2021 IEEE 34th International Conference on Micro Electro Mechanical Systems (MEMS 2021)

Virtual Conference
25-29 January 2021

Pages 1-516

IEEE Catalog Number: CFP21MEM-POD
ISBN: 978-1-6654-3024-1

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP21MEM-POD
ISBN (Print-On-Demand):	978-1-6654-3024-1
ISBN (Online):	978-1-6654-1912-3
ISSN:	1084-6999

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

MEMS 2021 PROGRAM SCHEDULE

Day 1 - Monday, 25 January

Welcome Address

07:45 **MEMS 2021 Conference Chairs**
Philip Feng, *University of Florida, USA*
Niclas Roxhed, *KTH Royal Institute of Technology, SWEDEN*
Haixia "Alice" Zhang, *Peking University, CHINA*

IEEE Electron Devices Society Robert Bosch Micro and Nano Electro Mechanical Systems Award

08:00 **Award Recipient**
Chang-Jin “CJ” Kim
University of California, Los Angeles, USA

Plenary Speaker Presentation I

08:15 **MICROTECHNOLOGIES AND NANOTECHNOLOGIES IN DRUG DELIVERY** **1**
Robert S. Langer
Massachusetts Institute of Technology, USA

09:00 - 09:05 Transition Break

Session Ia - Laser Machining & 3D Structures

09:05 **MICRO HEMISPHERICAL RESONATORS WITH QUALITY FACTOR OF 1.18 MILLION FABRICATED VIA LASER ABLATION** **6**
Yan Shi[1], Kun Lu[1], Bin Li[1], Yimo Chen[1], Xiang Xi[1], Yulie Wu[1], Xuezhong Wu[1,2], and Dingbang Xiao[1,2]
[1]National University of Defense Technology, CHINA and [2]Hunan MEMS Research Center, CHINA

09:20 **3D NANOPRINTED EXTERNAL MICROFLUIDIC STRUCTURES *VIA EX SITU* DIRECT LASER WRITING** **10**
Ruben Acevedo, Ziteng Wen, Ian B. Rosenthal, Emmett Z. Freeman,
Michael Restaino, Noemi Gonzalez, and Ryan D. Sochol
University of Maryland, College Park, USA

09:35 **MICROMACHINED MULTI-ION SOURCES INTEGRATED MICRO-FLUIDIC CHANNELS** **14**
Nguyen-Van Chinh, Le-Van Minh, Takahito Ono, and Hiroki Kuwano
Tohoku University, JAPAN

Session Ib - Drug Delivery

09:05 **A DISSOLVABLE MICRONEEDLE PATCH BASED ON MEDICAL ADHESIVE TAPE FOR TRANSDERMAL DRUG DELIVERY** **18**
Tingyu Li[1,2], Junshi Li[1], Zhongyan Wang[1], Yingjie Ren[1,2], Yufeng Jin[2], Dong Huang[1], Qining Wang[1], and Zhihong Li[1]
[1]Peking University, CHINA and [2]Peking University Shenzhen Graduate School, CHINA

09:20 **FIRST MICRO SWIRL NOZZLE FOR FAST DRUG DELIVERY TO THE LUNG** **22**
Torben S. Last, Göran Stemme, and Niclas Roxhed,
KTH Royal Institute of Technology, SWEDEN

09:35 **ULTRASOUND-TRIGGERED DRUG RELEASE FROM HYDROGEL MICROSPHERES WITH RELEASE BOOSTER** **26**
Takeshi Kubota[1], Yuta Kurashina[2], and Hiroaki Onoe[1]
[1]Keio University, JAPAN and [2]Tokyo Institute of Technology, JAPAN

Session Ic - Self-Powered/Wireless Sensors & Actuators

09:05 **AN ELECTROSPUN PVDF-TRFE/MXENE NANOFIBOURS MAT-BASED SELF-POWERED MOTION SENSOR** **30**
S M Sohel Rana, M. Toyabur Rahman, M. Salauddin, Hyunok Cho, and Jae Y. Park
Kwangwoon University, KOREA

09:20 **DOUBLE-SIDED LASER-INDUCED GRAPHENE BASED SMART BRACELET FOR SENSING AND ENERGY** **34**
Haobin Wang, Zehua Xiang, Ji Wan, Yu Song, and Haixia Zhang
Peking University, CHINA

09:35 **DUAL-TRANSDUCTION ELECTROMECHANICAL RECEIVER FOR NEAR-FIELD WIRELESS POWER TRANSMISSION** **38**
Spencer E. Smith, Miah A. Halim, Adrian A. Rendon-Hernandez, and David P. Arnold
University of Florida, USA

09:50 – 09:55 Transition Break

Flash Poster Presentation I

09:55 - 10:30

Poster Session I

10:30 – 11:30 **Presentations are listed by topic category with their assigned number starting on page 19.**

11:35 – 11:35 Transition Break

Invited Speaker Presentation Ia

11:35 **TUBULAR MICROMOTORS AND MICROROBOTS FOR BIOMEDICAL APPLICATIONS**
Oliver G. Schmidt
Institute for Integrative Nanosciences, Leibniz IFW Dresden, GERMANY

Invited Speaker Presentation Ib

12:05 - 12:10 Transition Break

Session IIa - Robot/Tactile Sensors

Session IIb - Nanofabrication & Surface Engineering

Session IIc - Actuators

12:10 **STIFFNESS-TUNABLE MICROSTRUCTURES BASED ON ELECTROTHERMAL BIMORPH BEAMS** **79**
Lei Xiao[1], Yingtao Ding[1], Peng Wang[2], Hengzhang Yang[1], and Huikai Xie[1]
[1]Beijing Institute of Technology, CHINA and [2]Wuxi WiO Technologies, Co. Ltd., CHINA

12:25 **MULTI-WAY IN-PHASE/OUT-OF-PHASE DRIVING CANTILEVER ARRAY FOR PERFORMANCE ENHANCEMENT OF PZT MEMS MICROSPEAKER** **83**
Yi-Jia Wang[1], Sung-Cheng Lo[1], Meng-Lin Hsieh[1], Shao-Da Wang[1], Yu-Chen Chen[1], Mingching Wu[2], and Weileun Fang[1]
[1]National Tsing Hua University, TAIWAN and [2]Coretronic MEMS Co., LTD, TAIWAN

12:40 **MODELING MATERIAL NONLINEARITIES IN PIEZOELECTRIC FILMS: QUASI-STATIC ACTUATION** **85**
Andrea Opreni[1], Nicoló Boni[2], Gianluca Mendicino[2], Massimiliano Merli[2], Roberto Carminati[2], and Attilio Frangi[1]
[1]Politecnico di Milano, ITALY and [2]STMicroelectronics, ITALY

12:55 **DUAL-AXIS RESONANT SCANNING MEMS MIRROR WITH PULSED-LASER-DEPOSITED BARIUM-DOPED PZT** **89**
Adrien Piot, Jaka Pribošek, and Mohssen Moridi
Silicon Austria Labs, AUSTRIA

13:10 Adjourn for the day

Day 2 - Tuesday, 26 January

Plenary Speaker Presentation II

08:00 **RECENT ADVANCES IN FLEXIBLE OPTOELECTRONICS** ..... **N/A**
Wei Huang
Northwestern Polytechnical University, CHINA

08:45 – 08:50 Transition Break

Session IIIa - Wearables

08:50 **DESIGN AND FABRICATION OF FLEXIBLE TWO-PHASE HEAT TRANSPORT DEVICE FOR WEARABLE INTERFACES** **95**
Kenya Sugimoto, Abdulkareem Alasli, Ai Ueno, and Hosei Nagano
Nagoya University, JAPAN

09:05 **A BIOINSPIRED WIRELESS EPIDERMAL PHOTORECEPTOR FOR SMART UV PROTECTION AND PHYSIOLOGICAL MONITORING** **99**
Yujia Zhang[1,2], Mengwei Liu[1,2], and Tiger H. Tao[1,2,3,4,5]
[1]Chinese Academy of Sciences (CAS), CHINA, [2]University of Chinese Academy of Sciences, CHINA, [3]ShanghaiTech University, CHINA, [4]Institute of Brain-Intelligence Technology, CHINA, and [5]Shanghai Research Center for Brain Science and Brain-Inspired Intelligence, CHINA

09:20 **WEARABLE PIEZOELECTRIC THIN-FILM BASED BREATH SENSING DEVICE WITH HIGHLY SENSITIVE AMMONIA DETECTION ABILITY FOR EXAMINING KIDNEY DISEASE** **103**
Guo-Hua Feng[1] and Pin-Cheng Su[2]
[1]National Tsing Hua University, TAIWAN and [2]National Chung Cheng University, TAIWAN

09:35 **SELF-POWERED HYBRID WEARABLE E-SKIN FOR ARTIFICIAL INTELLIGENCE SENSING SYSTEM** **107**
Jiayi Yang, Wei Xu, Shuangshuang Liu, Sida Liu, Di Feng, Yan Meng, and Meiqi Wang
Beijing Jiaotong University, CHINA

Session IIIb - Particle Handling

08:50 **ULTRAHIGH RESOLUTION ON-CHIP SEPARATION SYSTEM USING NEGATIVE MAGNETOPHORESIS** **111**
Lin Zeng, Xi Chen, Jing Du, Zitong Yu, Rongrong Zhang, Yi Zhang, and Hui Yang
Chinese Academy of Sciences (CAS), CHINA

09:05 **CONTINUOUS-FLOW ELECTROKINETIC ENRICHMENT/SEPARATION OF NANOPARTICLES USING 3D MICROELECTRODE TRACKS** **115**
Zili Tang, Stanley D. Kushigbor, and Levent Yobas
Hong Kong University of Science and Technology, HONG KONG

09:20 **ONE-STEP SYNTHESIS OF MAGNETIC HYDROGEL MICROPARTICLES BASED ON ACOUSTIC MICROFLUIDICS** **119**
Shanbo Jin[1], Ziwei Yang[1] Juan Ren[2], Zhuangde Jiang[1], and Xueyong Wei[1]
[1]Xi'an Jiaotong University, CHINA and [2]Chang'an University, CHINA

09:35 **MAGNETIC FORCE-BASED MICROFLUIDIC CHIP FOR PLANT SEED LEVITATION TO SIMULATE MICROGRAVITY ENVIRONMENT** **123**
Jing Du, Lin Zeng, Zitong Yu, Xi Chen, Yi Zhang, and Hui Yang
Chinese Academy of Sciences (CAS), CHINA

Session IIIc - Tactile & Pressure Sensors

08:50 **DEVELOPMENT OF FLEXIBLE HAPTIC DEVICE BASED ON ULTRA-THIN PZT/SILICON VIBRATOR ARRAY** **127**
Toshihiro Takeshita[1], Takahiro Yamashita[1], Toshiyuki Tsubakimoto[2], Hidetoshi Nishio[2], Hiroyuki Okuno[2], Takuto Ohzawa[2], and Takeshi Kobayashi[1]
[1]National Institute of Advanced Industrial Science and Technology (AIST), JAPAN and [2]OMRON Corporation, JAPAN

09:05 **A BIDIRECTIONAL CMOS MEMS THERMAL WALL SHEAR STRESS SENSOR WITH IMPROVED SENSITIVITY AND LOW POWER CONSUMPTION** **131**
Xiaoyi Wang[1,2], Yifei Guo[1], Xu Zhao[2], and Wei Xu[1]
[1]Shenzhen University, CHINA and [2]Hong Kong University of Science and Technology, HONG KONG

09:20 **A WIRELESS CARDIOVASCULAR PRESSURE SENSOR BASED ON AN IONTRONIC FILM WITH HIGH SENSITIVITY** **135**
Ming-Xian Cai and Yao-Joe Yang
National Taiwan University, TAIWAN

09:35 **AN ANTENNA-SHAPED MEMS TACTILE SENSOR WITH ANGLE DETECTION CAPABILITY** **139**
Hayahide Oka[1], Kyohei Terao[1], Fusao Shimokawa[1], and Hidekuni Takao[1,2]
[1]Kagawa University, JAPAN and [2]Japan Science and Technology Agency (JST), JAPAN

09:50 – 09:55 Transition Break

Flash Poster Presentation I

09:55 - 10:30

Poster Session II

10:30 – 11:30 **Presentations are listed by topic category with their assigned number starting on page 19.**

11:35 – 11:35 Transition Break

Invited Speaker Presentation IIa

11:35 **NEAR-ZERO POWER INTEGRATED MICROSYSTEMS FOR THE IoT** **143**
Sungho Kang, Vageeswar Rajaram, Sila Deniz Calisgan, Antea Risso, Zhenyun Qian and **Matteo Rinaldi**
Northeastern University, USA

Invited Speaker Presentation IIb

11:35 **BEYOND-MATERIALS FOR SUSTAINABLE POWER GENERATION** **149**
Miso Kim
Korea Research Institute of Standards and Science (KRISS), KOREA

12:05 - 12:10 Transition Break

Session IVa - Resonators

Session IVb - Microdroplets

Session IVc - Accelerometers

13:10 Adjourn for the day

Day 3 - Wednesday, 27 January

Plenary Speaker Presentation III

08:00 **MICROELECTROMECHANICAL SYSTEMS IN THE QUANTUM LIMIT** ..... **N/A**
Andrew N. Cleland
University of Chicago, USA

08:45 – 08:50 Transition Break

Session Va - GHz Acoustic Resonators

08:50 **ALUMINUM NITRIDE COMBINED OVERTONE RESONATOR FOR MILLIMETER WAVE 5G APPLICATIONS** **202**
Meruyert Assylbekova[1], Guofeng Chen[2], Michele Pirro[1], Giuseppe Michetti[1], and Matteo Rinaldi[1]
[1]Northeastern University, USA and [2]Skyworks Solutions, Inc, USA

09:05 **PHONON DIFFRACTION LIMITED PERFORMANCE OF FABRY-PÉROT CAVITIES IN PIEZOELECTRIC EPI – HBARS** **206**
Vikrant J. Gokhale, Brian P. Downey, D. Scott Katzer, and David J. Meyer
US Naval Research Laboratory, USA

09:20 **X-BAND AOM ON CHIP** **210**
Hao Tian[1], Junqiu Liu[2], Anat Siddharth[2], Terence Blésin[2], Tobias J. Kippenberg[2], and Sunil A. Bhave[1]
[1]Purdue University, USA and [2]École Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND

09:35 **THERMAL CHARACTERIZATION OF FERROELECTRIC ALUMINUM SCANDIUM NITRIDE ACOUSTIC RESONATORS** **214**
Jialin Wang, Mingyo Park, and Azadeh Ansari
Georgia Institute of Technology, USA

Session Vb - Microfluidic Control /Organ on Chip

08:50 **TRANSISTOR *OFF*-VALVE BASED FEEDBACK, METERING AND LOGIC OPERATIONS IN CAPILLARY MICROFLUIDICS** **218**
Claude Meffan, Julian Menges, Fabian Dolamore, Conan Fee, RenWICK Dobson, and Volker Nock
University of Canterbury, NEW ZEALAND

09:05 **"BEND-AND-BOND" POLYMER MICROFLUIDIC ORIGAMI** **222**
Weijin Guo[1,2], Jonas Hansson[1], Linnea Gustafsson[1], and Wouter van der Wijngaart[1]
[1]KTH Royal Institute of Technology, SWEDEN and [2]Shantou University, CHINA

09:20 **FABRICATION AND CHARACTERIZATION OF 3D MICROELECTRODE ARRAYS (3D MEAS) WITH "EDGE-WRAPPED" METAL INTERCONNECTS AND 3D-PRINTED ASSEMBLY RIGS FOR SIMULTANEOUS OPTICAL AND ELECTRICAL PROBING OF NERVE-ON-A-CHIP® CONSTRUCTS** **226**
Charles M. Didier[1], Corey Rountree[2], Julia Freitas Orrico[1], Avra Kundu[1], Nilab Azim[1], Hieu Nguyen[2], Syed K. Pasha[1], Laurie McCoy[2], J. Lowry Curley[2], Michael J. Moore[2,3], and Swaminathan Rajaraman[1]
[1]University of Central Florida, USA, [2]AxoSim Inc., USA, and [3]Tulane University, USA

09:35 **SHAPE RETAINING AND SACRIFICIAL MOLDING FABRICATION METHOD FOR ECM-BASED *IN VITRO* VASCULAR MODEL** **230**
Jumpei Muramatsu[1], Wei Huang Goh[2], Azusa Shimizu[1], Kenya Hashimoto[1], Michinao Hashimoto[2], Shigenori Miura[3], and Hiroaki Onoe[1]
[1]Keio University, JAPAN, [2]Singapore University of Technology and Design, SINGAPORE, and [3]University of Tokyo, JAPAN

Session Vc - Energy Harvesting

08:50 **CYLINDRICAL ELECTRET ENERGY HARVESTER WITH PERFORATED ELECTRODE FOR INTRACARDIAC PACEMAKERS** **234**
Wei-De Wang, Chia-Chun Hsieh, and Yi Chiu
National Chiao Tung University, TAIWAN

09:05 **ENHANCING THE OUTPUT CHARGE DENSITY OF TRIBOELECTRIC NANOGENERATOR VIA BUILDING CHARGE BLOCKING LAYER** **238**
Lingxiao Gao, Xin Chen, Fayang Wang, Daqiao Tong, Xianming He, and Xiaojing Mu
Chongqing University, CHINA

09:20 **PIEZOELECTRIC TANTALUM ALUMINUM NITRIDE FILMS FOR VIBRATIONAL MICRO ENERGY HARVESTERS** **242**
Le Van Minh and Hiroki Kuwano
Tohoku University, JAPAN

09:35 **MICROMACHINED FLEXIBLE SEMI-TRANSPARENT SILICON SOLAR CELLS AS POWER SOURCES FOR MICROSYSTEMS** **246**
Erfan Pourshaban, Aishwaryadev Banerjee, Chayanjit Ghosh,
Adwait Deshpande, Hanseup Kim, and Carlos H. Mastrangelo
University of Utah, USA

09:50 – 09:55 Transition Break

Flash Poster Presentation I

09:55 - 10:30

Poster Session III

10:30 – 11:30 **Presentations are listed by topic category with their assigned number starting on page 19.**

11:35 – 11:35 Transition Break

Invited Speaker Presentation IIIa

11:35 **IMPLANTABLE BRAIN COMPUTER INTERFACE DEVICES BASED ON MEMS TECHNOLOGY** **250**
Long-Chun Wang, Zhe-Jun Guo, Ye Xi, Ming-Hao Wang, Bo-Wen Ji,
Hong-Chang Tian, Xiao-Yang Kang, and **Jing-Quan Liu**
Shanghai Jiao Tong University, CHINA

Invited Speaker Presentation IIIb

11:35 **MEMS-ENABLED QUANTUM ATOMIC MAGNETOMETERS** **256**
Sean Krzyzewski[1], Orang Alem[1,2], and **Svenja A. Knappe**[1,2]
[1]University of Colorado, Boulder, USA and [2]FieldLine Inc., USA

12:05 - 12:10 Transition Break

Session VIa - Bio Electrodes

Session VIb - Thermal & Gas Sensors

Session VIc - Optical MEMS

13:10 Adjourn for the day

Day 4 - Thursday, 28 January

Plenary Speaker Presentation IV

08:00 **EXPLORING SYNERGY BETWEEN DRUG DELIVERY AND MEMS** ..... **N/A**
Anja Boisen
Technical University of Denmark, DENMARK

MEMS 2022 Announcement

09:00 - 09:05 Transition Break

Session VIIa - Biomarker Detection

09:05 **DETECTION OF METHYLATED CELL-FREE DNA FOR DIAGNOSIS AND PROGNOSIS OF OVARIAN CANCER ON AN INTEGRATED MICROFLUIDIC SYSTEM** **310**
Yu-Jen Cheng, Chih-Hung Wang, and Gwo-Bin Lee
National Tsing Hua University, TAIWAN

09:20 **HIGH-ENTROPY ALLOY NANOPARTICLES AS CATALYST FOR NANOMOLAR-LEVEL DETECTION OF NEUROTRANSMITTER SEROTONIN IN SERUM** **314**
Ming Li[1,2], Xuefeng Wang[1,2], Yarong Cheng[1,3], Li Su[1,3], Pengcheng Xu[1,2], and Xinxin Li[1,2]
[1]Chinese Academy of Sciences (CAS), CHINA, [2]University of Chinese Academy of Sciences, CHINA, and [3]Shanghai Normal University, CHINA

09:35 **AN INTEGRATED MICROFLUIDIC SYSTEM FOR EARLY DIASNOSIS OF BREAST CANCER IN LIQUID BIOPSY BY USING MICRORNA AND FET BIOSENSORS** **318**
Chi-Chien Huang, Yu-Husan Kuo, Yi-Sin Chen, and Gwo-Bin Lee
National Tsing Hua University, TAIWAN

Session VIIb: Humidity Sensors

09:05 **HIGHLY SENSITIVE AND FAST-RESPONSE HUMIDITY SENSOR BASED ON SAW RESONATOR AND MOS_2 FOR HUMAN ACTIVITY DETECTION** **322**
Hanyong Dong, Dongsheng Li, Jintao Pang, Qian Zhang, and Jin Xie
Zhejiang University, CHINA

09:20 **MICROMACHINED SILICON CANTILEVER RESONATOR-BASED HUMIDITY SENSORS FOR MULTIFUNCTIONAL APPLICATIONS** **326**
Jiushuai Xu and Erwin Peiner
Technische Universität Braunschweig, GERMANY

09:35 **A HIGHLY SENSITIVE HUMIDITY SENSOR BASED ON NANOFORESTS** **330**
Guidong Chen[1,2], Xin Dai[3], Yang Liu[1,2], Haiyang Mao[1,2,3], and Dapeng Chen[1,2]
[1]Chinese Academy of Sciences (CAS), CHINA, [2]University of Chinese Academy of Sciences, CHINA and [3]Jiangsu Hinovaic Technologies Co., Ltd, CHINA

Session VIIc: Gyroscopes

09:05 **AN ANTI-ALIASING AND SELF-CLOCKING ΣΔM COBWEB-LIKE DISK RESONANT GYROSCOPE WITH EXTENDED INPUT RANGE** **334**
Fang Chen[1], Zuxiang Wen[2], Dacheng Xu[2], Wei Zhou[1], and Xinxin Li[1]
[1]Chinese Academy of Sciences (CAS), CHINA and [2]Soochow University, CHINA

09:20 **DESIGN OF PIEZOELECTRIC MEMS BULK ACOUSTIC WAVE MODE-MATCHED GYROSCOPES BASED ON SUPPORT TRANSDUCER** **338**
Ngoc Minh Nguyen, Chin-Yu Chang, Gayathri Pillai, and Sheng-Shian Li
National Tsing Hua University, TAIWAN

09:35 **A STUDY OF MODE-MATCHING AND ALIGNMENT IN PIEZOELECTRIC DISK RESONATOR GYROS VIA FEMTOSECOND LASER ABLATION** **342**
Zhenming Liu, Anosh Daruwalla, Benoit Hamelin, and Farrokh Ayazi
Georgia Institute of Technology, USA

09:50 – 09:55 Transition Break

Flash Poster Presentation I

09:55 - 10:30

Poster Session IV

10:30 – 11:30 **Presentations are listed by topic category with their assigned number starting on page 19.**

11:35 – 11:35 Transition Break

Invited Speaker Presentation IVa

11:35 **DEVELOP MICRO/NANO TECHNOLOGIES FOR CANCER DIAGNOSIS** **346**
Si-Yang Zheng
Carnegie Mellon University, USA

Invited Speaker Presentation IVb

11:35 **IoT4Ag: MEMS-ENABLED DISTRIBUTED SENSING, COMMUNICATIONS, AND INFORMATION SYSTEMS FOR THE INTERNET OF THINGS FOR PRECISION AGRICULTURE** **350**
Cherie R. Kagan[1], David P. Arnold[2], Mark G. Allen[1], and Roy H. Olsson[1]
[1]University of Pennsylvania, USA and [2]University of Florida, USA

12:05 - 12:10 Transition Break

Session VIIIa - DNA/RNA Sensing

12:10 **SAPPHIRE-SUPPORTED NANOPORES FOR LOW-NOISE DNA SENSING** **354**
Pengkun Xia, Jiawei Zuo, Shinhyuk Choi, Xiahui Chen, Jing Bai, and Chao Wang
Arizona State University, USA

12:25 **HIGHLY SENSITIVE AND HIGHLY MULTIPLEXED CELL-FREE DNA GENOTYPING USING 7.7X10^4-WELL DIGITAL PCR WITH MELTING CURVE ANALYSIS** **358**
Tatsuo Nakagawa, Junko Tanaka, Kazuma Matsui, Kunio Harada, Akiko Shiratori, and Chihiro Uematsu
Hitachi, Ltd., JAPAN

12:40 **A HIGH-THROUGHPUT NANOFLUIDIC DEVICE FOR SMALL EXTRACELLULAR VESICLE NANOPORATION** **362**
Rui Hao[1], Zitong Yu[1], Jing Du[1], Hang Guo[2], Yi Zhang[1], and Hui Yang[1]
[1]Chinese Academy of Sciences (CAS), CHINA and [2]Xiamen University, CHINA

Session VIIIb - MEMS for Harsh Environment

Session VIIIc - Ultrasonic Transducers

13:10 Adjourn for the day

Day 5 - Friday, 29 January

Plenary Speaker Presentation V

08:00 **BERKELEY LIGHTS: MEMS TECHNOLOGY TO ENABLE A SCALABLE AND SUSTAINABLE CELL-BASED FUTURE** ..... **N/A**
Eric D. Hobbs
Berkeley Lights, Inc., USA

08:45 – 08:50 Transition Break

Session IXa - Organ on Chip

08:50 **THREE-DIMENSIONAL MICROFLUIDIC DRUG SCREENING PLATFORM TO STUDY VASCULARIZED HEPATOCELLULAR CARCINOMA IN HYPOXIC CONDITION** **403**
Jungeun Lim, Hyeri Choi, and Noo Li Jeon
Seoul National University, KOREA

09:05 **ENGINEERING MICROSCALE BIOMIMETIC HYDROSCAFFOLD FOR DYNAMIC THREE-DIMENSIONAL MODELING OF PANCREATIC CANCER** **407**
Frédérick De Miollis[1,2], Zied Souguir[3], Charles Poiraud[2], Joseph de Saxcé[2], Lucie Dercourt[1], Elodie Vandenhaute[3], Audrey Vincent[2], Nathalie Maubon[3], Isabelle Van Seuningen[2], and Vincent Senez[1]
[1]CNRS, FRANCE, [2]University of Lille, FRANCE, and [3]HCS Pharma, FRANCE

09:20 **HIGHLY ACCURATE MEASUREMENT OF TRANS-EPITHELIAL ELECTRICAL RESISTANCE IN ORGAN-ON-A-CHIP** **411**
Takashi Miyazaki[1], Jiandong Yang[1], Satoshi Imamura[1], Yoshikazu Hirai[1], Ken-ichiro Kamei[1], Toshiyuki Tsuchiya[1], and Osamu Tabata[1,2]
[1]Kyoto University, JAPAN and [2]Kyoto University of Advanced Science, JAPAN

09:35 **EVALUATION OF TRANS-EPITHELIAL ELECTRICAL RESISTANCE OF PROXIMAL TUBULE TISSUE BY INCLUSION AND REMOVAL OF EXTRACELLULAR CALCIUM ION** **415**
Yuji Takata[1], Ryohei Ueno[1], Ramin Banan Sadeghian[1], Kaori Naganuma[2], Kiyotaka Tsuji[2], and Ryuji Yokokawa[1]
[1]Kyoto University, JAPAN and [2]Panasonic Corporation, JAPAN

Session IXb - PMUT Sensors

08:50 **A PMUT-BASED ULTRASONIC PROBE USED FOR CONTACT FORCE SENSING** **419**
Tingzhong Xu, Libo Zhao, Zixuan Li, Jiawei Yuan, Yihe Zhao, Guoxi Luo, Jie Li, Zhiakang Li, Ping Yang, and Zhuangde Jiang
Xi'an Jiaotong University, CHINA

09:05 **PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS FOR BLOOD VESSEL MOTION TRACKING** **423**
Xiaoyue (Joy) Jiang[1], Vincent Perrot[2,3], François Varray[2], Mei-Lin Chan[1], Bala Govind[1], Stephen Bart[1], and Peter Hartwell[1]
[1]TDK InvenSense, USA, [2]University Lyon, FRANCE, and [3]Polytechnique Montréal, CANADA

09:20 **AlN BASED PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS FOR CONTINUOUS MONITORING OF THE MECHANO-ACOUSTIC CARDIOPULMONARY SIGNALS** **426**
Licheng Jia, Lei Shi, Chengliang Sun, Sheng Liu, and Guoqiang Wu
Wuhan University, CHINA

Session IXc - Gas Sensors

08:50 **A NOVEL LOW POWER HEXAGONAL GAS SENSOR CELL FOR MULTI-CHANNEL GAS DETECTION** **430**
Dongcheng Xie, Ruichen Liu, George Adedokun, Lei Xu, and Feng Wu
University of Science and Technology of China, CHINA

09:05 **PLANAR LAB-ON-A-CHIP MICRO MASS SPECTROMETER WITH TIME-OF-FLIGHT SEPARATION** **434**
Stephan Westerdick, Bent Walther, Patrick Hermanns, Florian Fricke, and Thomas Musch
Ruhr University Bochum, GERMANY

09:20 **RAPID GAS SENSING BASED ON PULSE HEATING AND DEEP LEARNING** **438**
Yushen Hu, Ye Tian, Yi Zhuang, Changhui Zhao, and Fei Wang
Southern University of Science and Technology, CHINA

09:35 **A HIGH RESPONSE THREE-DIMENSIONAL Ag NANOPARTICLES/RGO MICROTUBULAR FIELD EFFECT TRANSISTOR SENSOR FOR NO_2 DETECTIONS** **442**
Jingye Sun[1], Weijie Yin[1], Ying Zhang[1], Yang Zhang[1], Mingqiang Zhu[1], Hao Hong[2], Qiming Tian[3], Juntao Qi[3], Yutao Ba[3], and Tao Deng[1]
[1]Beijing Jiaotong University, CHINA, [2]Tsinghua University, CHINA, and [3]Insights Value Technology, CHINA

09:50 – 09:55 Transition Break

Flash Poster Presentation I

09:55 - 10:30

Poster Session V

10:30 – 11:30 **Presentations are listed by topic category with their assigned number starting on page 19.**

11:35 – 11:35 Transition Break

Invited Speaker Presentation Va

11:35 **WHAT DOES A CELL SECRETE? ON-CHIP ANALYSIS OF COMPOUNDS AND VESICLES RELEASED FROM SINGLE CELLS** **446**
Petra S. Dittrich
ETH Zurich, Basel, SWITZERLAND

Invited Speaker Presentation Vb

11:35 **THIN FILM DEVICES FOR 5G COMMUNICATIONS** **450**
Soumya Yandrapalli, Marco Liffredo, Muhammad Faizan, Seniz Küçük, Damien Maillard, and **Luis Guillermo Villanueva**
École Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND

12:05 – 12:10 Transition Break

Session Xa - Cell Handling/Analysis

12:10 **REAL-TIME THREE-DIMENSIONAL SINGLE-CELL-RESOLUTION MONITORING SYSTEM FOR OBSERVATION OF DYNAMIC CELL BEHAVIOR UNDER MECHANICAL STIMULI** **454**
Keitaro Kasahara[1], Yuta Kurashina[2], Shigenori Miura[3], Shogo Miyata[1], and Hiroaki Onoe[1]
[1]Keio University, JAPAN, [2]Tokyo Institute of Technology, JAPAN, and [3]University of Tokyo, JAPAN

12:25 **OXYGEN-TRANSPORTING PARYLENE-HT MESH FOR CELL TRANSPLANTATION TO REDUCE HYPOXIA** **458**
Kuang-Ming Shang[1], Hirotake Komatsu[2], and Yu-Chong Tai[1]
[1]California Institute of Technology, USA and [2]Beckman Research Institute of City of Hope, USA

12:40 **FEMTOSECOND LASER-INDUCED RESPONSE WAVE MEASURING METHOD FOR SINGLE CELL CHARACTERIZATION** **462**
Tang Tao[1], Yansheng Hao[1], Yo Tanaka[2], Yoichiroh Hosokawa[1], and Yalikun Yaxiaer[1]
[1]Nara Institute of Science and Technology, JAPAN and
[2]Institute of Physical and Chemical Research (RIKEN), JAPAN

Session Xb - $LiNbO_3$ and WBG Resonators

12:10 **LITHIUM NIOBATE THIN FILM BASED A3 MODE RESONATORS WITH HIGH EFFECTIVE COUPLING COEFFICIENT OF 6.72%** **466**
Yi Zhang[1], Liang Wang[2], Yang Zou[1], Qinwen Xu[1], Jieyu Liu[1], Qing Wang[2], Alexander Tovstopyat[1], Wenjuan Liu[1], Chengliang Sun[1], and Hongyu Yu[2,3,4]
[1]Wuhan University, CHINA, [2]Southern University of Science and Technology, CHINA,
[3]Shenzhen Institute of Wide-bandgap Semiconductors, CHINA, and [4]Ministry of Education, CHINA

12:25 **A THIN-FILM PIEZO-SILICON ACOUSTOELECTRIC ISOLATOR WITH MORE THAN 30 DB NON-RECIPROCAL TRANSMISSION** **470**
Hakhamanesh Mansoorzare and Reza Abdolvand
University of Central Florida, USA

12:40 **LOW LOSS AND WIDEBAND SURFACE ACOUSTIC WAVE DEVICES IN THIN FILM LITHIUM NIOBATE ON INSULATOR (LNOI) PLATFORM** **474**
Tzu-Hsuan Hsu, Feng-Chieh Su, Kuan-Ju Tseng, and Ming-Huang Li
National Tsing Hua University, TAIWAN

12:55 **TEMPERATURE DEPENDENCE OF MULTIMODE GALLIUM NITRIDE/ALUMINUM NITRIDE (GaN/AlN) HETEROSTRUCTURE STRING RESONATOR** **478**
Wen Sui[1], Xu-Qian Zheng[1], Ji-Tzuoh Lin[2], Bruce W. Alphenaar[2], and Philip X.-L. Feng[1]
[1]University of Florida, USA and [2]University of Louisville, USA

13:10 Conference Adjourns

POSTER PRESENTATIONS

M –	Monday, 25 January	10:30 - 11:30	**Th** –	Thursday, 28 January	10:30 - 11:30
T –	Tuesday, 26 January	10:30 - 11:30	**F** –	Friday, 29 January	10:30 - 11:30
W –	Wednesday, 27 January	10:30 - 11:30			

Classification Chart
(last character of poster number)

a	**Bio & Medical MEMS**
b	**Emerging Technologies & New Opportunities for MEMS/NEMS**
c	**Materials, Fabrication and Packaging for Generic MEMS & NEMS**
d	**MEMS Actuators & Power MEMS**
e	**MEMS Physical & Chemical Sensors**
f	**MEMS/NEMS for Optical, RF and Electromagnetics**
g	**Micro- & Nanofluidics**
h	**Industry MEMS and Advancing MEMS for Products and Sustainability**

a - Bio & Medical MEMS
Biosensors and Bioreactors

a - Bio & Medical MEMS
Devices & Systems for Cellular and Molecular Studies

a - Bio & Medical MEMS
Flexible and Wearable Devices and Systems

a - Bio & Medical MEMS
Manufacturing for Bio- & Medical MEMS & Microfluidics

a - Bio & Medical MEMS
Medical Microsystems

a - Bio & Medical MEMS
MEMS & BioMEMS for Healthcare and Public Health

a - Bio & Medical MEMS
Nanobiotechnology

a - Bio & Medical MEMS
Other Bio and Medical MEMS

a - Bio & Medical MEMS
Tissue Engineering

b - Emerging Technologies & New Opportunities for MEMS/NEMS
Machine Learning (ML) & Artificial Intelligence (AI)-Enhanced MEMS/NEMS Design, Manufacturing, and Applications

b - Emerging Technologies & New Opportunities for MEMS/NEMS
MEMS/NEMS for Advancing Scientific Instrumentation and Metrology

b - Emerging Technologies & New Opportunities for MEMS/NEMS
New Computing Devices and Systems with MEMS/NEMS

b - Emerging Technologies & New Opportunities for MEMS/NEMS
Nonlinear Dynamics in MEMS/NEMS

c - Materials, Fabrication and Packaging for Generic MEMS & NEMS
Advancement in Conventional Materials for MEMS & NEMS

c - Materials, Fabrication and Packaging for Generic MEMS & NEMS
Digital Micromanufacturing

c - Materials, Fabrication and Packaging for Generic MEMS & NEMS
Generic MEMS & NEMS Manufacturing Techniques

c - Materials, Fabrication and Packaging for Generic MEMS & NEMS
New & Emerging Materials for MEMS/NEMS

c - Materials, Fabrication and Packaging for Generic MEMS & NEMS
New Fabrication Processes for Making MEMS/NEMS

c - Materials, Fabrication and Packaging for Generic MEMS & NEMS
Packaging & Assembly

d - MEMS Actuators & Power MEMS
Actuator Components & Systems

d - MEMS Actuators & Power MEMS
Energy Harvesting Materials, Structures, and Transducers

d - MEMS Actuators & Power MEMS
Other Actuators & Power MEMS

d - MEMS Actuators & Power MEMS
Power MEMS Components & Systems

d - MEMS Actuators & Power MEMS
Self-Powered Devices and Microsystems

e - MEMS Physical & Chemical Sensors
Fluidic Sensors

e - MEMS Physical & Chemical Sensors
Force & Displacement Sensors

e - MEMS Physical & Chemical Sensors
Gas & Chemical Sensors

e - MEMS Physical & Chemical Sensors
Inertial Sensors

e - MEMS Physical & Chemical Sensors
Manufacturing Techniques for Physical Sensors

e - MEMS Physical & Chemical Sensors
Materials for Physical Sensors

e - MEMS Physical & Chemical Sensors
Metrology and Measurement Techniques for MEMS/NEMS Sensors

e - MEMS Physical & Chemical Sensors
Nanoscale Physical Sensors

e - MEMS Physical & Chemical Sensors
Other Physical Sensors

e - MEMS Physical & Chemical Sensors
Sonic & Ultrasonic MEMS Transducers

f - MEMS/NEMS for Optical, RF and Electromagnetics
Free Space Optical Components & Systems

f - MEMS/NEMS for Optical, RF and Electromagnetics
Infrared (IR) Sensors and Imaging Systems

f - MEMS/NEMS for Optical, RF and Electromagnetics
Manufacturing for Electromagnetic Transducers

f - MEMS/NEMS for Optical, RF and Electromagnetics
MEMS for Timing & Frequency Control

f - MEMS/NEMS for Optical, RF and Electromagnetics
Other Electromagnetic MEMS/NEMS

f - MEMS/NEMS for Optical, RF and Electromagnetics
Photonic Components & Systems

f - MEMS/NEMS for Optical, RF and Electromagnetics
RF MEMS Components & Systems

g - Micro- & Nanofluidics
Biological and Medical Microfluidics and Nanofluidics

g - Micro- & Nanofluidics
Generic Microfluidics & Nanofluidics

g - Micro- & Nanofluidics
Integrated/Embedded Microfluidics and Nanofluidic Systems & Platforms

g - Micro- & Nanofluidics
Manufacturing for Micro- and Nanofluidics

g - Micro- & Nanofluidics
Materials for Micro & Microfluidics

g - Micro- & Nanofluidics
Other Micro- and Nanofluidics

g - Micro- & Nanofluidics
Modeling of Micro & Nanofluidics

h - Industry MEMS and Advancing MEMS for Products and Sustainability
Measurement Methods for Product Specs

h - Industry MEMS and Advancing MEMS for Products and Sustainability
MEMS Packaging Techniques

h - Industry MEMS and Advancing MEMS for Products and Sustainability
MEMS/NEMS - CMOS Integration