Spatially Phase-modulated Femtosecond Laser**

Masaaki Sakakura
Office of Society-Academia Collaboration for Innovation, Kyoto University, Japan

- Femtosecond laser pulse was focused at multiple spots inside transparent materials.
- Multiple focal spots were made using a spatial light modulator.
- Transient stress distributions were modulated to control stress-induced structural changes. (Figure)
- Transient temperature distributions were modulated to control the flow of molten materials.



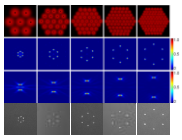

Notes

### 05-2 08:20–08:40

**Research on Femtosecond Laser Processing by Using Patterned Vector Optical Fields**

Hui-tian Wang and Chenghou Tu
MOE Key Laboratory of Weak Light Nonlinear Photonics and School of Physics, Nankai University, Tianjin 300071, China

- We have presented a new approach for fabricating multi-microholes by using the femtosecond patterned vector optical field (PVOF);
- We studied theoretically the focusing properties of patterned vector optical fields (PVOF);
- We processed experimentally the silicon wafer by focused PVOFs and characterized the focusing properties based on the surface microstructures;
- The PVOF, and consequently its focal field are of great diversity, which is possible to fabricate various multi-microholes patterns.



The PVOF arrangement (the first row), the focal field (the second row), and the microstructures fabricated by the corresponding focused PVOFs (the fourth row).

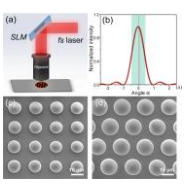
Notes

### 05-3 08:40–09:00

**SLM Based Highly-efficient Femtosecond Laser Fabrication**

Yanlei Hu, Chenchu Zhang, Jiawen Li, and Wenhao Huang*
Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, Hefei, Anhui 230026, P.R.China

- SLM based holographic processing provides us a simple, flexible and efficient approach to improve the fabrication efficiency.
- Both Fourier holography and Fresnel holography are involved and diverse structures are rapidly produced.
- Holographic processing is also extended to the field of multi-dimensional bits recording and desired patterns single-exposure fabrication.
- We also improve the digital holography into 3D dimensions for the future use of multilayer parallel data recording and 3D holographic fabrication




Notes

## Technical Special Session 05
## Holographic femtosecond laser nanofabrication and its applications

405B

08:00–10:00 Wednesday, 29 October

Organizer: Yoshio Hayasaki

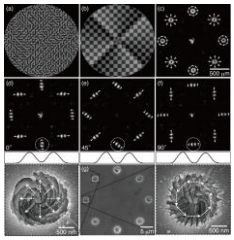
Second Chair: Satoshi Hasegawa

### 05-4 09:00–09:20

**Holographic Vector-wave Femtosecond Laser Processing**

Satoshi Hasegawa and Yoshio Hayasaki
Center for Optical Research and Education, Utsunomiya University, Japan

- Full control of phase distributions and polarization states of femtosecond laser by holograms
- A possibility of designing novel mechanisms for the control of the light-matter interaction
- Simultaneous fabrication of spatially complex nanostructures by an array of spots with a polarization control



Laser processing with multifocal vector beams

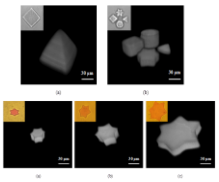
Notes

### 05-5 09:20–09:40

**Temporal Focusing-based Femtosecond Laser Processing and Its Bio-applications**

Yi-Cheng Li[1], Li-Chung Cheng[1], Chia-Yuan Chang[1], Chun-Yu Lin[2], Pei-Kao Li[2], and Shean-Jen Chen[2,3,*]
[1]Department of Photonics, NCKU, Tainan, Taiwan
[2]Department of Engineering Science, NCKU, Tainan, Taiwan
[3]Center for Micro/Nano Science and Technology, NCKU, Tainan, Taiwan

- An ultrafast laser processing system based on temporal focusing and patterned excitation.
- Fast fabrication and inspection of 3D freeform polymer and gray-level bio-microstructures.
- High-throughput multiphoton-induced (MPI) ablation micromachining of bio-tissues.
- This approach provides an increase in microprocessing speed of more than three-order, offering the possibility of mass-production.



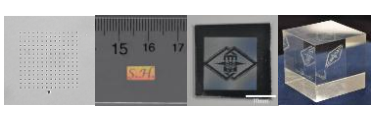
Notes

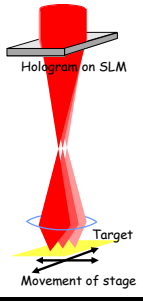
### 05-6 09:40–10:00

**Invitation to Holographic Femtosecond Laser Nanofabrication**

Yoshio Hayasaki
Center for Optical Research & Education (CORE), Utsunomiya University

- Holographic femtosecond laser fabrication has the advantages of high throughout and high light-use efficiency with a shaping of a pulse into an arbitrary optical pattern using a computer-generated hologram (CGH) displayed on a spatial light modulator (SLM).






Notes

# Technical Special Session 06
# Applications of micro-/nanorobotic systems and microfluidic channels

505B

08:00–10:00 Wednesday, 29 October

Organizer: Hongsoo Choi

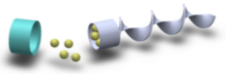
Second Chair: Jae Eun Jang

## 06-1 08:00–08:20

### Magnetically Actuated Microrobot with Open and Close Motion of a Container for Particle Transportation

Seungmin Lee, Sangwon Kim, and Hongsoo Choi
Department of Robotics Engineering, Daegu Gyeongbuk Institute of Science & Technology (DGIST), Daegu, Korea
DGIST-ETH Microrobot Research Center, DGIST, Daegu, Korea

- The microrobot can swim specific fluid environment in human body, such as brain, vitreous humour in eye, and ureter for access to kidney.
- We fabricate microrobot using 3-D laser lithography by a photocurable polymer.
- The microrobot is manipulated for cell and
- Drug delivery without fixation.



<Microrobot for cell and drug delivery>

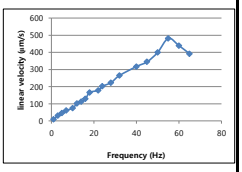
Notes

## 06-2 08:20–08:40

### Trajectory Planning and Control of Biomimetic Helical Microrobots

Ali Ghanbari and Hongsoo Choi
Department of Robotics Engineering, Daegu Gyeongbuk Institute of Science & Technology (DGIST), Daegu, Korea
DGIST-ETH Microrobot Research Center, DGIST, Daegu, Korea

- The micro-/nanorobot can be manipulated inside the body fluids, such as cerebrospinal fluid, in the fluid surrounding the fetus, or in vitreous humor.
- We model the dynamics of the helical microrobot and design a controller.
- The controller is designed for the helical microrobot to follow given trajectories.
- Special Session on Applications of Micro-/Nanorobotic Systems and microfluidic channels




Linear velocity-frequency graph for helical microrobot

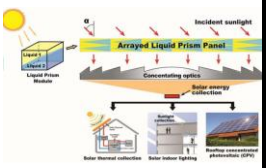
Notes

## 06-3 08:40–09:00

### Optofluidic Devices for Solar Energy Collection

Sung-Yong Park
Department of Mechanical Engineering, National University of Singapore, Singapore

- Developing a microfluidic solar energy collection system that enables to steer incoming sunlight without any mechanical aids.
- Design optimization and optical analyses to improve performance of solar capture.
- System fabrication and experimental demonstration.
- Potential applications:
  - Concentrated photovoltaic (CPV)
  - Solar thermal applications: CSP, Solar heating, Solar thermo-reaction
  - Solar indoor lighting




A schematic illustration of a microfluidic solar energy collection system

Notes

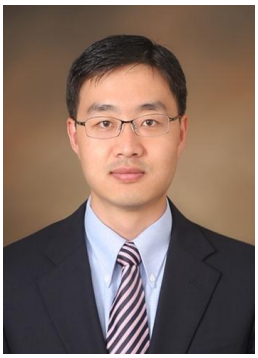
## Technical Special Session 06
## Applications of micro-/nanorobotic systems and microfluidic channels

505B

08:00–10:00 Wednesday, 29 October

Organizer: Hongsoo Choi

Second Chair: Jae Eun Jang

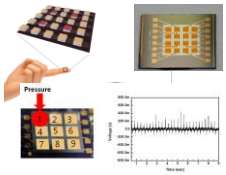


### 06-4 09:00–09:20

**Psychological Tactile Sensor Structure Using ZnO Nano Wires**

Jae Eun Jang
Department of Information and Communication Engineering, Daegu Gyeongbuk Institute of Science and Technology (DGIST), Daegu 711-873, Korea

- Most of touch sensors simply detect pressure or pressure distribution without psychological feelings such as soft, roughness or even pain.
- To produce artificial psychological feeling, we tried to develop touch sensor arrays and a signal process based on ZnO piezoelectric nanowires.
- Special Session on Applications of Micro-/Nanorobotic Systems and microfluidic channels




The schematic diagram of suggested tactile sensor and the measured electrical data

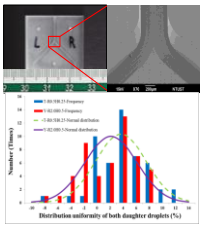
Notes

### 06-5 09:20–09:40

**The Dominant Factors of Designing Bifurcation Microchannel for Uniform Reagent Distribution**

Prof. Pin-Chuan Chen
Department of Mechanical Engineering
National Taiwan University of Science and Technology (NTUST)
Taipei, Taiwan

- Development of a bifurcation microfluidic device to achieve uniform reagent distribution, average reagent distribution uniformity of 2.13% with a standard deviation of 3.94%.
- Understanding the behavior of a plug reagent which undergoes the plug reagent fission process.
- Understanding the influence of micro geometry design to the reagent distribution performance.



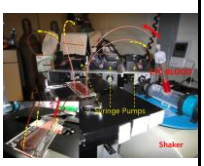
Notes

### 06-6 09:40–10:00

**Polymer Microfluidic Devices for Micron-scale Target Cell Capture and Manipulation**

Taehyun Park, Ph.D.
School of Mechanical Engineering, Kyungnam University, Changwon, S. Korea

- A new design concept for a high flow rate cell capture device was introduced to overcome the limitations of low flow rate target cell capture in current BioMEMS technology.
- Computational fluid dynamics (CFD) simulations validate the prospective device dimensions for the optimization of the device performance.
- High flow rate device captured the target cells and the blood cells could freely pass through the side channels.
- A new protocol for preparation of single/rare cell samples was introduced
- Viable MCF-7 cells were delivered at up to 750 μL/min and the average recovery rate was 80%.
- The exact number of viable CTCs (mean value = 14.7) verified the capture efficiency.




Capturing Target Cell Using Polym Microfluidic Device

Notes

# Technical Special Session 07
# Microwave to optical spectroscopy and imaging at nanoscale

B106

14:00–16:00 Wednesday, 29 October

Chair: Gilles Dambrine

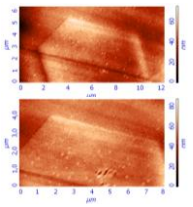
Second Chair: Jean-Fran ̧ois Lampin

## 07-1 14:00–14:20

### Near Field Microwave Microscopy for Nanoscale Characterization, Imaging and Patterning of Graphene

Tamara Monti, Andrea Di Donato, Davide Mencarelli, Giuseppe Venanzoni, Antonio Morini, Marco Farina
Dip. di Ingegneria dell'Informazione, Università Politecnica delle Marche, Italy
Ivan V. Vlassiouk, Alexander Tselev
Oak Ridge National Laboratory, Tennessee

- Near field Microwave Imaging and Characterization CVD graphene hexagons on copper substrate
- Use and concept of a broadband time-domain microwave microscope introduced by ourselves
- Investigation of patterning effects induced by increasing the microwave power
- Proposal of a model explaining the mechanisms underlying the patterning effects



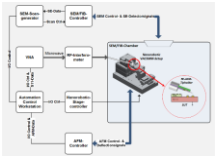
Notes

## 07-2 14:20–14:40

### Integration of a Scanning Microwave Microscope and a Scanning Electron Microscope: Towards a New Instrument to Imaging, Characterizing and Manipulating at the Nanoscale

Olaf C. Haenssler
Department of Computing Science
University of Oldenburg, Germany

- Design of a Scanning Microwave Microscope in the vacuum chamber of a SEM-FIB
- FEM-Simulation of the AFM-and-Microwave-Probeholder in the GHz-range
- HW- and SW Integration based on open-source Nanoautomation Framework



Block diagram of the SMM-in-SEM

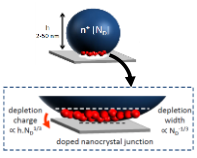
Notes

## 07-3 14:40–15:00

### Doped Silicon Nanocrystals Probed by Kelvin Probe Microscopy : Single Active Dopant Identification and Doped Semiconductor Junction Properties

Thierry Mélin and Lukasz Borowik
Institute of Electronics Microelectronics and Nanotechnology, CNRS, France
Thuat Nguyen-Tran and Pere Roca i Cabarrocas
Laboratoire de Physique des Interfaces et des Couches Minces, CNRS

- Characterization of single electrically active dopants in individual silicon nanocrystals by Kelvin probe force microscopy
- Model for doped semiconductor nanocrystal junctions (depletion charge & depletion width)
- Interplay between surface states and doping in nanocrystals




Notes

## Technical Special Session 07
## Microwave to optical spectroscopy and imaging at nanoscale

B106

14:00–16:00 Wednesday, 29 October

Chair: Gilles Dambrine

Second Chair: Jean-Fran ̧ois Lampin

### 07-4 15:00–15:20

**Mid-infrared Near-Field Nanoscopy of Organic and Inorganic samples: A valuable tool for the nanoscale**

A. Pagies, G. Moreno, D. Ducatteau, N. Clément, T. Akalin, J.-F. Lampin
Institute of Electronics, Microelectronics and Nanotechnology, Université de Lille 1
A. Emplit, I. Huynen
Institute of Information, Communication Technologies, Electronics and Applied Mathematics, Electrical Engineering, Université Catholique de Louvain

- Mid-infrared near-field nanoscopy is a new technique that allows to extract interesting informations at the nanoscale.
- After a short presentation of the technique, some electromagnetic simulations are showed and some examples of images obtained in two different cases are presented.

Notes

### 07-5 15:20–15:40

**Laser-combined STM for Probing Spin Dynamics**

Hidemi Shigekawa
Faculty of pure and applied science, University of Tsukuba
Tennodai 1-1-1, Tsukuba, 305-8573, Japan

- The studies of spin dynamics in low-dimensional systems have grown into a rapidly developing and important area from fundamental and practical points of view. In this talk, we demonstrate the optical pump-probe STM (OPP-STM) technique, which enables the nanoscale probing of spin dynamics with the temporal resolution corresponding to the optical pulse width in principle.
- Through the observation of spin precession, analysis of local g-factor has become possible.

[1] Y. Terada, S. Yoshida, O. Takeuchi, and H. Shigekawa: Nat. Photonics **4** (2010) 869.
[2] S. Yoshida, Y. Aizawa, Z. Wang, R. Oshima, Y. Mera, E. Matsuyama, H. Oigawa, O. Takeuchi, and H. Shigekawa, Nature Nanotechnlogy, DOI: 10.1038/NANO. 2014. 125.

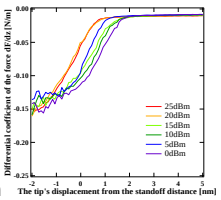
Notes

### 07-6 15:40–16:00

**Investigation of Interatomic Force under the Tip of Microwave-AFM Probe**

Yang Ju and Kazuma Hifumi
Department of Mechanical Science and Engineering
Nagoya University, Japan

- Microwave atomic force microscope (M-AFM) was demonstrated.
- Interatomic force under the tip of M-AFM probe was investigated.
- The relationship between the interatomic force and the tip-sample distance was obtained for different microwave signals.
- The identification of materials and the evaluation of electrical characteristics in local area becomes possible.




Result of the force-distance curve of the Glass in average

Notes

# Technical Session 08
# Nanometrology and nanocharacterization

C101-1

14:00–16:00 Wednesday, 29 October

Chair: Le Wang, Second Chair: Ivan. A. Aleksandrov

## 08-1 14:00–14:20

### Preparation of $Ba_3Si_6O_9N_4:Eu^{2+}$ Phosphor and Characterization of Their Luminescence Properties

LUO Dong, WANG Le, LI Yang-Hui, XU Guo-Tang, PAN Hua-Yan, LIANG Pei, CHEN Ru-Biao, ZHANG Hong
Laboratory of Optoelectronic Materials and Devices,
College of Optics and Electronic Science and Technology, China Jiliang University, Hangzhou 310018, China

- Bluish-green $Ba_3Si_6O_9N_4:Eu^{2+}$ phosphors were synthesized by two-step synthesis processes using $BaSiO_3$ as a precursor.
- The samples were investigated by X-ray diffraction (XRD) and fluorescence spectrometer photometer (PL) respectively. The results of XRD illustrated that two-step method was beneficial to improve phases of $Ba_3Si_6O_9N_4:Eu^{2+}$ phosphor and obtain higher crystallinity.
- Compared the emission spectrum of two-step process(the emission peak at 498 nm) with high-temperature solid phase method (the emission peak at 517 nm) under the excitation of 330 nm, an apparent electrophoresis of the blue shift was existed.
- The results of energy spectrum analysis clarified that the elements content of two-step method was closer to the theoretical stoichiometry ratio, which indicated that two-step preparation of $Ba_3Si_6O_9N_4$: $Eu^{2+}$ phosphor was an effective way to reduce the lattice defects.

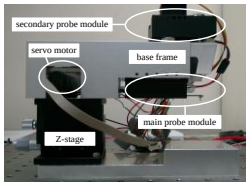
Notes

## 08-2 14:20–14:40

### Design of a Dual-probe Profilometer

Chiao-Hua Cheng[1] and Chih-Hsien Lin[2]
[1]Mechanical Engineering, National Chiao Tung University, Taiwan
[2]Force Precision Instrument Co. Taiwan
Shao-Kang Hung*
Mechanical Engineering, National Chiao Tung University, Taiwan

- Use two probe modules: main and secondary probe module.
- Use compensation method to decrease the unneeded distortion.
- Possess low scanning error.



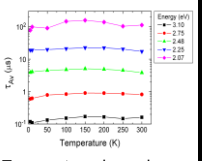

Notes

## 08-3 14:40–15:00

### Temperature Dependence of Photoluminescence Kinetics of GaN/AlN Quantum Dots

I.A. Aleksandrov, V.G. Mansurov and K.S. Zhuravlev
Rzhanov Institute of Semiconductor Physics
Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia

- Temperature dependence of time-resolved photoluminescence of GaN/AlN quantum dots has been investigated
- Photoluminescence kinetics of GaN/AlN quantum dots is governed by radiative recombination in quantum dots and weakly depends on temperature
- Photoluminescence intensity of GaN/AlN quantum dots considerably decreases with temperature increase
- This decrease has been attributed to nonradiative recombination through deep centers in a wetting layer




Temperature dependence of average lifetime in GaN/AlN QDs at different detection energies

Notes

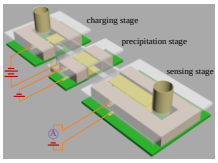
**Technical Session 08**
**Nanometrology and nanocharacterization**
C101-1
14:00–16:00 Wednesday, 29 October
Chair: Le Wang, Second Chair: Ivan. A. Aleksandrov

## 08-4 15:00–15:20

### A PCB Type Aerosol Sensor for Measuring Nanscale Aerosol Particles

Wenming Yang and Rong Zhu
Dept. Precision Instruments, Tsinghua University, China

- A PCB type aerosol sensor with small size and simple structure was developed.
- The experimental tests verified the measurements using the aerosol sensor.
- The ion concentration produced by the corona discharge in the aerosol sensor was about $10^{19}/m^3$ order of magnitude.
- The aerosol sensor can discriminate different number concentration and mean diameters of aerosol particles distributed lognormally with the maximum value in the range of 100-368nm.



Schematic view of the aerosol sensor

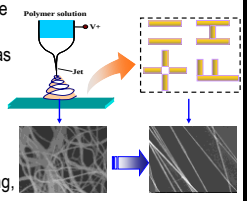
Notes

## 08-5 15:20–15:40

### Nanofiber Alignment During Electrospinning: Effects of Collector Structures and Governing Parameters

Yanli Gou, Canhua Liu, Tingping Lei, Fan Yang
Research Center for Smart Materials and Structures & Department of Mechanical and Electrical Engineering, Huaqiao University, Xiamen, China

- The influence of collector structures and some key electrospinning parameters on fiber alignment by using static parallel substrates as collector
- Analysis of the distribution of electric field between the tip and the collector
- The method to prepare aligned fibers
- Application of aligned fibers:tissue engineering, biomedicine,chemical sensors...



Electrospun fibers aligned by replacing the plate collector with parallel substrates

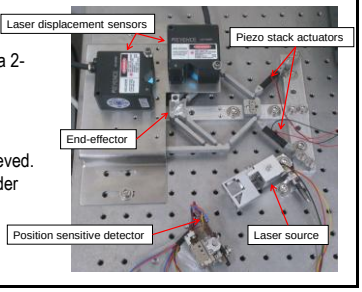
Notes

## 08-6 Poster 1

### Design and Analysis of a 2-DOF Planar Nano-positioner with Low Parasitic Rotation

Hung-Ruei Lin, Shao-Kang Hung*, and Chiao-Hua Cheng
Mechanical Engineering, National Chiao Tung University, Taiwan

- A novel schematic design of a 2-DOF planar positioner.
- Dynamic properties of the positioner are tested.
- Low parasitic rotation is achieved. The result is 0.48 arc sec under stroke of ±50 μm.




Notes

**Technical Session 08**
**Nanometrology and nanocharacterization**
C101-1
14:00–16:00 Wednesday, 29 October
Chair: Le Wang, Second Chair: Ivan. A. Aleksandrov

## 08-7 Poster 2

**Precise Multiple Wires Driven Manipulation With Visual Image Measurement**

Hisayuki Aoyama and Naoyuki Oko
Mechanical Engineering & Intelligent Systems,
University of Electro-Communications, Japan
Takashi Usuda
Metrology Management Center,
National Institute of Advanced Industrial Science &Technology, Japan
Nadine Le Fort Piat
FEMTO-ST/AS2M,
Ecole Nationale Superieure de Mecanique et des Microtechniques, France

- In this report, we are proposing the design and the development of the simple spatial manipulator capable of controlling the position, the rotation angle $\varphi$ and the inclined angle $\theta$ of the micro tool with multiple parallel wires driven mechanism.

Notes

**Technical Session 09**
ECROBOT
C102
14:00–16:00 Wednesday, 29 October
Chair: Carsten Maple, Second Chair: Yong Yue

## 09-1 14:00–14:20

### The Processing Technology of the Colored Ti-6Al-4V Alloy Surface by WEDM-HS and Hardness Analysis

Jinkai Xu, KuiXia, Linshuai Zhang, Huadong Yu, Zhanjiang Yu
Changchun University of Science and Technology
College of Mechanical and Electric Engineering
Changchun, Jilin Province, China

- Using high-speed WEDM, can achieve the different colors of titanium alloy surface.
- The colored surface after WEDM-HS processing has good stability.
- After processing of different color samples hardness are improved accordingly comparing with the matrix.

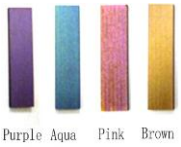



Fig. Displays four kinds of actual colors of titanium alloy

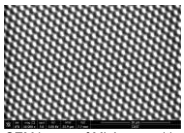
Notes

## 09-2 14:20–14:40

### Micro-lens Array Fabricated by Laser Interference Lithography

Ziang Zhang
CNM and JR3CN, Changchun University of Science and Technology, China
Changchun Observatory, National Astronomical Observatory, CAS, China
Zuobin Wang and Dapeng Wang
CNM and JR3CN, Changchun University of Science and Technology, China
JR3CN, University of Bedfordshire, United Kingdom

- Micro-lens array fabricated by laser interference lithography is proposed;
- The diameter of MLA can be modified by control the incident angle of LIL;
- The curvature of MLA can be modified through control the post bake temperature and time or exposure doze of LIL.
- This method has advantage of large area fabrication.



SEM image of MLA on positive photoresist

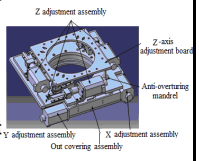
Notes

## 09-3 14:40–15:00

### Design of a Nanometer Five-dimension Adjusting Frame Used for Star Simulation Facility

Qimeng Chen[1] and Guoyu Zhang [1,2]
1Optical Engineering Institute,Changchun University of Science and Technology,China
2Jilin Engineering Research Center of Photoelectric Measurement &Control Instruments, China
Zhe Wang [1] Zhihai Wang [1]

- A five-dimension adjusting frame with high resolution and good stability is designed.
- The three-dimension model of designed frame is given by applying CATIA software.
- Experimental tests indicate the frame's displacement resolution is 25nm and angular resolution is 0.1 arc second.
- Calibration test shows that angular distance errors of star simulation facility are ＜12" .




Three-dimension model of general assembled structure

Notes

**Technical Session 09**
ECROBOT
C102
14:00–16:00 Wednesday, 29 October
Chair: Carsten Maple, Second Chair: Yong Yue

## 09-4 15:00–15:20

### Application of Image Processing and Recognition technology on The Automatic Test Platform of Electronic Products

Yanhua Cheng, Jingli Lu, Sheng Cheng
Kunshan Industrial Technology Research Institute, China
Jianwei Zhang
TAMS, University of Hamburg, Germany

- The location and extraction of the screen contour
- The seed filling process
- Tesseract-OCR character recognition
- The seed filling process
- Template matching recognition
- Sound Test
- Future research work

The screen area obtained by the edge detection

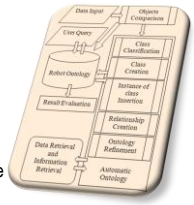
Notes

## 09-5 15:20–15:40

### Data-Information Retrieval Based Automated Ontology Framework for Service Robots

Saranya Kanjaruek and Dayou Li
Institute for Research in Applicable Computing
University of Bedfordshire, United Kingdom

- A framework regarding automated ontology building without human involvement.
- The Dynamic Semantics implemented the Object Finding scenario.
- The Object Finding scenario aims at solving the problem of dynamic ontology.
- The result will reveal the effective prediction of future location of specific object.




Data-Information Retrieval based Automated Ontology Framework

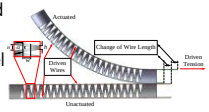
Notes

## 09-6 15:40–16:00

### Kinematics Modeling for a Kinematic-Mechanics Coupling Continuum Manipulator

Wenlong Yang, Wei Dong and Zhijiang Du
State Key Laboratory of Robotics and System
Harbin Institute of Technology, Harbin, China, 150080

- The mechanics-based forward kinematic model is built to map the driven space, the joint space and the workspace.
- The simplified geometric inverse kinematic model of the hyper-redundant continuum manipulator is built based on the “curve-fitting” method.
- Experimental results showed a good agreement with the proposed theoretical model.




Schematic drawing of the proposed continuum manipulator

Notes

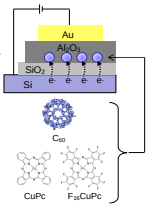
**Technical Session 10**
**Nanomaterials and applications**
B208
14:00–16:00 Wednesday, 29 October
Chair: Guy Le Lay, Second Chair: Yutaka Wakayama

## 10-1 14:00–14:20

### Multilevel Resonant Tunneling Through Multiple Molecules in Si-based Tunneling Device

Y. Wakayama, H.-S. Seo, T. Chikyow and R. Hayakawa
International Center of Materials Nanoarchitectonics (WPI-MANA)
National Institute for Materials Science (NIMS), Japan

- Double-tunneling junction with molecules as intermediate electrodes were papered on Si substrate.
- Coulomb staircases were ascribed to resonant tunneling via molecular orbitals.
- Threshold voltages were precisely controlled by changing molecular structures.
- Multiple tunneling was achieved by mixing multiple molecules in double-tunneling junction.




Double-tunneling junction on Si with molecular Coulomb islands

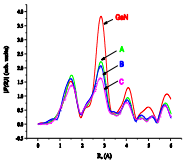
Notes

## 10-2 14:20–14:40

### EXAFS Study of Intermixing in GaN/AlN Quantum Wells

K. Zhuravlev[1], I. Alexandrov[1], T. Malin[1], V. Mansurov[1], S. Trubina[2], S. Erenburg[2], L. Dobos[3], B. Pecz[3]
[1]Rzhanov Institute of Semiconductor Physics SB of RAS, Novosibirsk, Russia
[2]Nikolaev Institute of Inorganic Chemistry, SB RAS, Novosibirsk, Russia
[3]Institute for Technical Physics and Materials Science, HAS, Budapest,Hungary

- Local structure of thin GaN/AlN MQWs grown by ammonia MBE at different temperatures has been studied by the EXAFS technique
- The heterointerface intermixing leads to a decrease in the Ga-Al interatomic distance and the Ga-Ga coordination number in MQWs
- The degree of intermixing linearly increases with increasing temperature, although one could expect an exponential growth




Fourier transform magnitude |F(R)| GaK EXAFS of MQWs and GaN reference samples

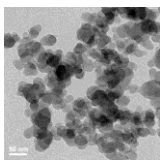
Notes

## 10-3 14:40–15:00

### Synthesis of Highly Graphitic Carbon Nano-sphere by Simple Flame Synthesis on Cobalt-Based Catalyst

Ian Yi-yu Bu
Department of Microelectronic Engineering, National Kaohsiung Marine University
Kaohsiung , 632, Taiwan , Republic of China

- Carbon nano-sphere were synthesized on Co coated glass substrate using low-cost candle synthesis
- The obtained carbon nano-sphere are highly graphitized
- Produce solar cell with power conversion efficiency ~3.5%



Notes

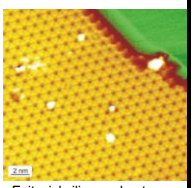
**Technical Session 10**
**Nanomaterials and applications**
B208
14:00–16:00 Wednesday, 29 October
Chair: Guy Le Lay, Second Chair: Yutaka Wakayama

## 10-4 15:00–15:20

**Silicene Phases on Ag(111)**

Guy Le Lay
CNRS-PIIM, Aix-Marseille University, France
Seymur Cahangirov, Lede Xian, Angel Rubio
ETSF and Universidad del Pais Vasco, Spain

- Silicene: a 2D sheet of Si atoms arranged in a buckled honeycomb lattice, first synthesized in 2012
- Strong interest as a potential alternative to graphene
- Single layer silicene on Ag(111) surfaces: 2 phases coinciding with 4x4 or $\sqrt{13}\times\sqrt{13}R\pm 13.9^\circ$ Ag(111) supercells
- Surface crystallography & DFT calculations: a claimed $2\sqrt{3}\times 2\sqrt{3}R30^\circ$ Ag(111) superstructure cannot accommodate a true silicene sheet



Epitaxial silicene sheet on Ag(111)4x4

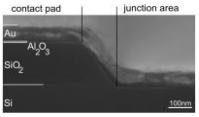
Notes

## 10-5 15:20–15:40

**Hybrid Metallic Nanostructures as Sensors Based on Electrically Excited Plasmons**

André Dathe, Mario Ziegler, Uwe Hübner, Ondrej Stranik, Wolfgang Fritzsche
Leibniz Institute of Photonic Technologies (IPHT), Jena, Germany

- Thin-film metal-oxide-semiconductor (MIS) structures were fabricated and characterized topographically and electrically
- Light emission by inelastic tunneling in the MIS-structures was investigated
- Emission enhancement/alteration by addition of nanostructures on the samples was studied
- Finite-element methods simulation of this concept as sensor were done



cross-section SEM image of the fabricated samples

Notes

## Technical Session 11
## Graphene, nanowires, nanotubes and nanoparticles
405B
14:00–16:00 Wednesday, 29 October
Chair: Kun Qian, Second Chair: Jens Gobrecht

### 11-1 14:00–14:20

**Dynamic and Static Mechanical Strength of Multi-Walled Carbon Nanotubes Polycarbonate Composites**

Prashant Jindal
University Institute of Engineering & Technology (UIET), Panjab University
Navin Kumar
Indian Institute of Technology (IIT)

- This paper highlights significant enhancements in dynamic as well as static mechanical properties of Multi-walled Carbon Nanotubes (MWCNT).
- We have used the instruments Split Hopkinson Pressure Bar (SHPB) and Nano-indenter for the evaluation of dynamic and static mechanical properties respectively. The experimental results on composites are also expressible in simple expressions and simple stress-strain
- Relations that give the numerical values at any given concentration of MWCNT in PC. These expressions can further be used to calculate results for various other compositions of MWCNTs for both static and dynamic mechanical strength, which can eventually assist in performing further experiments. This work is useful in developing light weight composite materials suitable for pressure and load absorbing applications.

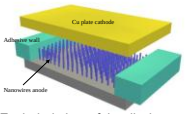
Notes

### 11-2 14:20–14:40

**Continuous Corona Discharge Using Nanowires**

Wenming Yang, Rong Zhu, Xianli Zong
Dept. Precision Instruments, Tsinghua University, China

- ZnO nanowires directly grow on micro electrodes using electric-field-assisted wet chemical method.
- Continuous corona discharge under hundred volts is realized using ZnO nanowires as anode tips of a micro discharger.
- The ion concentration in the corona discharge exceeds $10^{18}/m^3$ orders of magnitude.



Exploded view of the discharger using nanowires

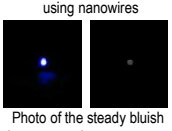


Photo of the steady bluish luminescence when corona occurs in the nanowire dischargers

Notes

### 11-3 14:40–15:00

**Hydration Layers on $CaF_2$(111) Trapped by Mechanically Exfoliated Graphene**

Tjeerd Bollmann
University of Twente, Inorganic Materials Science, MESA+ Institute for Nanotechnology, The Netherlands

- Confined hydration layers result from mechanical exfoliation of graphene on a hydrophilic substrate.
- We demonstrate the decay and ripening of the first persistent hydration layer by NC-AFM and KPFM.
- Created nanoblisters form a conceptual basis for a graphene-based nanosystem.
- The determined adhesion energy is important to evaluate the feasibility of transferring graphene.

Notes

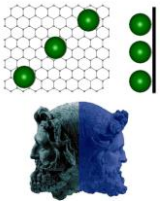
## Technical Session 11
## Graphene, nanowires, nanotubes and nanoparticles
405B
14:00–16:00 Wednesday, 29 October
Chair: Kun Qian, Second Chair: Jens Gobrecht

### 11-4 15:00–15:20

**Janus Graphene Hybrids: 2D Monodispersed Gold Nanoarrays on Graphene with Controlled Structure and High Stability**

Yaling Li[a], Jingjing Wan[b], Ying Wang[b], Jiao Wu[a], Baohong Liu*[b], Xiaojing Zhang[a,c], Kun Qian*[a]
[a]School of Biomedical Engineering, SJTU, China; [b]Department of Chemistry and Institute of Biomedical Science, FDU, China; [c]The University of Texas at Austin, USA.

- 2D Janus gold NPs/graphene hybrids fabricated in seconds and solvent-less.
- Very small size of gold NPs (down to 1.1 nm).
- NPs size, morphology and area density. controllable by varying sputtering current, time and angle, respectively.
- Ultra-high gold carriage and desirable thermal stability achieved.



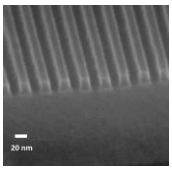
Notes

### 11-5 15:20–15:40

**Ultra-dense Silicon Nanowires Using Extreme Ultraviolet Interference Lithography**

Daniel Fan, Hans Sigg, Jens Gobrecht and Yasin Ekinci
Paul Scherrer Institut, Switzerland
Ralph Spolenak
Department of Materials, ETH Zurich, Switzerland

- Patterning of ultra-dense, large-area lines down to 11 nm half-pitch by extreme ultraviolet (EUV) interference lithography.
- Inorganic photoresists based on $HfO_2$ and $SiO_2$ used.
- Pattern transfer into silicon using plasma etching.
- 14 nm half-pitch silicon nanowires with 1:1 aspect ratio and square cross-sectional profile was achieved.



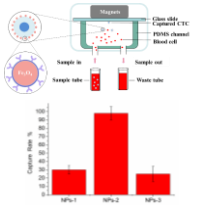

Notes

### 11-6 15:40–16:00

**Functional Magnetic Nanoparticles for Circulating Tumor Cells Screening in Integrated Microfluidic System**

Jiao Wu[1], Yaling Li[1], Ting Shen[2], Kun Qian[1]*, Xiaojing Zhang[1, 3]*
[1]School of Biomedical Engineering, Shanghai Jiao Tong University, China; [2]NanoLite Systems, TX, USA; [3]The University of Texas at Austin, USA.

- 3 functional magnetic nanoparticles (NPs) designed to capture CTCs.
- Optimized surface chemistry and structure parameters.
- CTCs captured in whole blood through integrated microfluidic systems.
- Comparable performance against commercial NPs.



Notes

## Technical Special Session 12
## Femtosecond laser nanofabrication

505B

14:00–16:00 Wednesday, 29 October

Organizer: Hong-Bo Sun

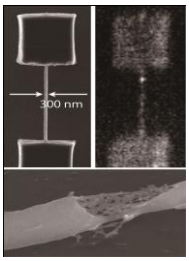
Second Chair: Vygantas Mizeikis

### 12-1 14:00–14:20

**Nanomaterials/polymer Composite 3D Nanofabrication Through Two-photon Lithography**

Satoru Shoji
Department of Engineering Science,
The University of Electro-Communications, Japan

- Our recent progress on development of single-wall carbon nanotubes/polymer nanocomposite 3D micro/nano structures by means of two-photon lithography will be presented.
- We succeeded in controlling the alignment of carbon nanotubes in polymer structures.
- We will also show micro/nano structures of plasmonic metal nanoparticles/polymer composites.



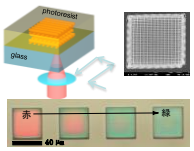

Notes

### 12-2 14:20–14:40

**Fabrication of Structural Color Materials by Femtosecond Direct Laser Write Technique**

Vygantas Mizeikis
Research Institute of Electronics, Shizuoka University, Japan

- Structural color in dielectrics is a coloration which arises due to light scattering on nanoscale periodic structure rather than light emission or absorption
- 3D photonic crystals exhibiting controllable structural color phenomenon were fabricated by Direct Laser Write (DLW) technique in photoresist
- Physical origin and potential applications of structral color in the fabricated structures will be discussed




Top left: principle of direct laser write technique, top right: SEM image of 3D woodpile photobic crystal in photoresist, bottom: optical microscopy images reveal controllable structural colour

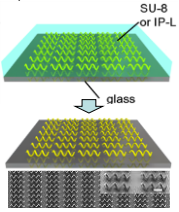
Notes

### 12-3 14:40–15:00

**Magnetic Helical Micromachines: Fabrication by Two-Photon Polymerization & Biomanipulation**

Li Zhang
Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong, Hong Kong SAR, China

- Helical micromachines, mimicking swimming strategy of *E. coli* bacteria, are fabricated by two-photon polymerization with various photocurable materials.
- High swimming velocity, up to ~15 body lengths per second, was obtained using a rotating magnetic field.
- The functionalized helical micromachines are capable of performing micromanipulation at single-cell level.
- This is collaborative work with Prof. B. Nelson, Prof. Ch. Hierold, Prof. M. Zenobi-Wong and Prof. J. Vörös from ETH Zurich, Switzerland.




Fabrication of helical micromachines. (Tottori *et al.*, *Adv. Mater.*, 2012)

Notes

## Technical Special Session 12
## Femtosecond laser nanofabrication

505B

14:00–16:00 Wednesday, 29 October

Organizer: Hong-Bo Sun

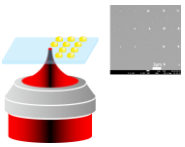
Second Chair: Vygantas Mizeikis

### 12-4 15:00–15:20

**Direct laser writing of metallic nanostructures by femtosecond laser assisted photoreduction**

Atsushi Ono, Seiya Toriyama, and Vygantas Mizeikis
Research Institute of Electronics, Shizuoka University, Japan

- The metallic nanostructures exhibit unique plasmonic resonance have been applied for surface enhanced Raman scattering, sensitivity improvement, and fluorescence enhancement.
- Metallic nanostructures such as nanodots array, grating are fabricated by two-photon femtsecond laser induced photoreduction in mtal ion-doped polymer.
- The possible applications of fabricated metallic nanostructures will also be introduced.



Femtosecond laser fabrication of metallic nanodots array

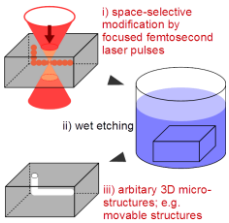
Notes

### 12-5 15:20–15:40

**Fabrication of movable 3D microstructures in glass**

Shigeki Matsuo
Department of Mechanical Engineering, Shibaura Institute of Technology, Japan
(until March 2014: Department of Optical Science and Technology,
The University of Tokushima, Japan)

- Femtosecond laser-assisted etching was developed for fabricating movable 3D microstructures in glass substrates.
- Thus-fabricated microstructures were trapped and rotated by a non-contact technique of optical tweezers.
- This is a new strategy for fabricating and manipulating micro 3D structures.
- Application fields include micro-total-analysis-systems (μ-TAS) and opto-fluidic devices.




Process of femtosecond laser-assisted etching

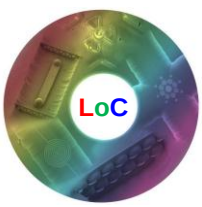
Notes

### 12-6 15:40–16:00

**Femtosecond laser direct writing of highly functional Lab-on-a-Chip systems**

Yan He and Yong-Lai Zhang
State Key Laboratory on Integrated Optoelectronics, Jilin University, China

- Femtosecond laser direct writing technique has been used for chip functionalization.
- Functional components including micro-mixer, micro-heater, micro-sieves, catalysts and SERS substrates have been integrated.
- Femtosecond laser on-chip nanofabrication allows flexible and designable integration.
- The present works are supported by Prof. Hong-Bo Sun.




Schematic illustration for the functionalization of LoC systems

Notes

# Technical Session 13
# Precision engineering

B106

08:00–10:00 Thursday, 30 October

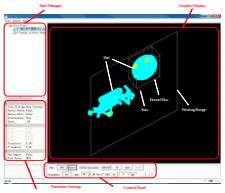
Chair: Dae-Gab Gweon, Second Chair: Qingsong Xu

## 13-1 08:00–08:20

### Design of Extendable Tool Path Generation Software for 3D Printing

Jie Liu, Yanbin Fan and Qinghua Lu
School of Mechanical & Electric Engineering, Foshan University, China
Yongqiang Yang
School of Mechanical & Automotive Engineering, South China University of Technology, China

- Tool Path Generation is one of the important steps in 3D printing (3DP) processes. An extendable tool path generation software is designed aimed at supporting all 3DP processes in this paper.
- At first, an extendable architecture is created based on the principle of tool path generating which all 3DP processes should follow.
- Then, the Graphical User Interface (GUI) is designed with a Visual Studio like style and OpenGL is used to display slicing layers and tool paths in both 2D and 3D.
- At last, the parallel computing is introduced to save the generation time. Experiment result shows that, the presented software works faster than the commercial software CTools.



Extendable tool path generation software for 3D printing

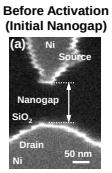
Notes

## 13-2 08:20–08:40

### Structural Tuning of Nanogaps Using Field-Emission-Induced Electromigration with Bipolar Biasing

Mamiko Yagi, Mitsuki Ito, and Jun-ichi Shirakashi
Department of Electrical and Electronic Engineering,
Tokyo University of Agriculture & Technology, Japan

- A New Approach for Fabrication of Nanogaps.
- Electromigration method induced by a field emission current with alternately reversing polarities was used.
- Separation of gap became narrower from approximately 95 nm to less than a few nm.
- Alternately biased activation is suitable for formation of ultrasmall nanostructures of interest.




SEM images of nanogaps (a) before and (b) after activation by a current source with alternately reversing polarities

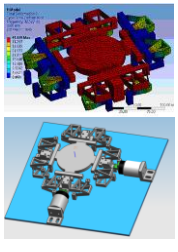
Notes

## 13-3 08:40–09:00

### Design of a New Compliant XY Micro-positioning Stage Based on Roberts Mechanism

Sicong Wan and Qingsong Xu
Department of Electromechanical Engineering
University of Macau
Macao, China

- A new type of flexible parallel-kinematic XY micro-positioning stage based on Roberts mechanism has been proposed
- Analytical modeling and FEA simulation are conducted to evaluate the static and dynamic performances
- Results show that the stage exhibits a stroke larger than 14 mm in each axis and possesses a crosstalk less than 0.1%
- A prototype is fabricated for further investigation



Notes

**Technical Session 13**
**Precision engineering**
B106
08:00–10:00 Thursday, 30 October
Chair: Dae-Gab Gweon, Second Chair: Qingsong Xu

## 13-4 09:00–09:20

### Fuzzy Control of Piezoelectric Actuator with Inverse Compensation

Ziqiang Chi and Qingsong Xu
Department of Electromechanical Engineering
University of Macau
Macao, China

- A new fuzzy PID controller is designed to realize a fuzzy feedback control system of the piezoelectric actuator with inverse-based feedforward compensation
- The classical Preisach model is employed to describe the hysteresis characteristic of piezoelectric actuator, and then an inverse Preisach model is constructed to compensates for the hysteresis effect
- Simulation investigations show that fuzzy PID control achieves significant improvements in terms of response time, overshoot, and steady-state error as compared with traditional PID control

Notes

## 13-5 09:20–09:40

### Quality Factor and Resonant Frequency Measurement by ARMA Process Identification of Randomly Excited MEMS/NEMS Cantilever

Grzegorz Jóźwiak, Daniel Kopiec, Wojciech Majstrzyk and Teodor Gotszalk
Faculty of Microsystems Electronics and Photonics, WRUT, Poland
Piotr Grabiec
Institute of Electron Technology, Poland

- Damped harmonic oscillator (DHO) is a model of many different vibrating MEMS/NEMS devices
- DHO excited by a stochastic signal may be modeled as a digital ARMA process
- Only few values of autocorrelation function may be used to calculate the ARMA process parameters
- Low complexity of the estimation procedure makes the proposed solution ideal choice for real time measurements of quality factor and resonant frequency

Nanometrology group

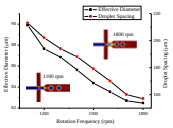
Notes

## 13-6 09:40–10:00

### Simulations of Centrifugal Microfluidic Droplet Formation Using Two-phase Level Set Method

G.Tang, J.Jin, Q.Chen, S.Di and R.Du
Precesion engineering research center
Guangzhou institute of advanced technology, CAS, China

- Flow rate and droplet breakup on a rotating disc were calculated by COMSOL Multiphysics 4.4.
- The effect of rotation frequency and channel geometry were investigated.
- The size and mutual spacing of generated droplets were derived.
- The results show that centrifugal microfluidics is a viable platform for producing highly monodisperse emulsion.



The effective diameter and droplet spacing at different rotation frequency

Notes

**Technical Session 13**
**Precision engineering**
B106
08:00–10:00 Thursday, 30 October
Chair: Dae-Gab Gweon, Second Chair: Qingsong Xu

## 13-7 Poster 1

**Multi-channel confocal laser scanning microscopy**

J. Ryu, H. Kim, D.R. Lee and D.G. Gweon
Dep. of Mechanical Engineering, KAIST, Republic of Korea
J.B. Kim, J.W. Song and J.W. Kim
Cardiovascular center, Korea University Guro Hospital, Republic of Korea
H. Yoo
Dep. of Biomedical Engineering, Hanyang University, Rebulic of Korea

- Confocal laser scanning microscopy is an optical imaging technique with high lateral/axial resolution.
- We designed optimized confocal microscope system to detect reflection/fluorescence signals from multiple light sources.
- Acquisition of images representing appearance, multi-wavelength reflectivity and fluorescence-labeled molecules is possible.

Notes

## 13-8 Poster 2

**Optimal design of voice coil motor of a fine stage of dual-servo stage**

MyeongHyeon Kim, Jaehun Jeong, Dongryung Lee and DaeGab Gweon
Dept. Of Mechanical Engineering, KAIST, Republic of Korea

- Dual-servo stage was developed in order to overcome weakness of single-servo stage. Generally, dual-servo stage was composed of fine stage and coarse stage.
- This paper introduces design of actuator of fine stage. Fine stage has voice coil motor for actuator. Two different types of actuators for control 6 degrees of freedom. Each actuator was proposed and optimized. Designed actuators were evaluated and verified by FEM simulation.

Notes

# Technical Special Session 14
# Microsystems for biological and medical applications

C101-1

08:00–10:00 Thursday, 30 October

Organizer: Chao-Min Cheng

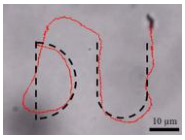
Second Chair: Hsu Chao-Kai

## 14-1 08:00–08:20

### Magnetic control and nanoscale self-assembly of low Reynolds Number swimmers

U Kei Cheang and Min Jun Kim
Dept. of Mechanical Engineering & Mechanics, Drexel University, USA

- Micro- and nanoscale robotic swimmers can potentially enhance our ability to perform minimally invasive surgery.
- Using self-assembly of nanoparticles, micro- and nanoswimmers can be fabricated.
- The flexible bodies of the swimmers can propel through low Reynolds number environments.
- Swimmers can be controlled using rotating magnetic fields, achieving manipulation at very small scales.




Trajectory of a self-assembled swimmer spelling out DU, representing Drexel University.

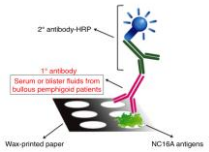
Notes

## 14-2 08:20–08:40

### Paper-based ELISA for the Detection of Autoimmune Antibodies in Body Fluid: Bullous Pemphigoid

Chao-Kai Hsu, Hsin-Yu Huang
Department of Dermatology, National Cheng Kung University, Taiwan
Chao-Min Cheng
Institute of Nanoengineering and Microsystems, National Tsing Hua University, Taiwan

- Bullous pemphigoid (BP), a common autoimmune blistering disease, is noted for its high mortality.
- Noncollagenous16A domain (NC16A) is identified as the major pathogenic epitope of BP.
- Paper-based ELISA provides a portable, inexpensive, and simple diagnostic tool to detect anti-NC16A autoantibodies in the serum or blister fluid of BP patients.




Anal. Chem. 2014, 86, 4605−4610

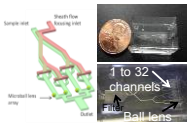
Notes

## 14-3 08:40–09:00

### High throughput and high sensitivity parallel fluorescence detection

Yu-Jui Fan, and Horn-Jiunn Sheen
Institute of Applied Mechanics, National Taiwan University, Taiwan
Pei-Yu Chiou
Mechanical Engineering, University of California Los Angeles, USA

- We have developed a high throughput, multicolor cell detector using parallel microfluidic channel integrating with microball lens array.
- 3D microfluidic technique and cascaded microfluidic channel design solved the routing and parallel flow focusing problem.
- PDMS embedded microball lens array with high N.A. provides high fluorescence light collection ability.




A microball lens array integrated parallel microfluidic channel was developed for high throughput, parallel, multicolor fluorescence labeled cell detection

Notes

**Technical Special Session 14**
**Microsystems for biological and medical applications**
C101-1
08:00–10:00 Thursday, 30 October
Organizer: Chao-Min Cheng
Second Chair: Hsu Chao-Kai

## 14-4 09:00–09:20

### Photo-responsive Nanoplatforms for Cancer Therapy

Huan-Pu Yeh and Yu-Fen Huang*
Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Taiwan,

- Photosensitizers, rose bengal (RB) were successfully encapsulated in a nanocomplex of chitosan, polyvinyl alcohol and polyethylenimine (PEI) prepared with an emulsion method.
- This multipolymeric nanocomplex displayed high water dispersibility and the cationic groups of PEI were effective for RB loading through electrostatic interaction.
- Triggered release of the loading payloads also occurred simultaneously during the photodynamic reaction.
- The improvement of photodynamic-stimulated triggered release holds great promise in precise control of drug and gene delivery.

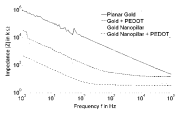
Notes

## 14-5 09:20–09:40

### PEDOT:PSS coated Gold Nanopillar Microelectrodes for Neural Interfaces

Christoph Nick and Christiane Thielemann
BioMEMS Lab, University of Applied Sciences Aschaffenburg, Germany
Helmut F. Schlaak
Institute of Electromechanical Design, Darmstadt University of Technology, Germany

- The fabrication of microelectrodes with high aspect ratio gold nanopillars coated with PEDOT is presented
- PEDOT coated Nanopillar electrodes show reduced impedance over the entire studied frequency range
- Impedance at 1 kHz is up to 350 times smaller compared to planar gold electrodes
- The capacity is more than 1000 times higher in comparison to the planar reference



Impedance spectra of a planar gold electrode, a PEDOT covered gold electrode, a gold nanopillar electrode and a gold nanopillar electrode coated with PEDOT.

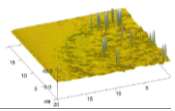
Notes

## 14-6 09:40–10:00

### Micro/Nano Manipulation Enabled Cancer Cell Detection, Separation and Investigation for Personalized Medicine

Lianqing Liu, Mi Li, Wenfeng Liang, Na Liu
State Key Lab of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China.

- The current challenge for cancer targeted therapy is the clinical response is various for different people.
- Based on Nanorobot, the binding force between the antigen and antibody can be measured, the density of antigen in living cell can be quantified.
- The technology of Optical Induced Electrical Tweezers is developed that can be used for label – free cell separation.
- The dynamic motion is different for cells, which can be used as a bio-marker to identify the cells without any fluorescence labeling.



Antigen density measurement in cancer cell surface

Notes

# Technical Special Session 15
# Probe induced dielectrophoresis for 3D manipulation of nanoparticles based on AFM

C102

08:00–10:00 Thursday, 30 October

Organizer: Lianqing Liu

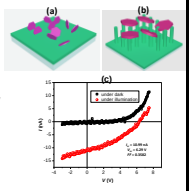
Second Chair: Yajing Shen

## 15-1 08:00–08:20

### Facile Hydrothermal Synthesis of ZnO/Co3O4 Heterogeneous Nanostructures and its Electric Property

Fanan Wei and Lianqing Liu
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Minlin Jiang
Department of Electrical and Computer Engineering, University of Pittsburgh, Pittsburgh, United States

- ZnO/$Co_3O_4$ heterojunction nanostructures are prepared through solution process
- Both planar ZnO and nanowire structure ZnO are adopted to synthesize the heterogeneous structures
- Using conductive AFM, we characterized the local I-V curve of single ZnO/$Co_3O_4$ structure
- Photovoltaic effect is observed from the I-V curves. While, the extremely high open circuit voltage is still to be explained.



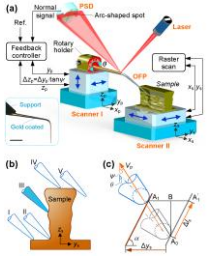
Notes

## 15-2 08:20–08:40

### Three-Dimensional Atomic Force Microscopy Imaging

Hui Xie[1], Feng Yang[1], Danish Hussain[1] and Lining Sun[1,2]
[1] The State Key Lab of Robotics and Systems, Harbin Institute of technology, China
[2] Robotics and Microsystems Center, Soochow University, China

- A three-dimensional imaging atomic force microscope (3DAFM) has been developed
- The 3DAFM consists of two independent DOF scanners to drive the probe on YZ-plane while the sample on XY-plane
- Unlike the single-axis feedback control of the conventional AFM, the probe in the 3DAFM is driven in dual-axis movement makes it possible to profile three-dimensional surface of the micro and nanostructures



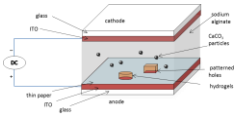
Notes

## 15-3 08:40–09:00

### Controllable Gel Patterning based on Double Layer Electrodes

Wenfeng WAN and Yajing SHEN
Mechanical and Biomedical Engineering Department, City University of Hong Kong, Hong Kong, China
Wanfeng SHANG
Mechanical Engineering Department, Xi'an University of Science and Technology, Xi'an, China.

- A 3D gel patterning method was reported based on electrodeposition.
- The patterned electrodes was designed based on plain paper in our daily life.
- Gel with different shapes, including triangle, rectangle and circle pattern, were demonstrated.



3D Gel generation based on patterned electrodes

Notes

## Technical Special Session 15
## Probe induced dielectrophoresis for 3D manipulation of nanoparticles based on AFM

C102

08:00–10:00 Thursday, 30 October

Organizer: Lianqing Liu

Second Chair: Yajing Shen

### 15-4 09:00–09:20

**A Bi-direction Asymmetric Scanning Method**

Yinan Wu , Yongchun Fang and Xiao Ren
Institute of Robotics and Automatic Information System, Nankai University, China

- This paper proposes a novel bi-direction asymmetric scanning method specifically designed for AFM;
- The proposed scanning method fuses forward and opposite process successfully to distribute scanning time reasonably;
- The proposed scanning method reduces scanning time vastly and acquires higher-quality imaging of samples.

Notes

### 15-5 09:20–09:40

**AFM Tip-Induced Dielectrophoresis for 3D Manipulation of Nanoparticles**

Peilin Zhou[1,2], Haibo Yu[2,*], Peitian Cong[1], Peng Li[2], Fanan Wei[2], Lianqing Liu[2,*]
[1] School of Mechanical Engineering, Shenyang Ligong University, Shenyang 110159, China
[2] State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang 110016, China
*Corresponding-author: yuhaibo@sia.cn; lqliu@sia.cn

- We report a simple and novel method of AFM tip-induced DEP for 3D manipulation of nanoparticles, by integrating AFM with DEP techniques.
- Compared with traditional DEP method, pre-designed electrodes are not required, the AFM tip-induced DEP method is more flexible.

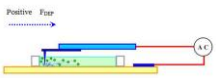


Figure 1. Schematic of AFM tip-induced DEP for 3D manipulation.

Notes

### 15-6 09:40–10:00

**Alginate Gel Electro-deposition for Cell Writing**

Jun He, Zhan Yang, Tao Chen, Haibo Huang and Lining Sun
Jiangsu Provincial Key Labratory of Advanced Robotics, Soochow University, China

- We presented electro deposition of calcium alginate for cell writing directly
- The calcium alginate is generated on the surface of anode, which is immersed in mixed solution of sodium alginate and CaCO3 powder, when charged with electricity.
- We mixed yeast cells in the sodium alginate solution (1%) with suspended CaCO3 particles (0.5%) to observe the growth situation of yeast cells.

Yeast Cell writing with Alginate Gel Electro-deposition

Notes

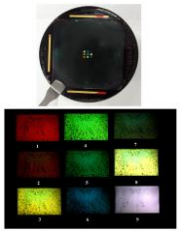
**Technical Session 16**
**Nanophotonics and photonic crystals**
B208
08:00–10:00 Thursday, 30 October
Chair: Jingquan Lin, Second Chair: Hairong Wang

## 16-1 08:00–08:20

### The Fabrication of a Multi-Spectral Lens Array and Its Application in Assisting Color Blindness

Jian Jin, Si Di, Peng Liu, Guanrong Tang, Xianshuai Chen, Ruxu Du
Precision Engineering Research Center, Guangzhou Institute of Advanced Technology, CAS, China

- The fabrication process of a novel multi-spectral lens is introduced briefly
- Based on the multi-spectral lens, a multi-spectral imaging system is setup
- Imaging results indicate that the system can reveal the hidden patterns
- It's probable to assisting color blindness by this multi-spectral imaging system



The sample of multi-spectral lens and its imaging results

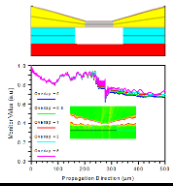
Notes

## 16-2 08:20–08:40

### A Novel Simple 3D SU8 Prism-SOI Waveguide Interface for Light Coupling Improvement

Minh-Hang Nguyen, Tuan-Hung Nguyen
Center for Microelectronic and Information Technology, NACENTECH, Vietnam
Hai-Binh Nguyen
Institute of Materials Science, VAST, Vietnam
Fan-Gang Tseng, Jain-Ren Lai
Department of Engineering and System Science, NTHU, Taiwan R.O.C.
Ming-Chang Lee, Kai-Ning Ku
Department of Electrical Engineering, NTHU, Taiwan R.O.C.

- A simple 3D SU8 prism-SOI waveguide interface for reduced coupling loss to 10% is presented
- At the interface, SU8 prism's low edge overlays SOI waveguide's tip, BOX is partly etched
- Transmission efficiency is 70% for a system of two small-angle SU8-prisms and a SOI-waveguide
- The interface can be easily fabricated with large tolerance up to 5 μm.



Notes

## 16-3 08:40–09:00

### Reflectivity Measurement Method for Nano-scale Anti-reflection Periodic Structures

Jin Zhang, Sanlong Wang, Shilei Jiang, Guobin Sun
Shaanxi Province Key Lab of Thin Films Technology and Optical Test, Xi'an Technological University, Xi'an, China
Zuobin Wang
CNM & IJRCNB Centers,
Changchun University of Science and Technology, Changchun, China

- The relationship between the reflectivity and the parameters of anti-reflection structures
- The method to measure the reflectivity of the anti-reflection structures
- The experimental setup to test the reflectivity of nano-scale gratings

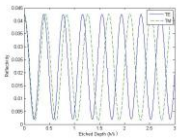


Figure. The relationship between the reflectivity and the etched depth

Notes

**Technical Session 16**
**Nanophotonics and photonic crystals**
B208
08:00–10:00 Thursday, 30 October
Chair: Jingquan Lin, Second Chair: Hairong Wang

## 16-4 09:00–09:20

### Fast Predicting Statistical Subsurface Damage Parameters of the K9 Sample

Hairong Wang * , Hongfeng Chen, Lihui Xiao, Bike Zhang, Zhuangde Jiang
State Key Laboratory for Manufacturing Systems Engineering Mechanical Engineering, Xi'an Jiaotong University,China

- This paper proposes ***a fast method*** based on HF etching experiment and image processing to calculate ***a set of parameters*** to characterize the subsurface damage of the K9 sample.
- These parameters of micro cracks (length, depth, density, angle )are important for ***optimizing the processing technology*** in order to reduce subsurface damage and to improve the mechanical and optical property of high precision optical component.

| | | | |
|---|---|---|---|
| Microcracks | Length(μm) | L(mean) | 1.0691 |
| | | L(max) | 2.3270 |
| | | L(min) | 0.4701 |
| | | L(Std) | 0.3653 |
| | Depth(μm) | D(mean) | 0.0887 |
| | | D(max) | 0.1931 |
| | | D(min) | 0.0390 |
| | | D(Std) | 0.0303 |
| | Angle(degree) | A(mean) | 91.6169 |
| | | A(max) | 180.0000 |
| | | A(min) | 0.6875 |
| | Number | | 96.0000 |
| | Density(/μm2) | | 0.0234 |
| Pits | Number | | 98.0000 |
| | Density(/μm2) | | 0.0239 |

Information of subsurface damage

Notes

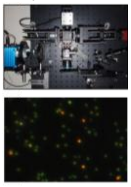
## 16-5 09:20–09:40

### Application of Fourier Transform Imaging Spectroscopy for LSPR-sensing

David Zopf, Ondrej Stranik, André Dathe, Jacqueline Jatschka, Wolfgang Fritzsche
Nanobiophotonics, Leibniz-Institute of Photonic Technologies, Jena, Germany

- A Fourier transform imaging spectrometer was built up and calibrated
- The spectra of immobilized spherical gold nanoparticles were measured
- The obtained spectra were compared with the ones measured with micro-spectroscopy
- Polyelectrolyte layers were deposited on the nanoparticles as a biological test system

Fourier transform imaging spectrometer.





Calculated RGB color image of gold nanoparticles immobilized on a surface.

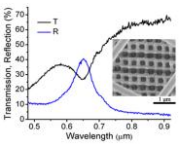
Notes

## 16-6 09:40–10:00

### Femtosecond Laser Direct Writing of 3D Photonic Crystals with Stop Gaps in the Visible Regime

Quan Sun, Takaya Tokiwa, Kosei Ueno, and Hiroaki Misawa
Research Institute for Electronic Science, Hokkaido University, Japan

- Freestanding geometry in direct laser writing enables uniform shrinkage of the photo-polymerized structures
- Post-thermal annealing induces additional shrinkage
- Combination of the freestanding geometry and post-thermal annealing gives huge but useful shrinkage
- Achieve stop gaps of the fabricated photonic crystals in visible regime utilizing the shrinkage positively




A stop band centered at 650 nm can be clearly observed from both transmission and reflection spectra

Notes

**Technical Session 16**
**Nanophotonics and photonic crystals**
B208
08:00–10:00 Thursday, 30 October
Chair: Jingquan Lin, Second Chair: Hairong Wang

## 16-7 Poster

**Design of Single-polarization Single-mode Splitter based on Liquid Filling Dual-core Photonic Crystal Fiber**

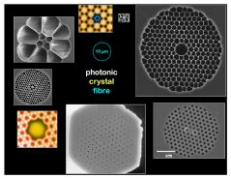
Wen Liu , Ye Cao , and Zhengrong Tong
Key Laboratory of Film Electronics and Communication Devices, Tianjin University of Technology, Tianjin, China

- PCF introduction
- SPSM PCF splitter

In 2011, a single-polarization wavelength splitter has been proposed.

In 2012, orthogonal single-polarization single-core PCF splitter has been designed.

In 2014, a polarization splitter with single-polarized based on elliptical-hole core circular-hole holey fibers has been designed




Notes

## Technical Special Session 17
## Design and fabrication of micronano mechanisms devices/micronano mechanism design and control

405B

08:00–10:00 Thursday, 30 October

Organizer: Yanling Tian

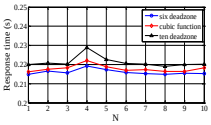
Second Chair: Xianping Liu

### 17-1 08:00–08:20

**Modified Rate-dependent Hysteresis Modeling of Piezoelectric Actuator**

Zhiyong Guo and Yanling Tian
Key Laboratory of Mechanism Theory and Equipment Design of Ministry of Education, Tianjin University, China
Houjun Qi
Tianjin Key Laboratory of High Cutting and Precision Machining, Tianjin University of Technology and Education, China

- A modified rate-dependent hysteresis model for the piezoelectric is proposed;
- The modified model improves the modeling precision more efficiently;
- The modified model has a shorter response time in same parameter number;
- The modified model perfectly predicts the output of piezoelectric.




The comparison of response time

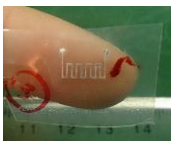
Notes

### 17-2 08:20–08:40

**Ultrasonic assisted imprint for microfluidic chips**

Liangyu Cui, Yanling Tian, Dawei Zhang and Chenjuan Yang
School of Mech. Eng., Tianjin University, P. R. China
Houjun Qi
School of Mech. Eng., Tianjin University of Tech. and Edu., P. R. China

- Ultrasonic assistant imprint is a fast and low cost replication technology.
- Conductor path below 100 μm can be realized on thin polymer foil
- Conductor paths can be integrated onto micro fluidic chips as sensing elements



Fine conductor path on polymer foil based on ultrasonic assistant imprint technology

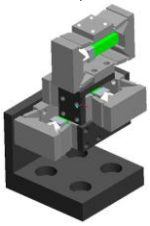
Notes

### 17-3 08:40–09:00

**Modularized Design and Development of a Piezo-Actuated Translational Manipulator**

Yanding Qin and Xin Zhao
Institute of Robotics and Automatic Information System, Nankai Univ., China
Bijan Shirinzadeh
Department of Mechanical and Aerospace Eng., Monash Univ., Australia

- A modularized design methodology for piezo-actuated micro/nano manipulators is proposed;
- The 1-DOF module allows two installation positions for the piezoelectric actuator;
- Multiple 1-DOF modules can be combined in different patterns to satisfy different requirements;
- This design methodology is easy to follow and it gives the users more freedom in building and modifying their own manipulators.



Modularization of a piezo-actuated manipulator

Notes

## Technical Special Session 17
## Design and fabrication of micronano mechanisms devices/micronano mechanism design and control

405B

08:00–10:00 Thursday, 30 October

Organizer: Yanling Tian

Second Chair: Xianping Liu

### 17-4 09:00–09:20

**Mathematical Modelling of a Droplet Sitting on Superhydrophobic Surface with Hertz Model**

Xinyao Zhu, Xianping Liu
School of Engineering, University of Warwick
Yanling Tian
School of Mechanical Engineering, Tianjin University

- In this paper, Hertz contact model is applied to predict the contact area of a water droplet sitting on hydrophobic surface. Unlike Molotskii's model, the volume of the water droplet is treated invariant before and after sitting on the surface.
- The copper sheets treated with the silver nitrate and n-octadecanethiol solutions are utilized as the superhydrophobic surfaces, which have a contact angel 145° . The volume of the water droplets changes to obtain the data of different contact areas and radius.
- Based on the experimental tests, the parameter α in the analytical model is obtained by least square fitting method. It is demonstrated that the established mathematical model is in good agreement with experimental data for the superhydrophobic surfaces.

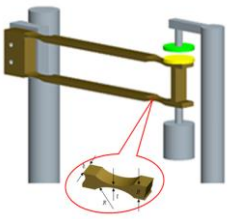
Notes

### 17-5 09:20–09:40

**A Structure to Reduce the Mechanism Stiffness for Force Measurement and Reproduction**

Yelong Zheng and Le Song
PMTI, Tianjin University, China
Hongguang Liu
Tianjin Institute of Metrological Supervision and Testing

- Force from $10^{-8}$ N to $10^{-4}$ N can be traced to SI based on the principle of electrostatic force.
- A pair of coaxial cylindrical capacitors is used to generate electrostatic force.
- Electrical compensation method is used to reduce the mechanism stiffness and thus meet the sensitive range of force measurement.



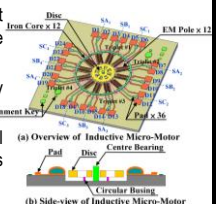
Notes

### 17-6 09:40–10:00

**Radial Position Deviation Measurement for Inductive Micro-motor**

Chih-Che Lin and Nan-Chyuan Tsai*
Department of Mechanical Engineering, National Cheng Kung University, Tainan 70101, Taiwan

- An innovative capacitive gap-sensing readout circuit to replace traditional gap sensor for the inductive micro-motor is proposed.
- The induced capacitance change is fairly sensitive with respect to air gap change.
- It is intrinsically immune to parallel and serial parasitic capacitances by an embedded DC bias regulator.
- The mean of output voltage of gap-sensing readout circuit is about 327*mV* under the position deviation of the disc being 8*μm*.




Design of Proposed Inductive Micro-motor

Notes

# Technical Special Session 18
# Micro-nanotechnology for energy harvesting

505B

08:00–10:00 Thursday, 30 October

Organizer: Fei Wang

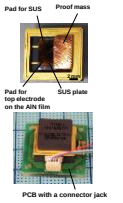
Second Chair: Gonzalo Murillo

## 18-1 08:00–08:20

### Aluminum Nitride Energy Harvester Using a Stainless Steel Plate

Motoaki Hara, Jianjun He, Qi Wang and Hiroki Kuwano
Graduate school of Engineering, Tohoku University, Japan

- SUS304 based vibrational energy harvesters using AlN thin film was developed and hermetically packaged.
- The piezoelectric AlN film was deposited on 50-μm-thick SUS304 substrate with AC magnetron reactive sputtering system.
- The deposited AlN film indicated highly c-orientation with FWHM of 1.39 deg.
- the output power of 72.6 μW at 1 g with optimal vibration conditions was achieved.




The developed energy harvesters using SUS304 plates

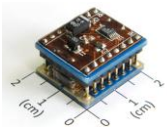
Notes

## 18-2 08:20–08:40

### Development of Electrostatic Energy Harvesters: from Rigid to Flexible Devices

Yi Chiu
Department of Electrical and Computer Engineering
National Chiao Tung University, Hsin Chu, Taiwan, R.O.C.

- Theory and modeling of electrostatic energy harvesters are reviewed
- Silicon-based energy harvesters were fabricated in SOI substrates
- Stable electret was developed in both $SiN/SiO_2$ and Parylene-C
- Pulsed output of 2.2 mW was delivered in an energy harvesting module based on flexible PCB
- Flexible PDMS harvester was demonstrated



Electrostatic energy harvesting module based on flexible printed circuit board technology

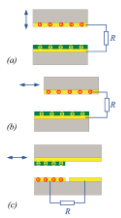
Notes

## 18-3 08:40–09:00

### MEMS Electrostatic Energy Harvesting from Vibration Sources

Fei Wang
Department of Electronic and Electrical Engineering,
South University of Science and Technology of China,
Shenzhen, P.R. China, 518055

- Energy can be harvested from both in-plane and off-plane vibration sources;
- RMS power of 32.5 nW has been harvested at a low vibration amplitude of 0.03 g;
- All the devices can be fabricated with MEMS compatible technology;
- Reliability of the electret based device in humid environment is also investigated;



Three configurations of the electret based energy harvesting devices.

Notes

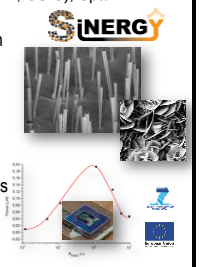
**Technical Special Session 18**
**Micro-nanotechnology for energy harvesting**
505B
08:00–10:00 Thursday, 30 October
Organizer: Fei Wang
Second Chair: Gonzalo Murillo

## 18-4 09:00–09:20

**Silicon-friendly Piezoelectric Materials For Energy Harvesting**

Gonzalo Murillo, Carlos Camargo and Jaume Esteve
National Center of Microelectronics (IMB-CNM, CSIC), Spain

- The European project, SINERGY, dealing with silicon friendly materials and device solutions for microenergy will be presented.
- We will develop thermoelectric and piezoelectric energy harvesters and novel batteries to obtain an integrated system.
- ZnO nanostructures and AlN thin-films will be used as key piezoelectric materials for the silicon integration.




Notes

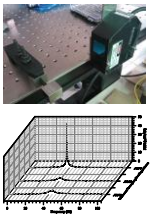
**Technical Special Session 19**
**New developments of the compliant mechanisms**
B106
14:00–16:00 Thursday, 30 October
Organizer: Xianmin Zhang
Second Chair: Guimin Chen

## 19-1 14:00–14:20

### Leaf Flexure Hinge With a Damping Layer: Theoritical Model and Experiments

Zhong Chen, Guisheng Chen and Xianmin Zhang
School of Mechanical & Automotive Engineering, South China University of Technology, China

- A theoretical model of a leaf flexure hinge with damping layers is presented using strain energy method and Kelvin damping model.
- The damping coefficients and 1st bending natural frequency measured by experimental mode analysis and free vibration response.
- The constrained layer (CL) damping can enhance the structure damping of the hinge obviously, dimension optimization of damping layer and basic layer should be performed in the design stage.



Free vibration experiment set-up and FRFs in three kinds of damping conditions

Notes

## 19-2 14:20–14:40

### Design and Test of A Novel Planar 3-DOF Precision Positioning Platform with A Large Magnification

Ruizhou Wang and Xianmin Zhang
School of Mechanical and Automotive Engineering,
South China University of Technology, China

- Design of the two-level lever amplifier, 3RRR parallel mechanism and tiny angular measurement
- Displacement loss of the flexible lever mechanism and the actuating subsystem
- Dynamic modeling and analysis
- Prototype test results on workspace, resolution and natural frequency and discussion

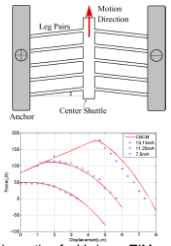
Notes

## 19-3 14:40–15:00

### Modeling of V-Shape Thermal In-Plane Microactuator Using Chained Beam-Constraint-Model

Fulei Ma and Guimin Chen
School of Electro-Mechanical Engineering, Xidian University, China

- A brief review of thermal modeling of TIM was given
- Chained Beam-Constraint-Model was introduced and employed to model the deflections of the legs of TIM during actuation
- The load capability of the TIM designs were characterized.




Schematic of a V-shape TIM and its load capability

Notes

## Technical Special Session 19
## New developments of the compliant mechanisms

B106

14:00–16:00 Thursday, 30 October

Organizer: Xianmin Zhang

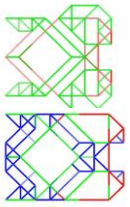
Second Chair: Guimin Chen

### 19-4 15:00–15:20

**Multi-Material Topology Optimization of Compliant Mechanism Using Ground Structure Approach**

Nianfeng Wang and Xianmin Zhang
Guangdong Province Key Laboratory of Precision Equipment and Manufacturing Technology, South China University of Technology, China

- Multi-material compliant mechanisms can enhance the performances of monolithic compliant mechanisms by integrating multiple materials.
- As to the design method, Parallel Optimization Tactic (POTT is a optimization method formalizing the process of propagating multi-material optimization into separate single-material optimizations. The overall mechanical properties of a multi-material structure are generally formulated according to the tensor addition theorem, and the objective function is additively separable.



Sketch of a microgripper

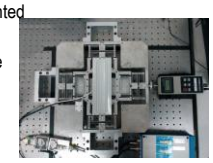
Notes

### 19-5 15:20–15:40

**Constraint Design Principle of Large-Displacement Flexure Systems**

Jingjun Yu, Dengfeng Lu and Yan Xie
Robotics Institute, Beihang University
Beijing, 100191, China
jjyu@buaa.edu.cn

- Design of large-range flexure systems is presented using the constraint-based design principle.
- The proposed approach is established upon the combination of type synthesis and improved stiffness design within the framework of screw theory.
- The constraint-based principle and approach is effectively used for designing a large-range XY nanopositioning stage by a case study.



Prototype of large-range XY stage

Notes

## Technical Special Session 20
## Micronano technology used in aerospace

C101-1

14:00–16:00 Thursday, 30 October

Organizer: Zhonghe Jin

Second Chair: Jun Zhou

### 20-1 14:00–14:20

**CubeSat: A Candidate for the Asteroid Exploration in the Future**

Xiaozhou Yu and Jun Zhou
Shaanxi Engineering Laboratory for Microsatellites, Northwestern Polytechnical University,China

- CubeSat is a kind of low cost micro-satellites,CubeSat could be used for asteroid exploration.
- Two methods to explore the asteroids by using CubeSat is given.
- One way is only using CubeSat and another way is using CubeSat as drone.
- The paper gives an possible CubeSat configuraion for asteroid exploration of second method.

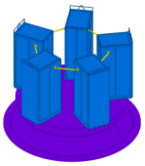
Notes

### 20-2 14:20–14:40

**Design and Analysis of Multiple Payload Adapters of Nanosatellite**

Jing Guo
School of astronautics, Beihang University, China
Xinsheng Wang
School of astronautics, Beihang University, China

- The Adapters can reduce the cost of satellite launch
- The Adapters provide good launch environment and separation ways for satellites
- The Adapters have simple structure
- The Adapters adopt modular design method which is easy to maintain and modify



Mechanical structure of the multiple

Notes

### 20-3 14:40–15:00

**Study on On-Orbit Demonstration Technology for Space-Biology Nanosatellites**

Xiang Zhang, Wenhe Liao and Lianxin Zhang
School of Mechanical Engineering, Nanjing University of Science and Technology, Nanjing
Min Chen, Youquan Yang
Agriculture Ecology Institute, Fujian Academy of Agricultural Sciences, Fuzhou

- The space biology related to experiments performed by NASA using CubeSats are reviewed.
- The objective of the space biology experiment using Azolla is described.
- The technical requirements to the satellite system are presented .
- A general design scheme for the Azolla-carrying nanosatellite is proposed.
- The paper proposes an on-orbit experimental scheme for monitoring the growth state of a advanced plant for the first time.

Notes

**Technical Special Session 20**
**Micronano technology used in aerospace**
C101-1
14:00–16:00 Thursday, 30 October
Organizer: Zhonghe Jin
Second Chair: Jun Zhou

## 20-4 15:00–15:20

### Application and Prospect of Micro-Nano Device in Spacecraft Attitude Control System

Tao Meng, Zhonghe Jin
Microsat Research Center, Zhejiang university, China

- The vital solution of Nano/Pico Satellite.
- Multiple benefits include mass, power, volume, and cost, etc.
- Help to create next generation, multifunctional, highly integrated modular ACS system.
- Will become commonplace on space platforms

ZDPS-1A, developed by ZJU
Weight:3.5kg
Power Consumption:3.5W.

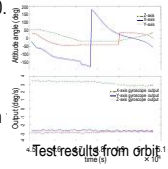
Notes

## 20-5 15:20–15:40

### Application of MEMS Gyroscope in ZDPS-1A Pico-Satellite

Huiquan Wang, Xing Su, Hao Wang and Zhonghe Jin
Micro-Satellite Research Center, Zhejiang University, China

- ADXX MEMS gyroscope has been used in ZDPS-1A pico-satellite. The resolution of the gyroscope is 0.2deg/s, dynamic range is ±75deg/s, and the power consumption is 15mW.
- Temperature cycle, thermal vacuum, mechanical vibration and aging test has been done on the gyroscope to improve its reliability.
- The gyroscope has been launched into orbit at 2010. It shows that output of the gyroscope is consistent with the angle rate calculated from attitude control system. Based on this result, output of the gyroscope has been used in attitude control system when the satellite works in shadow region.



Test results from orbit

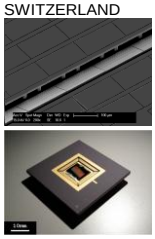
Notes

## 20-6 15:40–16:00

### Design and Test of Components for Space: Lessons Learned from MOEMS Devices

F. Zamkotsian, P. Lanzoni
Laboratoire d'Astrophysique de Marseille (LAM), FRANCE
M. Canonica, W. Noell
Ecole Polytechnique Federale de Lausanne (EPFL), SWITZERLAND

- Micromirror array development for multi-object spectroscopy in astronomy: MIRA
- Array with single-crystal silicon 200 x 100 µm² mirrors
- Large array of 2048 micromirrors (64 x 32)
- Performances:
  Tilt angle: 24° for 130V actuation voltage
  Actuated successfully at cryogenic temperature 162K
  Mirror deformation: 10nm PtV at 300K, 27nm at 162K
- Design rules and characterization procedures to be adapted for Nano-components



64 x 32 micromirror array
(mirror size: 200 x 100 µm²)

Notes

## Technical Special Session 21
## Nanomaterials synthesis, characterization & applications

C102

14:00–16:00 Thursday, 30 October

Organizer: Ian Bu

Second Chair: Bill Milne

### 21-1 14:00–14:20

**Fabrication of Metal Oxide Resistive Random Access Memory by Atomic Force Microscopy Local Anodic Oxidation**

Jeff T. H. Tsai
Institute of Optoelectronic Sciences, National Taiwan Ocean University, Taiwan

- Gallium, Zinc, and Nicole oxide nano-dots for application of resistive random access memory (RRAM) using atomic force microscopy (AFM) local anodic oxidation technique are achieved.
- Ag coated AFM probe contacts the metal film locally to generate 50 nm metal oxide nano-dots.
- Using a current-biased method, the device can switch from a high-resistance state (HRS) to a low-resistance state (LRS) with a low writing voltage of 0.64 V to preform RRAM.

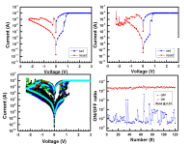


Fig.1 AFM LAO processed RRAM I-V characterizations

Notes

### 21-2 14:20–14:40

**Bulk Acoustic Wave Resonators: Towards a Low Cost Mobile Sensing Platform**

W.I. Milne, L. Garcia-Gancedo and A.J. Flewitt
Electrical Engineering Division,Cambridge, UK.
J. K.Luo
Inst. of Renewable Energy & Environment Tech, Bolton Univ.,UK
Y. Q. Fu
University of West of Scotland, Paisley, UK
E. Iborra and D. Ramos
Universidad Politécnica de Madrid, 28040Madrid, SPAIN
Jian Lu and Xiubo Zhao
School of Physics & Astronomy, University of Manchester, UK

- Biological Sensors based on Surface Acoustic Wave (SAW) and FBAR technologies.
- Both the SAW and FBAR devices were fabricated on nanocrystalline ZnO thin films.
- Results on dual mode thin film FBARs for parallel sensing of both mass loading and temperature will be described.

Notes

### 21-3 14:40–15:00

**Properties and Applications of Dry-spun Yarns from Vertically Superaligned Carbon Nanotube Forests**

Yasuhiko Hayashi and Toru Iijima
Graduate School of Natural Science and Technology, Japan
Yuzo Sumita
SUMITA Nanotechnologies, Co., Ltd., Japan

- Growth of few-wall carbon nanotubes with narrow diameter distribution (CNT arrays)
- Development of directly dry-spun CNT yarn from vertically aligned CNT arrays
- Construct ion of macro to bulk scale nanotube devices and structures
- CNT yarn towards a new generation of energy efficient devices

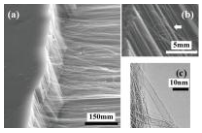


Fig. SEM images while drawing directly from vertically aligned CNT arrays CNT at (a) low and (b) high magnification. (c) TEM image of CNTs.

Notes

## Technical Special Session 21
## Nanomaterials synthesis, characterization & applications

C102

14:00–16:00 Thursday, 30 October

Organizer: Ian Bu

Second Chair: Bill Milne

### 21-4 15:00–15:20

**Silicon Quantum Dot Devices for Future Electronics**

Shunri Oda
Quantum Nanoelectronics Res. Ctr., Tokyo Institute of Technology, Japan

- Silicon quantum dots fabricated either by bottom-up or top-down processes
- Integrated NeoSilicon prepared by Si nano dot ink - for high on/off transistors and solar cells
- Surface nitridation of Si nanocrystal films - effective to prevent oxidation and enhance transport properties.
- Pauli spin blockade observed in coupled quantum dots prepared by EB lithography – promising for future spin based qubits

Notes

### 21-5 15:20–15:40

**Integrating Carbon-based 1D-2D Materials in PEM Fuel Cells**

Daniel HC Chua
Department of Materials Science & Engineering, National University of Singapore, Singapore

- Carbon materials such as carbon nanotubes and graphene have unique structure which is applied in hydrogen PEM fuel cells.
- In this work, 1D carbon nanotubes, 2D graphene and nanocomposite compounds consisting of 1D-2D nanotube/graphene will be applied as electrodes and gas diffusion layer for PEM fuel cells.
- Electrochemical Impedance analysis and various cyclic voltammetry studies will also be shown.
- The design of the nanocomposites play a significant role in the reliability and stability of the PEM fuel cells.

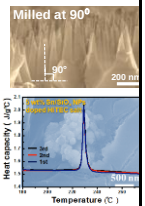
Notes

### 21-6 15:40–16:00

**Solar Energy Harvesting Scheme Utilizing Three-Dimensional Hierarchical Nanostructures**

Yu-Lun Chueh
Department of Materials Science and Engineering
National Tsing-Hua University, Hsinchu, Taiwan
*E-mail: ylchueh@mx.nthu.edu.tw

- Energy harvesting from solar energy
  -Harvesting from photo energy (photo-solar)
  -Energy harvesting thermal heating from solar energy (thermal-solar).
- A large area Cu(In,Ga)$Se_2$ nanotip arrays (CIGS NTRs) by using one step Ar+ milling process without template.
  -Nanostructured CIGS NTRs with efficiency enhancement of ~160 %.
  -Controllable milling time and incident angles
- An enhanced heat capacity of modified HITEC molten salt by doping of metal NPs will be reported
  -The SiOx@Sn NPs provides a stable leant heat value of 28.36 J/g.
  -Effective heat capacity of HITEC salt with Sn/SiOx core-shell NPs can be enhanced to be 30 % a mixture percentage of 5 wt%.







Notes

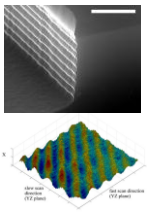
**Technical Session 22**
**ECNANOMAN**
B208
14:00–16:00 Thursday, 30 October
Chair: Qingkang Wang, Second Chair: Valentin L. Popov

## 22-1 14:00–14:20

### Atomic Force Microscopy for High Resolution Sidewall Scans

Florian Krohs, Olaf Haenssler, Malte Bartenwerfer, Sergej Fatikow
Division Microrobotics and Control Engineering,
Dept. Computer Science, University of Oldenburg, Oldenburg, Germany

- Novel AFM mode enabling sidewise surface scanning
- Applicable on standard AFM instruments
- Using standard AFM cantilevers with customized FIB-milled lateral protruding tips
- Torsional deflection feedback loop controlling the lateral position of the tip



Notes

## 22-2 14:20–14:40

### Dynamic Tangential Contacts: Numerical Description of Nano-Positioning Devices

Elena Teidelt, Valentin L. Popov
Institute of Mechanics TechnicalUniversity of Berlin, Berlin, Germany
Ha X. Nguyen, Sergej Fatikow
Division of Microrobotic and Control Engineering, The University of Oldenburg, Oldenburg, Germany

- Piezoelectric motors using the stick-slip principle are standard technical devices. However, their physical description remains case specific and is often based on multiple empirical parameters.
- We will describe the method of dimension reduction and how it can be used to describe dynamic tangential contacts. Considering the positioning axis of the nano-positioning device Ramona, we will exemplarily show how this method is used.
- The runner is driven by six piezo actuators, rotating ruby hemispheres. Different models describing the sphere-runner interaction are presented.

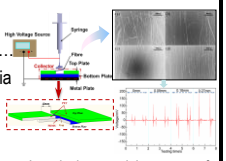
Notes

## 22-3 14:40–15:00

### Piezoelectric Properties of PVDF Nanofibers via Non-uniform Field Electrospinning

Dezhi Wu, Shaohua Huang, Zhiming Xiao, Daoheng Sun *et. al*
School of Physics and Mechanical & Electrical Engineering, Xiamen University, China
Dezhi Wu
Shenzhen Research Institute of Xiamen University, Shenzhen, China

- As its strong piezoelectricity, PVDF has been widely utilized in areas of energy, biology, sensor…
- More orderly PVDF nanofibers can be obtained via Non-uniform field electrospinning (NUFES).
- The introduction of a double-plate collector can improve the order of fibers along the gap.
- Increasing the thickness of PET, more aligned and well-piezoelectric properties PVDF nanofibers can be achieved.



Introducing special structure of collector to align the PVDF fibers and strengthen the piezoelectric properties of PVDF

Notes

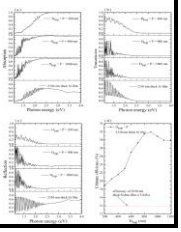
**Technical Session 22**
**ECNANOMAN**
B208
14:00–16:00 Thursday, 30 October
Chair: Qingkang Wang, Second Chair: Valentin L. Popov

## 22-4 15:00–15:20

**Effect of hexagonal nanoconical hole arrays based solar cells on the light absorption enhancement**

Kexiang Hu, Enjie Ding
Research Center of Internet of Things, China University of Mining and Technology, China
Peihua Wangyang, Qingkang Wang
National Key Laboratory of Micro/Nano Fabrication Technology, Key Laboratory for Thin Film and Microfabrication Technology of Ministry of Education, Shanghai Jiao Tong University

- The optical properties of the SiHNH arrays based solar cells is systematically studied via simulation based on RCWA.
- An ultimate efficiency of the optimized SiHNH Arrays based solar cell is up to 31.92%.
- The absorption enhancement of the SiHNH Arrays is due to its lower reflectance and more supported guided-mode resonances.



Notes

## 22-5 15:20–15:40

**Raman Spectrum Calculation and Analysis of P-xylene**

Jing Shi[1], Yu Liu[1], Xinhui Miao[1], Mingshan Zhang[1], Yong Tan[1], Hongxing Cai[1, 2*]
[1]Science School , Changchun Universiy of Science and Technology, Changchun;
[2]IJRCNB Centers, Changchun Universiy of Science and Technology, Changchun

- The introduction of P-xylene .
- The molecular geometry optimization and vibrational wavenumber calculations of P-xylene through Gaussian05 software .
- Two theoretical raman spectrum of P-xylene spectrum were compared .
- Identify and analyse the spectrum of the P-xylene .

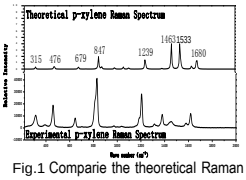



Fig.1 Comparie the theoretical Raman spectrum and the experimental Raman spectrum of P-xylene in the 0~2000cm$^{-1}$ spectral range.

Notes

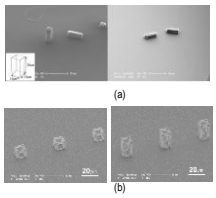
## Technical Session 23
## Nanomanipulation, nanofabrication and systems
405B
14:00–16:00 Thursday, 30 October
Chair: Dong-Yol Yang, Second Chair: Futoshi Iwata

### 23-1 14:00–14:20

**Micro Open Structure using 3D Laser Scanning Method in Nano-sterolithogarphy**

Cheol Woo Ha and Dong-Yol Yang
Department of Mechanical Engineering, KAIST, KOREA

- Due to the surface tension, the closed structure was easily fallen down on the substrate.
- Open structure can be perfectly supported on the substrate because it feels less surface tension.
- Comparing to the closed structure, open structure has advantages for fabrication and functional perspective




SEM imges of (a) closed structure and (b) open structure fabricated by nano-stereolithography.

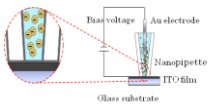
Notes

### 23-2 14:20–14:40

**Micro Electrophoresis Deposition Using a Nanopipette for Three Dimentional Structure**

Futoshi IWATA and Junya METOKI
Department of mechanical engineering,
Graduate school of engineering, Shizuoka University
Hamamatsu, Japan

- A novel fabrication technique of micro scale three dimensional fabrication using a capillary glass nanopipette
- Gold nano particles are depositted by local electrophoresis deposition
- Mechanical stiffness of the fabricated pillar was evaluated using an AFM micro cantilever




Deposition method of nanoparticles using a nanopipette.

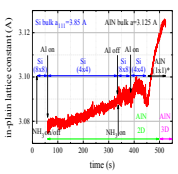
Notes

### 23-3 14:40–15:00

**2D AlN Layer Formation on (111)Si Surface by Ammonia MBE**

Timur Malin, Vladimir Mansurov, Yury Galitsyn, Konstantin Zhuravlev
Rzhanov Institute of Semiconductor Physics
Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia

- Kinetics of the 2D AlN formation on (111)Si surface was studied
- For the first time the (4x4) superstructure of AlN on the (111)Si surface was observed by RHEED
- The lattice parameter of 3.08 A of the 2D AlN commensurate phase was measured experimentally
- Variation of 2D AlN lattice parameter was observed




Evolution of in-plain lattice constant during the 2D AlN formation process

Notes

# Technical Session 23
## Nanomanipulation, nanofabrication and systems

405B

14:00–16:00 Thursday, 30 October

Chair: Dong-Yol Yang, Second Chair: Futoshi Iwata

### 23-4 15:00–15:20

**Simultaneous Fabrication of Nanogaps Using Field-Emission-Induced Electromigration**

Mitsuki Ito, Mamiko Yagi, Kohei Morihara, and Jun-ichi Shirakashi
Department of Electrical and Electronic Engineering,
Tokyo University of Agriculture & Technology, Japan

- The activation was performed to control the multiple series-connected Ni nanogaps at room temperature simultaneously.
- This method is based on field-emission-induced electromigration.
- Current-voltage properties of series-connected nanogaps were simultaneously varied, as shown in Fig.1.
- Activation is suitable for the simultaneous control of the electrical properties of multiple nanogaps.

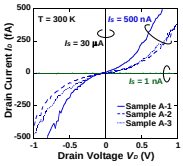



Fig 1. $I_D$-$V_D$ characteristics of samples after performing the activation with different preset currents $I_s$ = 1 nA, 500 nA, and 30 μA.

Notes

### 23-5 15:20–15:40

**Practical System for Nanomanipulation**

Victor Koledov, Vladimir Shavrov, Svetlana von Gratowski
Kotelnikov Institute of Radioengineering and Electronics of the Russian Academy of Sciences, Russia
S. Petrenko,
Lileya Ltd, Ukraine,

- The practical 3D nanomanipulation system based on advanced high precision piezoelectric resonance motors and the bimetallic composite nanotweezers based on Ti2NiCu alloy with shape memory effect. Can manipulate real nano-objects: i.e nanotubes, bio-nanoparticles etc.
- The motion range – 15 mm, minimal step – 10 nm, thermal drift <5 nm/h at 20˚C; speed of linear motion: 20 nm/s - 20 mm/s, nanotweezers dimensions:20x2.3x1.6 μm$^3$,the size of the objects to be manipulated:30–1000nm

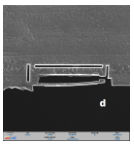
Notes

### 23-6 15:40–16:00

**Ion Beam Nanofabrication for Mass Production of Nanotweezers Based on New Composite Functional Material with Shape Memory**

Victor Koledov, Vladimir Shavrov, Svetlana von Gratowski
Kotelnikov Institute of Radioengineering and Electronics of the Russian Academy of Sciences, Russia
R. Jede,
Raith GmbH, Germany

- Experimental design and test of the new generation nanomecanical devices like nanotweezers based on original bilayer Ti2NiCu/Pt composite structures.
- Standard ion beam nanofabrication technology is quit suitable for full cycle of production operational stages of practical nanotweezers production.
- IonLiNETM was applied for experimental composite nanotweethers production on the base of Ti2NiCu/W with length–30 μm, gap width 0.9 μ.
- The tests showed high quality of reproduction and long term operation under thermal control at temperature change only 14K.



Notes

**Technical Session 24**
**BioRA**
505B
14:00–16:00 Thursday, 30 October
Chair: Dayou Li, Second Chair: Pasi Kallio

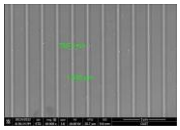
## 24-1 14:00–14:20

### Direct Laser Interference Technology and Potential Applications

Dapeng Wang[2,3], Yong Yue[1,2,3,*], Ziang Zhang[3], Dayou Li[2], Renxi Qiu[2], Carsten Maple[2,3], and Zuobin Wang[2,3]

[1]DCSSE, Xi'an Jiaotong-Liverpool University, China
[2]IRAC and JR3CN, University of Bedfordshire, UK
[3]CNM and JR3CN, Changchun University of Science and Technology, China

- Development of direct laser interference technology reviewed in the paper.
- Significant results achieved by ns, ps, and fs laser interference technology introduced.
- Future challenges and promising applications highlighted.



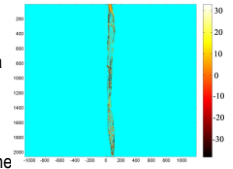
Notes

## 24-2 14:20–14:40

### Semi-Automatic Measurement of Microfibril Angle on a Microrobotic Platform

Juha Hirvonen[1], Kourosh Latifi[1], Karri Palovuori[2] and Pasi Kallio[1]
[1]Department of Automation Science and Engineering
[2]Department of Electronics and Communications Engineering
Tampere University of Technology, Finland

- Microfibril angle (MFA) influences strongly to the mechanical properties of paper fibers
- MFA measurement method based on transmission ellipsometry is implemented on a microrobotic platform
- For the first time, a system that enables automatic MFA measurements is developed
- The measurements are moderately fast and the results are extremely promising



MFA in degrees along a fiber

Notes

## 24-3 14:40–15:00

### The Comparison of Measurement of Mechanical Properties of Viscoelastic Material by Dynamic and Creep Nano-indentation with Spherical Tip

Lei Wang and Xianping Liu
School of Engineering, University of Warwick, UK

- Characterization of viscoelastic materials by nano-indentation experiments which were performed using the home-made facility.
- Both dynamic and creep indentation were performed on PTFE and styrene rubber sample.
- Differences in these results from two approaches indicated current model was inadequate.
- Pave a new way for further study the mechanical properties of viscoelastic materials in this area

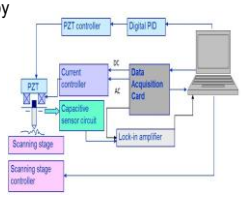



Figure.1 Scheme of home made measurement system (Tribological Probe Microscopy)

Notes

**Technical Session 24**
**BioRA**
505B
14:00–16:00 Thursday, 30 October
Chair: Dayou Li, Second Chair: Pasi Kallio

## 24-4 15:00–15:20

### Experimental Evaluation of Z-Directional Fibre-Fibre Bond Strength using Microrobotics

Seyed Kourosh Latifi, Pooya Saketi, Pasi Kallio
Automation Science and Engineering Department, Tampere University of Technology, Finland

- A new method for measuring the Z-directional pulp/paper fibre bond strength is developed using microrobotics.
- A PVDF microforce sensor is calibrated and used for Z-directional pulp/paper fibre bond strength at the individual fibre level.
- The practical effect of the deformation rate on the PVDF microforce sensor performance is studied.
- Successful experiments on bleached softwood Kraft pulp fibres are performed.

TUT Microrobotic Platform for Fibre Studies

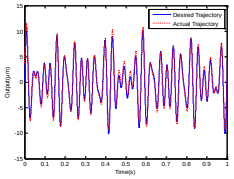
Notes

## 24-5 15:20–15:40

### An Improved Direct Inverse Modeling Approach for High-Speed Feedforward Tracking Control of a Piezoelectric Tube Actuator

Han Lu, Yongchun Fang, Xiao Ren, Xuebo Zhang
Institute of Robotics and Automatic Information System,
Tianjin Key Laboratory of Intelligent Robotics,
Nankai Univ., China

- An improved direct inverse rate-dependent PI model
- Polynomial function module
- Preprocessing procedure
- Nonlinear parameter optimization
- High-speed feedforward tracking control




Trajectory tracking for a sinusoidal superposed signal

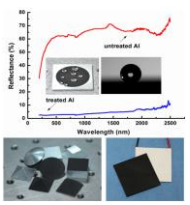
Notes

## 24-6 15:40–16:00

### Multifunctional Nano- and Microscale Structures on Metals Fabricated by Femtosecond laser

Haiyan Tao, Zuoqiang Hao and Jingquan Lin*
Ultrafast Optics Lab, Changchun University of Science and Technology, China

- One-step formation of superhydrobolic and high absorption nano- and microscale structures on metal surface by use of femtosecond laser.
- The fabricated multi-functional structures can be extended from a planar surface to almost any irregular ones.
- The striking feature of femtosecond laser-processed metal drives us to apply it to the outdoor solar-driven thermoelectric devices.




Photos of the fabricated Al samples and their properties testing.

Notes

**Technical Session 24**
**BioRA**
505B
Thursday, 30 October 14:00 - 16:00
Chair: Dayou Li, Second Chair: Pasi Kallio

## 24-7 Poster

### Tunable Oscillatory Phenomenon during Anodic of n-InP (100) by the CPCR Model

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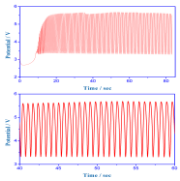
- Obtained the constant periods and amplitude of the oscillations by the CPCR model.
- Observed tunable potential oscillations during anodic of n-InP (100) by the CPCR model.
- Designed the periods and the amplitude at certain electrochemical parameters (scan rate).
- Discussed the effect of the scan rate.



Potential oscillatory phenomenon during anodic of n-InP (100) by the CPCR Model

Notes

# General Information

## Taiwan's history

Taiwan's history goes as far back as ten thousands of years. According to archeologists, prehistoric people were the first to have lived in Taiwan, proof of which can be found in archaeological dig and sites in Taitung and elsewhere. The indigenous people who first came to Taiwan so long ago formed the northernmost branch of the Austronesia culture group. The indigenous people who remain till today are divided into 14 tribes: the Amis, Atayal, Paiwan, Bunun, Puyuma, Rukai, Tsou, Saisiyat, Yami (or Tao), Thao, Kavalan, Truku, Sakizaya, and the Sediq. Over the years, other tribes, especially flatland groups, have increasingly came in contact with the Han Chinese, their daily lives become more and more integrated, and by now most have assimilated with the Chinese. The other tribes, however, have also managed to preserve some of their traditional customs, tribal structures and architecture, and continue to keep the tribal spirit alive through the practice of traditional worship.

In 1544, the Portuguese passed by the island with rocky coasts, lush plains and rugged mountains, they called Taiwan "Ilha Formosa", meaning "beautiful island". Before long, the Europeans took notice and the Dutch soon set up a trading spot at Penghu Islands. In 1626, the Spanish invaded what is now Keelung and established their territory all the way down the west coast to Tamsui and eventually all over northern Taiwan. Later, the Spanish was threatened by typhoons, several catastrophes and attacks from the aboriginals. In 1638, the Spanish withdrew from Tamsui and the Dutch moved in to take control of Keelung in 1642.

Exiled by the collapsed Ming dynasty, Cheng-Kung Cheng sent his troops on the small island of Kinmen, and was convinced to invade Taiwan and overthrow the Dutch. The Dutch surrendered to Cheng in 1662 and left for good. With the number of 30,000 mainland Chinese and the growing population for

the next 200 years, the fertile plains along the western Taiwan grew fast. In 1683, the Qing dynasty took over the island.


View of Datun Mountain from inside Taipei City (1930).


Taipei South Gate in 1896 (22nd year of the Guangxu reign)



## Climate

Taiwan lies on the Tropic of Cancer, and its climate is marine tropical. The northern part of the island has a rainy season that lasts from January through late March during the northeast monsoon, and experiences meiyu in May. The entire island experiences hot, humid weather from June through September. The middle and southern parts of the island do not have an extended monsoon season during the winter months. Typhoons are common between July and October. Overall, end of October is the perfect time to visit Taiwan for cool temperature and sunny sky. Deeply affected by the topography, the climate also shows evident spatial variations. Temperature decreases as altitude increases, and climate variations are more evident in winter than in summer.

Take Taipei Plain as an example, data provided by the Central Weather Bureau recorded from the Taipei Meteorological Station in 2010 are as follows:

Accumulated Rainfall: 2,278.3 millimeters

Heaviest Rainfall in a Single Day: 132 millimeters (August 30, 2010)

Annual Rainy Days: 168 days

Average Temperature: 23.3℃

Absolute Highest Temperature: 38.6℃ (July 3, 2010)

Absolute Lowest Temperature: 7℃ (January 13, 2010)

Average Relative Humidity: 75.5%

Affected by latitude, altitude, terrain and monsoons, Taipei’s climate is generally characterized as warm in the winter and hot in the summer. It rains throughout the four seasons and is generally warm and humid.

## Multicultural City

Taipei is the capital, political, economic, and cultural center of Taiwan. Situated at the northern tip of Taiwan, Taipei is located on the Tamsui River, it is about 25 km (16 mi) southwest of Keelung, a port city on the Pacific Ocean. It lies in the Taipei Basin, an ancient lakebed bounded by the two relatively narrow valleys of the Keelung and Xindian rivers, which join to form the Tamsui River along the city's western border. The city proper is home to an estimated 2,618,772 people. Considered to be a global city, Taipei is part of a major industrial area. Railways, high speed rail, highways, airports, and bus lines connect Taipei with all parts of the island. The city is served by two airports - Taipei Songshan and Taiwan Taoyuan.


## Shopping and Recreation

Taipei is known for its many night markets, the most famous is the Shilin Night Market in the Shilin District. The surrounding streets by Shilin Night Market are extremely crowded during the evening, usually opening late afternoon and running well past midnight. Most night markets feature individual stalls selling a mixture of food, clothing, and consumer goods.

The newly developed Xinyi District is popular with tourists and locals alike for its many entertainment and shopping venues, as well as being the home of Taipei 101, a prime tourist attraction. Malls in the area include the sprawling Shin Kong Mitsukoshi complex, Taipei 101 mall, Eslite Bookstore's flagship store (which includes a boutique mall), The Living Mall, ATT shopping mall, and the Vieshow Cinemas (formerly known as Warner Village). The Xinyi district also serves as the center of Taipei's active nightlife, with several popular nightclubs concentrated in a relatively small area around the Neo19 and Taipei 101 buildings.


## Gourmet Guide

Chinese cuisine can be traced back to ancient times and has achieved its present level of excellence through the accumulation of thousands of years of practical knowledge and experience in cookery. Emphasis is placed on the perfect combination of color, aroma, flavor, and appearance, through which the most common ingredients are transformed into culinary tours de force. In Taiwan, cooking techniques from all areas of China have fused; the Taiwanese have not only mastered the traditional local Chinese specialties, but have also

used traditional techniques to develop new culinary treats. These features attract many tourists to Taiwan every year to savor these Chinese specialties, ranging from small steamed buns to boiled dumplings.


Here are some highlights that we would like you to explore during your stay in Taiwan.

## Seafood

Taiwan is surrounded by the sea, the unique ocean currents flow made it a great environment for the breeding of marine resources. Lobster, red frog crab, swimming crab, grouper, and big eye tuna, the great variety of marine production has made Taiwan a major country in the world to export seafood.

The way how we cook seafood is influenced by the cultivation of Fujian, Guangdong and Japan. The original freshness and sweetness is an experience you don’t want to miss, that is why the flavor of the seafood itself is being emphasized, rather than the seasonings. Seafood is cooked through stewed, stir-fried, steamed or boiled. It creates a simple but deep flavor which derives abundant delicacy of the ocean. Everywhere around the harbor cities would be a good choice for a local seafood feast. Here, diners can select the fish or crustacean they wish to eat, which is then cooked on-site. These fresh products, together with the house specialties of different restaurants, will satisfy even the choosiest of gourmets.

## Kingdom of Fruits

Since the colonial period of the Japanese, fruit was one of the main exports of Taiwan. The Japanese government had introduced pineapples, oranges, grapes, persimmons, pears and other fruits, more than half of the fruit grown in Taiwan was exported to Japan, the major fruit exports being bananas, pineapples, and oranges.

Due to the special location where covering subtropical zone and temperate-zone, a great varieties of fruits are bred well on this small island. With the large plains and high mountains, accompanying warm climate and abundant rainfall, give it a good quality and unique flavor for Taiwan’s fruits, and earned a reputation as “kingdom of fruits”.

For foreign visitors to Taiwan, you may not have enough time to visit the traditional market for fresh fruits and cut them into pieces to enjoy the feast. However, if you ever have time for night markets, pay a small visit to the street vendors, the tasty and seasonal flavor will freshen you after a heavy dinner.

## Japanese Cuisine

Japanese restaurants are easy to find, several cuisines are popular among Taiwanese, which will be Sushi, Yakiniku, Sashimi, Ramen, and Izagaya. Japanese feast becomes more appealing because of the freshness of local seafood. We recommend Taiwanese beer being the best drink with your night feast.

## Festivals and Events

Many national festivals are held in Taipei. In recent years some festivals, such as the Double Ten Day firework show and concerts, are not only being hosted in Taipei, several cities are taking turns to celebrate these events.

When New Year's Eve arrives on the solar calendar, thousands of people converge on Taipei's Xinyi District for parades, outdoor concerts by popular artists, street shows, round-the clock nightlife. The high point is of course the countdown to midnight, when Taipei 101 assumes the role of the world's largest fireworks platform.

The Taipei Lantern Festival concludes the Lunar New Year holiday. The timing of the city's lantern exhibit coincides with the national festival in Pingxi, when thousands of fire lanterns are released into the sky. The city's lantern exhibit rotates among different downtown locales from year to year, including Liberty Square, Taipei 101, and Zhongshan Hall in Ximending.

On Double Ten Day, patriotic celebrations are held in front of the Presidential Building. Other annual festivals include Ancestors Day (Tomb-Sweeping Day), the Dragon Boat Festival, the Ghost Festival, and the Mid-Autumn Festival (Moon Festival).

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