

京都大学デザインシンポジウムシリーズ

第10回 MicRO アライアンスシンポジウム  
～「マイクロシステムがもたらす社会変革」～

日時：2013年11月21日、22日

於：京都大学桂キャンパス 桂ホール

実行責任者

工学研究科マイクロエンジニアリング専攻

田畑 修

11月21日、22日、京都大学桂キャンパスにおいてデザイン学ユニットの支援を得て、京都大学ーミシガン大学ーフライブルク大学の第10回マイクロアライアンスシンポジウムが開催された。2日目は船井交流センターで高等研究院ナノミクス研究部門の共催で若手研究者によるポスターセッションを開催した。

初日のシンポジウムは、サブテーマ「マイクロシステムがもたらす社会変革」が示すように、マイクロシステムの実用化によって社会に与えることができるインパクトに焦点をあてた講演が企画された。京都大学、ミシガン大学、フライブルク大学からそれぞれ2件の講演が行われた。マイクロシステムの医療分野への応用、マイクロシステム技術の再生医療への応用、あるいはワイヤレス通信技術とマイクロシステムの融合によるアプリケーションなどが生み出す社会変革に関する話題が提供された。また、香水デザイナーRoland Tentunian氏を講師に招き、特別講演として香りの分析、調合を含む香りのデザインに関する講演が行われ、出席者の興味を集めた。

**21日 シンポジウム**

**10:00 – 10:10**

**Welcome address**

Osamu Tabata, *Kyoto University*



**10:10 – 10:30**

**Wireless integrated micro sensing and systems**

Katsuo Kurabayashi, *University of Michigan*

**Abstract**

Microsystems technologies hold the promise for transforming healthcare, communication, entertainment, and other important aspects of modern life. Research at the Center for Wireless Integrated MicroSensing and Systems (WIMS2) currently involves more than 40 faculty and 70 graduate students spread across several different departments and colleges at the University of Michigan. This presentation will review selected research efforts and highlight a few of the opportunities and challenges. Examples of current efforts include sensor-enhanced medical implants and surgical tools; portable microsystems for gas chromatography and other enabling technologies for environmental sensing; and wireless microsystems for structural health monitoring. Taken together, these applications in healthcare, environmental monitoring, and infrastructure monitoring drive basic research in sensing, stimulation, signal conditioning, communication and control circuits, packaging, and power management. A systems perspective helps to keep the research focused, accelerating and amplifying the societal gain with available resources. This type of research greatly benefits from collaborations and partnerships between specialists, and between academia and industry.

**10:30 – 11:00**

### **MST Design issues and POC diagnosis**

Jan G. Korvink, *University of Freiburg*

#### **Abstract**

Micro NMR technology can make a contribution to change society. I will carefully address this issue for the case of Tuberculosis detection in Africa.

**11:00 – 11:30**

### **Always a matter of taste: Multisensual design of products - regarding the olfactive dimension**

Roland Tentunian (Perfume Designer), *FLORASCENT Duftmanufaktur Ltd.*

#### **Abstract**

Multisensual design plays a role designing new products in consumer industries. Besides the visual and haptic concepts the olfactive dimension of materials is crucial as well. The systematic application of fragrances to products can provoke a deep emotional reaction which binds consumers to the product. The lecture illustrates the physiological basics of the effects fragrances have on humans. Also an overview of natural and synthetic fragrance materials which are suitable for various applications is given. The selective use of fragrances as a marketing tool requires a delicate interaction of fragrance design and the technical realization of fragrance application to the product. This interaction is illustrated by examples.



**13:10 – 13:40**

### **Micro/nano fabrications and motor proteins: applications at countable number of molecules**

Ryuji Yokokawa, *Kyoto University*

**Abstract**

Motor proteins have been expected to be an alternative to micro/nano actuators in MEMS/NEMS. Although several technically challenging shortcomings prohibit their use in practical applications, we observed affinity bindings of target molecules carried by kinesin and dynein on a microtubule array. This is the first demonstration of active binding of molecules, since conventional cargo transports by kinesin motors have been achieved by static incubation with microtubules. We also present the kinesin and dynein integration for tug-of-war of microtubules. This assay system will be a platform to understand intracellular transport, because tug-of-war is considered as one of the mechanisms for bidirectional motility in vivo.

**13:40 – 14:10**

**Programmed patterning and assembly of proteins and cells for bio-integrated microdevices**

Katsuo Kurabayashi, *University of Michigan*

**Abstract**

The ability to pattern and assemble proteins and cells in a programmed manner holds promise to open a door to manufacturing of novel bio-integrated devices and microfluidic systems. Devices and systems incorporating protein biosensors and cellular assemblies serve for clinical diagnosis, biological assays, and fundamental cell studies. This talk discusses our three key technologies: (1) electrically programmable patterning of biological materials; (2) mechanically programmed self-organization of ATP-fueled biomolecular motor proteins; and (3) fully passive surface immobilization of proteins by preprogrammed capillary force-driven flow. Specifically, our study demonstrates the loading and assembling of proteins and cells into a microfluidic structure under post-device fabrication conditions. The demonstrated technologies provide the functions of assembling, manipulating, and analyzing biomaterials, analyses, and fluids with great simplicity, flexibility, and programmability at low power, cost, and volume.

**14:10 – 14:40**

**MEMS meets computer science meets biology meets medicine: the excellence cluster BRAINLINKS – BRAINTOOLS**

Oliver Paul, *University of Freiburg*

**Abstract**

The study of brain function and the clinical treatment of its pathologies, such as movement disorders and epilepsy, have greatly benefited from dedicated technical tools for the direct interaction with neuronal signals at the microscopic and macroscopic levels. However, a much wider spectrum of patients could benefit from the solution of scientific, medical, and technical challenges in neurotechnology.

BRAINLINKS-BRAINTOOLS is a coherent effort of neuroscientists, engineers, and computer scientists at the University and University Clinic of Freiburg to raise the bi-directional interaction between technical instruments and the brain to a new level by developing flexible yet stable, and adaptive yet robust applications of hybrid brain-machine interface systems. Our scientific approach is guided by two visions for intelligent neuroprosthetic technology platforms:

- (1) Prosthetic Limbs with Neural Control define brain-controlled assistive devices and prostheses to return movement capacity in paralyzed patients and amputees, and to

improve the rehabilitation of patients suffering from stroke or brain trauma.

(2) Smart Energy-Autonomous Micronodes are fully implanted, autonomous devices with closed-loop feedback through implanted recording and stimulation for the treatment of neurological disorders originating in pathological network structure and activity dynamics, such as epilepsy, Parkinson's disease, and other neurological conditions.

### **15:00 – 15:30**

#### **Bio-inspired microfluidic platform to control cell functions**

Ken-ichiro Kamei, *Kyoto University*

##### **Abstract**

Cells are well-organized their functions within tissues as well as a body. To control cell functions as we desired, we need to learn how our body can regulate their functions. The key is “niche”. Cellular “niche”, or in vivo cellular microenvironments, consisted with soluble factors, extracellular matrices (ECMs) and cell-cell interactions, have critical roles for determining functions, such as self-renewal, differentiation, survival and apoptosis. Conventional macro-scale techniques can only provide limited controls of microenvironments over cells, therefore, there is a current lack of tools to perform accurate and effective procedures. To meet this urgent need, we propose to develop microfabrication technologies to create bio-inspired microenvironments within a microfluidic device for a better control of cell function, including human pluripotent stem cells (hPSCs). In my presentation, I will introduce our on-going projects of developing a high-throughput microfluidic platform in conjunction with for screening microenvironments for hPSC self-renewal/differentiation.

### **15:30 – 16:00**

#### **Neural recording arrays for optical stimulation and flexible polymer probes**

Euisik Yoon, *University of Michigan*

##### **Abstract**

Recent progress in neural probe technologies for chronic electrical recording and optical stimulation will be presented. Silicon optical probes have been monolithically integrated with optical waveguide for \*in-vivo\* recording of photo-induced neural activity. For chronic applications, the flexible polymer probes have been developed. Biodegradable silk coating was applied to give tentative mechanical stiffness during insertion but completely dissolved inside the tissue to give flexibility for reduced tissue reactions induced from micromotion.

### **16:00 – 16:30**

#### **Bio-inspired optics for an artificial eye**

Hans Zappe, *University of Freiburg*

##### **Abstract**

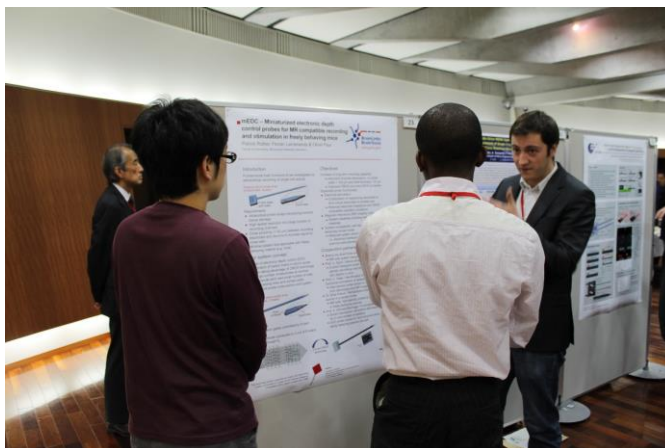
Nature provides myriad models for optical imaging and the mammalian eye is one of the most sophisticated natural optical structures. Using biology as an inspiration, we are developing an artificial eye consisting of a tunable lens and a variable iris, both using novel approaches to realize their optical functions. The lens is a deformable structure whose curvature may be varied by application of strain, using the same principle as in the human eye. The iris employs opaque and transparent liquids which are controllably

actuated to allow tuning of an aperture.

The lens and a second iris concept employ liquid crystal elastomers, "artificial muscles", which provide controllable contraction and relaxation, analogous to animal muscles. This means for actuation of tunable optical components opens new directions in adaptable optical systems.

## 22日 ポスタセッション

二日目のポスタセッションでは、ナノテクノロジーおよびマイクロシステム技術に関する最新の研究成果に関して学生および若手研究者による32件のショートプレゼントポスター発表が行われ、活発な議論が行われた。



### **11:00 – 11:05**

#### **Opening**

Osamu Tabata, *Kyoto University*

### **11:05 – 12:30**

#### **Short presentation (2 min/presentation)**

### **12:30 – 14:00**

#### **Poster presentation (Poster floor plan → Page 8)**

### **14:00 – 14:30**

#### **Award ceremony**

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#### **P-1**

##### **AC signal transmission through atomic junctions of Au**

Shodai Aoyama, *Kyoto*

#### **P-2**

##### **Mesoscopic Yb(III)-based porous coordination polymer with high catalytic performance**

Tomokazu Kiyonaga, *Kyoto*

#### **P-3**

##### **Preparation and characterization of peptide nanotubes of cyclic $\beta$ -peptides on gold substrate**

Shota Mitani, *Kyoto*

**P-4**

**Effects of helix length and helicity on phase separation in nanotube molecular assemblies composed of amphiphilic helical peptides**

Tsuguaki Uebayashi, *Kyoto*

**P-5**

**SiO<sub>2</sub> nanocolumns as a seed layer for vanadium oxide nanowire growth**

Kyoko Namura, *Kyoto*

**P-6**

**Selective growth of gold nanostructures on external field-induced amorphous silicon surface**

Hiroki Itasaka, *Kyoto*

**P-7**

**Forward emission of secondary ions from phenylalanine films on SiN membranes penetrated by MeV Cu<sup>4+</sup> and C<sub>60</sub><sup>+</sup> from the backside**

Kengo Nagano, *Kyoto*

**P-8**

**Effect of surface morphology and crystal anisotropy on tensile fracture of thin film (110) single crystal silicon**

Akio Uesugi, *Kyoto*

**P-9**

**Preparation of yttrium iron garnet thin films by mist chemical vapor deposition method**

Situ Yao, *Kyoto*

**P-10**

**Optimization approaches for 3D lithography utilizing DMD maskless exposure system**

Xiaoxu Ma, *Kyoto*

**P-11**

**RUMS: Rolled up microsystem simulation**

Maryam Bahrami, *Freiburg*

**P-12**

**Propagation of elementary excitations probed by scanning near field optical microscopy**

Akio Kaneta, *Kyoto*

**P-13**

**Narrow-field illumination of single NPC by TIRF microscopy**

Oghenechukome Lolodi, *Kyoto*

**P-14**

**Surface potential measurement of fulleren ultrathin films by FM-KFM**

Akihiro Noda, *Kyoto*

**P-15**

**Local impedance measurements of organic field-effect transistors by frequency-modulation scanning impedance microscopy**

Tomoharu Kimura, *Kyoto*

**P-16**

**Folding and unfolding of single stranded RNA under different environments revealed with atomic force microscopy**

Katashi Deguchi, *Kyoto*

**P-17**

**Revealing the mechanical properties of DNA origami with AFM based force microscopy**

Zhipeng Ma, *Kyoto*

**P-18**

**Micro-integrated gradient system for magnetic resonance microscopy**

Markus Meissner, *Freiburg*

**P-19**

**Vibration-coupling control of out-of-plane coupled resonators for anti-shock tuning fork gyroscopes**

Thakur Praveen Singh, *Kyoto*

**P-20**

**A numerical study on combined device of memory and logic gate in a MEMS resonator**

Atsushi Yao, *Kyoto*

**P-21**

**Ultracompact optrode with integrated laser diode chips and SU-8 waveguides for optogenetic applications**

Frederick Pothof, *Freiburg*

**P-22**

**A double-side-drive MEMS optical chopper for dynamic stress measurement of single crystalline silicon resonator using time-resolved micro raman spectroscopy**

Yusuke Kogita, *Kyoto*

**P-23**

**mEDC-miniaturized electronic depth control probes for MR compatible recording and stimulation in freely behaving mice**

Florian Larramendy, *Freiburg*

**P-24**

**Manipulating cell sorting in MSC/Islet multicellular spheroids**

Ian T. Hoffecker, *Kyoto*

**P-25**

**High-throughput screening platform for engineered microenvironments for human pluripotent stem cells**

Yasumasa Mashimo, *Kyoto*

**P-26**

**Preconcentration of biomacromolecules by isotachopheresis for effective cell**

**electroporation**

Yuko Juri, *Kyoto*

**P-27**

**Solvent dependent shift of fluorescence properties of fluorescent proteins**

Hideaki Konishi, *Kyoto*

**P-28**

**mRNA expression of mechanically stimulated mouse embryonic stem cell during the differentiation process**

Hiroshi Fujimoto, *Kyoto*

**P-29**

**Development of dynamic micro channel toward intracellular transport reconstruction driven by kinesin**

Kazuya Fujimoto, *Kyoto*

**P-30**

**Electrophoretic mobility measurement of DNA-labeled microtubules toward the evaluation of the charge effect of microtubule**

Suguru Ando, *Kyoto*

**P-31**

**Detection of tau isoforms and mutations by kinesin-microtubule gliding assay**

Subramaniyan Parimalam Subhathirai, *Kyoto*

**P-32**

**Integration of DNA origami into MEMS**

Yuto Mori, *Kyoto*

