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POWERMEMS 2022

Technical Program

Conference Co-Chairs
Shad Roundy, University of Utah, USA
Hanseup Kim, University of Utah, USA

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MEMS
IEEE MEMS TECHNICAL COMMUNITY

Monday, 12 December

All indicated times are Mountain Standard Time (MST).

PowerMEMS School

08:00 **Topic 1: Energy Conversion, Transfer, and Storage**

Douglas Ballroom West

- **Biofuel Cells**
  Sean Choi, *Binghamton University, USA*
- **Triboelectricity**
  Philippe Basset, *University Gustave Eiffel, FRANCE*
- **Wireless Power Transfer**
  Paul Mitcheson, *Imperial College London, UK*

Topic 2: Materials and Manufacturing Methods

Douglas Ballroom West

- **Additive Manufacturing**
  Rafal Walczak, *Wrocław University of Science and Technology, POLAND*
- **Printed Circuit Boards Inspired Manufacturing**
  Peter Woias, *Albert-Ludwig-University Freiburg, GERMANY*

Topic 3: PowerMEMS Applications

Douglas Ballroom West

- **Autonomous Microrobots**
  Kevin Chen, *Massachusetts Institute of Technology, USA*
- **Power Limits in Small, Fast Biological and Engineered Systems**
  Ryan St. Pierre, *University at Buffalo, USA*

17:10 **End of Day**

17:00 - 19:00 **Registration**

Douglas Ballroom Foyer

17:00 - 19:00 **Welcome Reception**

Granite Ballroom

Tuesday, 13 December

All indicated times are Mountain Standard Time (MST).

08:00 **Conference Welcome**

Douglas Ballroom West

Shad Roundy, *University of Utah, USA*
Hanseup Kim, *University of Utah, USA*

08:20 **Plenary Presentation I**

Session Chair: Shad Roundy, University of Utah, USA

TPA-01 **ADVANCES IN BATTERIES FOR MICRO POWER SYSTEMS**
Dan Steingart
Columbia University, USA

09:00 **Focus Session I - Powering Implantables & Wearables**

Session Chair: Philippe Basset, University Gustave Eiffel, FRANCE and Seokheun "Sean" Choi, Binghamton University, USA

09:00 - 09:20

TFA-01 **DIRECT THERMAL-TO-ELECTROCHEMICAL ENERGY CONVERSION *VIA* A PYROELECTROCHEMICAL CELL**
Tim Kowalchik, Fariha Khan, Shad Roundy, and Roseanne Warren
University of Utah, USA

09:20 - 09:40

TFA-02 **SELF-POWERED PLANTAR PRESSURE AND TEMPERATURE MONITORING SYSTEM FOR ULCERATION PROGNOSIS**
Gagan Bahadur Pradhan, Trilochan Bhatta, Kumar Shrestha, Sanghyun Lee, and Jae Yeong Park
Kwangwoon University, KOREA

09:40 - 10:00

TFA-03 **GEAR-PUMP-BASED TURBINE GENERATOR FOR HUMAN GAIT ENERGY HARVESTING IN FOOTWEAR**
Stefan Bertsch[1], Elias Büchel[1], Ekatarina Möhr[1], George Mutafov[2], and Tzeno Galchev[3]
[1]Eastern Switzerland University of Applied Sciences, SWITZERLAND, [2]Micromotor Ltd., BULGARIA, and [3]Analog Devices, Inc., USA

10:00 **Refreshment Break**

Granite Ballroom

10:30 **Session T1A: Wearable and Stretchable Harvesters Implantables and Wearables**

Session Chair: Steve Beeby, University of Southampton, UK and Jan Dziuban, Wrocław University of Science and Technology, POLAND

10:30 - 10:50

T1A-01 **INTRINSICALLY STRETCHABLE POLYMER ELECTRET FOR POWERING SKIN ELECTRONICS**
Rui Wang, Kuniko Suzuki, Tomoya Miyoshi, and Yuji Suzuki
University of Tokyo, JAPAN

This paper will also be presented in the PowerMEMS-in-Action Session A.

10:50 - 11:10

T1A-02 **OUTPUT ENERGY EVALUATION OF WRIST-WORN ELECTRET ENERGY HARVESTER FOR DAY-LONG ACTIVITIES OF DAILY LIVING**
Tomoya Miyoshi, Gouki Minegishi, and Yuji Suzuki
University of Tokyo, JAPAN

11:10 - 11:30

T1A-03 **A MULTILAYER STRETCHABLE TRIBOELECTRIC NANOGENERATOR BASED ON METAL-ORGANIC FRAMEWORK FOR WEARABLE SELF-POWERED BIOMOTION AND TACTILE SENSORS**
SM Sohel Rana, Md Salauddin, Sang Hyun Lee, and Jae Yeong Park
Kwangwoon University, KOREA

11:30 **Poster Session A Preview**

Session Chair: Luc Frechette, Universite de Sherbrooke, CANADA

12:00 **Lunch on Own**

13:30 **PowerMEMS In-Action A and Poster Session A**

Granite Ballroom

See page 26 for the listing of poster presentations

Session T2A: Electrostatic Harvesting Technologies **Session Chair:** Yuji Suzuki, University of Tokyo, JAPAN	Session T2B: Emission-Based Conversion Technologies **Session Chair:** Luis Fernando Velásquez-García, Massachusetts Institute of Technology, USA
Douglas Ballroom West	Douglas Ballroom East
15:00 - 15:20	
T2A-01 **SPACE CHARGE INDUCED FLEXOELECTRIC TRANSDUCERS FOR ENERGY HARVESTING** Arash Kazemi[1], Travis Peters[2], Susan Trolier-McKinstry[2], and Shad Roundy[1] *[1]University of Utah, USA and [2]Pennsylvania State University, USA*	**T2B-01** **DENSELY PACKED, ADDITIVELY MANUFACTURED, IN-PLANE GATED CARBON NANOTUBE FIELD EMISSION ELECTRON SOURCES** Alex Kachkine and Luis Fernando Velásquez-García *Massachusetts Institute of Technology, USA*
15:20 - 15:40	
T2A-02 **FLEXIBLE DC TRIBOELECTRIC GENERATOR WITH ASSOCIATED CONDITIONING CIRCUIT** Sourav Naval, Pratibha Verma, Nadeem Tariq Beigh, Dibyajyoti Mukherjee, Ankesh Jain, and Dhiman Mallick *Indian Institute of Technology Delhi, INDIA*	**T2B-02** **MEMS X-RAY SOURCE: ELECTRON-RADIATION CONVERSION** Pawel Urbański, Marcin Białas, Michał Krysztof, and Tomasz Grzebyk *Wrocław University of Science and Technology, POLAND*
15:40 - 16:00	
T2A-03 **A FLAPPING LEAF STRUCTURE FOR ELECTRET-BASED LOW-SPEED WIND ENERGY HARVESTING** Seyedali Sabzpoushan and Peter Woias *University of Freiburg, GERMANY*	**T2B-03** **3D-PRINTED, INTERNALLY FED, MEMS ELECTROSPRAY THRUSTERS** Hyeonseok Kim and Luis Fernando Velásquez-García *Massachusetts Institute of Technology, USA*

16:00 **Refreshment Break**
Granite Ballroom

Session T3A: Wireless Power Transfer **Session Chair:** Paul Mitcheson, Imperial College London, UK	Session T3B: Piezoelectric Power Management Systems **Session Chair:** Adrien Morel, Université Savoie Mont Blanc, FRANCE
Douglas Ballroom West	Douglas Ballroom East
16:30 - 16:50	
T3A-01 **WIRELESS POWER TRANSFER USING A HALBACH ARRAY AND A MAGNETICALLY PLUCKED PIEZOELECTRIC TRANSDUCER FOR MEDICAL IMPLANTS** George Gibson and Hailing Fu *Loughborough University, UK*	**T3B-01** **PERFORMANCE ENHANCEMENT OF BISTABLE PIEZOELECTRIC ENERGY HARVESTERS USING NON-LINEAR ENERGY EXTRACTION CIRCUIT** Quentin Demouron, Adrien Morel, David Gibus, Aya Benhemou, and Adrien Badel *University Savoie Mont Blanc, FRANCE*
16:50 - 17:10	
T3A-02 **ASYMMETRIC WIRELESS POWER TRANSFER WITH A FLEXIBLE CONTACT LENS INDUCTOR** Khandaker Reaz Mahmud, Ashrafuzzaman Bulbul, Seungbeom Noh, Carlos Mastrangelo, and Hanseup Kim *University of Utah, USA*	**T3B-02** **OPTIMAL IMPEDANCE CALCULATION WITH A TWO-MEASUREMENT MPPT ALGORITHM FOR PIEZOELECTRIC VIBRATION HARVESTERS** Nicolas Decroix[1,2], Pierre Gasnier[1], Adrien Morel[2], David Gibus[2], and Adrien Badel[2] *[1]University Grenoble Alpes, FRANCE and [2]University Savoie Mont Blanc, FRANCE*

17:10 **End of Day**

19:30 - 22:00 **Banquet**
Natural History Museum of Utah

Wednesday, 14 December

All indicated times are Mountain Standard Time (MST).

08:15 **Announcements**

08:20 **Plenary Presentation II**

Session Chair: Tzeno Galchev, Analog Devices, USA

WPA-01 **NEAR-ZERO POWER INTEGRATED MICROSYSTEMS FOR THE IoT**
Matteo Rinaldi
Northeastern University, USA

09:00 **Session W1A: Zero Power Systems**

Session Chair: Binh Truong, University of Utah, USA and
Peter Woias, Albert-Ludwig-University Freiburg, GERMANY

09:00 - 09:20

W1A-01 **ULTRA-LOW POWER GAS SENSOR BASED ON ^{3}D ARRAY OF NANOGAPS**
Farhan Sadik Sium, Shakir-ul Haque Khan, Seungbeom Noh, Rana Dalapati, Ling Zang, Carlos Mastrangelo, and Hanseup Kim
University of Utah, USA

09:20 - 09:40

W1A-02 **IOT EDGE NODE NETWORK POWERED BY TEG**
Deepak Kumar, Zhenming Liu, Jane Cornett, and Baoxing Chen
Analog Devices Inc, USA

09:40 - 10:00

W1A-03 **AN ELECTROMAGNETIC AND TRIBOELECTRIC HYBRID MOTION SENSING SYSTEM FOR SELF-POWERED ROBOTIC BALANCING PLATFORMS**
Trilochan Bhatta, Gagan Bahadur Pradhan, Sanghyun Lee, and Jae Yeong Park
Kwangwoon University, KOREA

10:00 - 10:20

W1A-04 **BIOLOGICAL ENERGY HARVESTING FOR AUTONOMOUS TEMPERATURE SENSORS**
Giacomo Clementi, Igor Neri, Francesco Cottone, Alessandro Di Michele, Francesco Verducci, Antonio Michelucci, Guglielmo Sorci, Luigi Catacuzzeno, and Luca Gammaitoni
University of Perugia, ITALY

10:20 **Refreshment Break**

Session W2A: Electromagnetic Technologies **Session Chair:** Einar Halvorsen, University of South-Eastern Norway, NORWAY	Session W2B: Wireless Power Transfer **Session Chair:** Darrin Young, University of Utah, USA
Douglas Ballroom West	Douglas Ballroom East
10:50 - 11:10	
W2A-01 **CLAMPED CLOSED-LOOP FLUX GUIDES FOR POWER LINE INDUCTIVE HARVESTING** Steven W. Wright[1], Michail E. Kiziroglou[1,2], and Eric M. Yeatman[1] *[1]Imperial College London, UK and* *[2]International Hellenic University, GREECE*	**W2B-01** **SYSTEM DEMONSTRATION AND CHARACTERIZATION OF A SELF-BIASED MAGNETOELECTRIC WIRELESS POWER TRANSFER SYSTEM FOR BIOMEDICAL IMPLANTS** Erik Andersen[1], Orpita Saha[2], and Shad Roundy[2] *[1]Arizona State University, USA and* *[2]University of Utah, USA*
11:10 - 11:30	
W2A -02 **BATTERYLESS WIRELESS ANEMOMETER WITH BLE CONNECTIVITY** Samuel K.E. Yang, Bharat Chilukuri, Pawan Ratra, Georgios Lepipas, and Andrew S. Holmes *Imperial College London, UK* This paper will also be presented in the PowerMEMS-in-Action Session B.	**W2B-02** **WIRELESS POWER TRANSMISSION USING ACOUSTIC-TO-INDUCTIVE RELAYED TRANSFER** Victor Farm-Guoo Tseng[1], Tobias Kiebala[2], Dylan Bruno[2], Benjamin Novick[2], Nathan Lazarus[3], and Sarah S. Bedair[1] *[1]Army Research Laboratory, USA,* *[2]Rochester Institute of Technology, USA, and* *[3]University of Delaware, USA*
11:30 - 11:50	
W2A -03 **ON-CHIP MICRO SUPERCAPACITOR BASED ON CUSTOMIZABLE POROUS TI ELECTRODE AND ULTRA-THIN PSEUDOCAPACITANCE LAYER** Zhangshanhao Li[1], Sixing Xu[2], Minghao Xu[1], and Xiaohong Wang[1] *[1]Tsinghua University, CHINA and* *[2]Hunan University, CHINA*	

11:50 **Poster Session B Preview**
Session Chair: Andrew Holmes, Imperial College London, UK

12:15 **Exhibitor Tabletop Industry Spotlight**
IEEE MEMS Technical Community and NOVA Electronic Materials, LLC

12:20 **Lunch on Own**

13:50 **PowerMEMS In-Action B and Poster Session B**
Granite Ballroom

See page 29 for the listing of poster presentations

Session W3A: Non-Linear Mechanical Harvesters **Session Chair:** Francesco Cottone, University of Perugia, ITALY	Session W3B: Thermal Technologies **Session Chair:** Tomoya Miyoshi, University of Tokyo, JAPAN
Douglas Ballroom West	Douglas Ballroom East
15:20 - 15:40	
W3A-01 **A MULTI-STABLE ROTATIONAL ENERGY HARVESTER USING A ROLLING SPHERE AND MAGNETIC COUPLING FOR ULTRA-LOW FREQUENCY MOTIONS** Sayed N. Masabi, Hailing Fu, and Stephanos Theodossiades *Loughborough University, UK*	**W3B-01** **PLANAR-TYPE NANO-SILICON THERMOELECTRIC GENERATOR OVER 100 μWcm^{-2}** Ryoto Yanagisawa[1], Patrick Ruther[2], Oliver Paul[2], Naohito Tsujii[3], Takao Mori[3], and Masahiro Nomura[1] *[1]University of Tokyo, JAPAN, [2]University of Freiburg, GERMANY, and [3]International Center for Material Nanoarchitectonics (WPI-MANA) NIMS, JAPAN*
15:40 - 16:00	
W3A-02 **PREDICTIVE MODELLING APPROACH FOR A PIEZOELECTRIC BISTABLE ENERGY HARVESTER ARCHITECTURE** Aya Benhemou[1], Thomas Huguet[2], David Gibus[1], Camille Saint Martin[1], Quentin Demouron[1], Adrien Morel[1], Emile Roux[1], Ludovic Charleux[1], and Adrien Badel[1] *[1]Université Savoie Mont Blanc, FRANCE and [2]Université de Toulouse, FRANCE*	**W3B-02** **MICROFABRICATED SELF-OSCILLATING FLUIDIC HEAT ENGINE (SOFHE) WITH ENHANCED PHASE CHANGE THROUGH CORNER CAPILLARIES** Nooshin Karami, Albert Tessier-Poirier, Alihossein Nikkhah, Étienne Leveille, Amrid Amnache, and Luc G. Frechette *Université of Sherbrooke, CANADA*
16:00 - 16:20	
W3A-03 **REPULSIVE-TORQUE-ENHANCED WRIST-WORN ROTATIONAL ELECTRET ENERGY HARVESTER** Tomoya Miyoshi, Takuma Mori, and Yuji Suzuki *University of Tokyo, JAPAN*	**W3B-03** **METAL ADDITIVE MICROFABRICATED MICROFLUIDIC PACKAGES FOR INTEGRATED THERMAL MANAGEMENT IN POWER APPLICATIONS** Bhushan Lohani and Robert C. Roberts *University of Texas, El Paso, USA*

16:20 **Nanofab Tour**

17:00 **End of Day**

Thursday, 15 December

All indicated times are Mountain Standard Time (MST).

08:15 **Announcements**

Douglas Ballroom West

08:20 **Plenary Presentation III**

Session Chair: Hanseup Kim, University of Utah, USA

ThPA-01 **CAPABILITIES NEEDED FOR A SCALED MARINE NEGATIVE CARBON INDUSTRY: CAN MEMS ENABLE A NEW BLUE ECONOMY?**

Simon Freeman

ARPA-E, USA

09:00 **Session Th1A: Sustainable Energy Applications**

Session Chair: Hailing Fu, Loughborough University, UK and Takayuki Fujita, University of Hyogo, JAPAN

09:00 - 09:20

Th1A-01 **A BUOYANT BIO-SOLAR CELL ARRAY WITH LONG-LASTING HIGH-POWER OUTPUT: ENERGY HARVESTING FROM AQUATIC ENVIRONMENTS**

Anwar Elhadad, Maryam Rezaie, and Seokheun Choi

State University of New York (SUNY), Binghamton, USA

09:20 - 09:40

Th1A-02 **DESIGN AND EXPERIMENT OF A HYBRID WAVE ENERGY HARVESTER BASED ON TAPERED ROLLERS**

Yunfei Li[1,2], Tianyi Tang[1,2], Yan Fang[2], Manjuan Huang[2], Cheng Hou[2], Huicong Liu[2], and Lining Sun[1,2]

[1]Harbin Institute of Technology (HIT), CHINA and [2]Soochow University, CHINA

09:40 - 10:00

Th1A-03 **LAND VEHICLE-BASED WIRELESS POWER TRANSFER THROUGH SOIL FOR ENABLING BATTERYLESS UNDERGROUND SOIL MOISTURE SENSING APPLICATION**

Sheng Ding[1], John Sanchez[1], Shad Roundy[1], Ramesh Goel[1], Cody Zesiger[2], and Darrin J. Young[1]

[1]University of Utah, USA and [2]Utah State University, USA

10:00 **Refreshment Break**

Granite Ballroom

Session Th2A: Triboelectric Energy Harvesters **Session Chair:** Eric Yeatman, Imperial College London, UK	Session Th2B: Microfabrication for Energy **Session Chair:** Robert "Chris" Roberts, *University of Texas, El Paso, USA*
Douglas Ballroom West	Douglas Ballroom East
10:30 - 10:50	
Th2A-01 **TRIBOELECTRIC-POWERED SYSTEM FOR PEDESTRIAN AND VEHICLE DETECTION WITH WIRELESS DATA TRANSMISSION** Ahmad Delbani[1], Armine Karami[1], Dimitri Galayko[2], Naida Hodzic[1], Srikumar Vaidyanathan[1], Malal Kane[1], and Philippe Basset[1] *[1]Université Gustave Eiffel, FRANCE and [2]Sorbonne Université, FRANCE*	**Th2B -01** **FULLY 3D-PRINTED SOLENOIDS FOR COMPACT SYSTEMS** Jorge Cañada and Luis Fernando Velásquez-García *Massachusetts Institute of Technology, USA*
10:50 - 11:10	
Th2A-02 **OPTIMAL CONTROL OF ELECTRICAL INTERFACES FOR TRIBOELECTRIC KINETIC ENERGY HARVESTERS POWERING LOW-VOLTAGE LOADS** Armine Karami[1], Philippe Basset[1], and Dimitri Galayko[2] *[1]Université Gustave Eiffel, FRANCE and [2]Sorbonne Université, FRANCE*	**Th2B-02** **PIEZOELECTRIC TANTALUM ALUMINUM NITRIDE GROWN ON STAINLESS STEEL FOR LOW-FREQUENCY VIBRATION-DRIVEN ENERGY HARVESTERS** Le Van Minh[1] and Hiroki Kuwano[1,2] *[1]Tohoku University, JAPAN and [2]Sendai Smart Machines Co., Ltd., JAPAN*
11:10 - 11:30	
Th2A-03 **ROBUST SYNCHRONOUS SWITCHING POWER MANAGEMENT FOR THE MAXIMUM ENERGY OUTPUT OF TRIBOELECTRIC NANOGENERATORS** Dongping Zheng[1], Xiaohong Wang[2], and Sixing Xu[1] *[1]Hunan University, CHINA and [2]Tsinghua University, CHINA*	**Th2B-03** **ULTRA-THIN PACKAGING FILMS FOR ENCAPSULATION OF MECHANICALLY IMPERCEPTIBLE PRINTED PHOTOVOLATICS** Mayuran Saravanapavanantham, Jeremiah Mwaura, and Vladimir Bulović *Massachusetts Institute of Technology, USA*

11:30 **Award Ceremony and Closing Remarks**

Douglas Ballroom West

Shad Roundy, *University of Utah, USA*
Hanseup Kim, *University of Utah, USA*
Robert "Chris" Roberts, *University of Texas, El Paso, USA*

12:00 **Conference Adjourns**

Poster Session A

Tuesday, 13 December
13:30 - 15:00

Actuation and Micro-Propulsion

PT-01a **3D-PRINTED PERISTALTIC VACUUM PUMPS FOR COMPACT APPLICATIONS**
Hanjoo Lee and Luis Fernando Velásquez-García
Massachusetts Institute of Technology, USA

Applications and Innovations in Micro Energy Systems

PT-02b **TESTING, MODELING, AND SIMULATION OF A MINIATURE ELECTROMAGNETIC HARVESTING POWER GENERATOR FOR SELF-POWERED, CONNECTED WIRELESS SWITCH**
Adrian A. Rendon-Hernandez[1], Jose Desforges[2], and Stephane Follic[2]
[1]Schneider Electric, USA and [2]Schneider Electric, FRANCE

Electrical Power Management and Transfer

PT-03d **EFFECT OF THE COIL INNER DIAMETER ON THE POWER TRANSFER EFFICIENCY OF AN ELECTROMAGNETIC HALBACH ARRAY WIRELESS POWER TRANSFER SYSTEM**
Tamuno-omie Gogo[1] and Dibin Zhu[2]
[1]University of Exeter, UK and [2]Shanghai Jiao Tong University, CHINA

PT-04d **SYNCHRONOUS RECTIFICATION THROUGH SENSE COIL IN HF-IPT SYSTEMS**
Nunzio Pucci and Paul D. Mitcheson
Imperial College London, UK

Energy Harvesting (Mechanical, Thermal, Solar, Bio, Triboelectric, RF, etc)

PT-06f **A FLEXIBLE RF ENERGY HARVESTER FOR SMART BANDAGES**
Irfan Ullah[1], Abiodun Komolafe[1], Mahmoud Wagih[2], and Steve Beeby[1]
[1]University of Southampton, UK and [2]University of Glasgow, UK

PT-07f **CORELESS DUAL ROTOR AXIAL FLUX PERMANENT MAGNET GENERATOR FOR PORTABLE APPLICATIONS**
Charisma Clarke, Edwar Romero-Ramirez, Elisabeth Kames, and Seyed Soltani
Florida Polytechnic University, USA

PT-08f **DIRECT ELECTRIFICATION BY USING NANOPARTICLES BETWEEN PARALLEL METAL ELECTRODES WITH MICROMETER GAPS**
Jian Lu[1], Minoru Sakata[2], Lars M. Andersson[2], Takahiro Nakamura[2], Masahiro Goto[2], Lan Zhang[1], and Hiroshi Goto[2]
[1]National Institute of Advanced Industrial Science and Technology (AIST), JAPAN and [2]GCE Institute Inc., JAPAN

PT-10f **STRETCHABLE ELECTRET ENERGY HARVESTER USING THE FRINGE FIELD**
Masaya Takebe, Tomoya Miyoshi, and Yuji Suzuki
University of Tokyo, JAPAN

PT-11f **TOWARDS A CMOS-COMPATIBLE ACCELEROMETER USING SELF-POWERED TENG SYSTEM**
Mohammad Alzgool[1], Yu Tian[1], Benyamin Davaji[2], and Shahrzad Towfighian[1]
[1]Binghamton University, USA and [2]Northeastern University, USA

Focus Session: Micro and Nano Technology in Support of Mitigating or Reversing the Effects of Climate Change

PT-12h **MICROFABRICATION-ENHANCED CARBON FIBER CATHODES FOR HIGH DISCHARGE RATE ALUMINUM-AIR BATTERIES**
Yanghang Huang[1], Jackson Vyletel[2], Mark G. Allen[1], and Sue Ann Bidstrup Allen[1]
[1]University of Pennsylvania, USA and [2]University of Notre Dame, USA

Focus Session: Technology in Support of Energy Delivery, Storage and Management for Wearable or Implantable Systems

PT-13i **DESIGN OF A MEMS PIEZOELECTRIC FREQUENCY-UP CONVERTER FOR POWERING PACEMAKER FROM HEARTBEAT**
Bilel Maamer, Sinda Kaziz, Nesrine Jaziri, Mohamed Masmoudi, and Fares Tounsi
Université de Sfax, TUNISIA

General Energy Conversion and Delivery

PT-14j **PIEZOELECTRIC–ELECTROMAGNETIC HYBRID ENERGY HARVESTING SYSTEM: WHEN IS IT USEFUL?**
Binh D. Truong[1], Cuong P. Le[2], and Shad Roundy[1]
[1]University of Utah, USA and
[2]Norwegian University of Science and Technology, NORWAY

Materials for Energy Conversion

PT-15k **UV POLYMERIZED SEMIPERMEABLE STRUCTURES FOR RAPID OSMOTIC PUMPING**
Pin-Yen Yu and Yu-Chuan Su
National Tsing Hua University, TAIWAN

Micro Energy Storage: Batteries, Supercapacitors, Micro Fuel Cells

PT-16l **ENHANCED TEXTILE HYBRID ENERGY STORAGE DEVICE**
Sheng Yong, Nicholas Hillier, and Stephen Beeby
University of Southampton, UK

Thermal and Chemical Science and Technologies for Power, Propulsion, and Cooling

PT-17m **DEVELOPMENT AND EVALUATION OF A TEMPERATURE CONTROL SET-UP FOR THE THERMAL CONDUCTIVITY MEASUREMENT OF PHASE CHANGE MATERIALS**
Swathi Krishna Subhash, William Felipe Chaverra Ordoñez, Harald Hillebrecht, Peter Woias, and Uwe Pelz
University of Freiburg, GERMANY

Zero- and Ultra-Low- Power Sensors and Systems

PT-18n **AUTONOMOUS LOW POWER ENERGY MANAGEMENT BRIDGE FOR INDUSTRY IOT APPLICATION**
Koki Yamamoto[1], Shione Utsumi[2], and Takayuki Fujita[2]
[1]Ebara Corporation and [2]University of Hyogo, JAPAN

PT-19n **MEMS ION OPTICAL SPECTROMETER FOR METHANE DETECTION ON MARS**
Jan A. Dziuban[1], Pawel Knapkiewicz[1], Tomasz Grzebyk[1], and Pin Chen[2]
[1]Wrocław University of Science and Technology, POLAND and [2]California Institute of Technology, USA

PT-20n **ULTRA-LOW-POWER LOGIC WITH CONTACTLESS CAPACITIVE MEMS**
Aleksandra Marković[1], Laurent Mazenq[1], Adrian Laborde[1], Hervé Fanet[2], Gaël Pillonnet[2], and Bernard Legrand[1]
[1]Université de Toulouse, FRANCE and [2]Université Grenoble Alpes, FRANCE

Late News

PT-21o **SELF-POWERED TRIBOELECTRIC OPTICAL COMMUNICATION SYSTEM FOR WIRELESS HUMAN-MACHINE INTERACTION**
Puran Pandey, Min-Kyu Seo, and Jung Inn Sohn
Dongguk University, KOREA

PT-22o **RELATIONSHIP BETWEEN OUTPUT CURRENT AND SURFACE POTENTIAL IN SELF-ASSEMBLED ELECTRET-BASED VIBRATIONAL ENERGY HARVESTER**
Yuya Tanaka[1], Hideyuki Kayaguchi[2], Keisuke Kurihara[2], and Hisao Ishii[2]
[1]Gunma University, JAPAN and [2]Chiba University, JAPAN

PT-23o **SURVEY OF PERMANENT MAGNET FOR A LASER-ASSISTED HEATING MAGNETIZATION TO GENERATE DESIGNED SURFACE MAGNETIC FLUX DENSITY DISTRIBUTION FOR MAGNETIC MEMS DEVICES**
Keita Nagai, Naohiro Sugita, and Tadahiko Shinshi
Tokyo Institute of Technology, JAPAN

Poster Session B

Wednesday, 14 December
13:50 - 15:20

Actuation and Micro-Propulsion

PW-01a **LASER ACTUATION OF 3D PRINTED MICROBEAM WITH CNT AS FUNCTIONAL LAYER**
Tymon Janisz, Karolina Laszczyk, and Rafał Walczak
Wrocław University of Science and Technology, POLAND

Biochemical and Bio-Inspired Power/Energy Systems

PW-02c **STACKABLE, STORABLE, MILLIMETER-SCALE BIOBATTERIES HAVING HIGH INSTANTANEOUS POWER OUTPUTS**
Maryam Rezaie, Anwar Elhadad, and Seokheun Choi
State University of New York (SUNY), Binghamton, USA

Electrical Power Management and Transfer

PW-03d **RADIOFREQUENCY (RF) POWER TELEMETRY SYSTEM FOR HIGH-POWER MOBILE DEVICES**
Pawan Gaire and Shubhendu Bhardwaj
University of Nebraska, Lincoln, USA

Electron, Ion, Photon and Radiation Energy Conversion

PW-04e **FIRST SIMULATIONS ON HIGHER-EFFICIENCY BETAVOLTAIC BATTERY INTEGRATED WITH ELECTRETS FOR SPACE, MEDICINE AND REMOTE SENSING APPLICATIONS**
Carmen Altana[1,2], Francesco Cottone[3,4], and Daniele Mengoni[1,2]
[1]University of Padova, ITALY, [2]Istituto Nazionale di Fisica Nucleare, Sezione di Padova, ITALY, [3]Universitá di Perugia, ITALY, and
[4]Istituto Nazionale di Fisica Nucleare, Sezione di Perugia, ITALY

PW-05e **MEMS X-RAY SOURCE: ELECTRON EMITTER DEVELOPMENT**
Michal Krysztof[1], Paweł Urbański[1], Tomasz Grzebyk[1], Matthias Hausladen[2], and Rupert Schreiner[2]
[1]Wrocław University of Science and Technology, POLAND and
[2]Ostbayerische Technische Hochschule, GERMANY

Energy Harvesting (Mechanical, Thermal, Solar, Bio, Triboelectric, RF, etc)

PW-06f **A FULLY INTEGRATED MEASUREMENT SETUP FOR THE IN-SITU CHARACTERIZATION OF VERTICAL THERMOLEGS WITH THE HELP OF THE TRANSFER LENGTH METHOD**
Negin Sherkat, Athira Kattiparambil Sivaprasad, Peter Woias, and Uwe Pelz
University of Freiburg, GERMANY

PW-07f **DESIGN OF A HIGH-POWER DENSITY FLUX-SWITCHING MICROGENERATOR FOR A STEAM-DRIVEN MICROTURBINE**
Marc-André Bisaillon[1], Amrid Amnache[1], Jeffrey H. Lang[2], and Luc G. Fréchette[1]
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[2]Massachusetts Institute of Technology, USA

PW-08f **DYNAMICAL BEHAVIOR OF FREQUENCY UP-CONVERTED PIEZOELECTRIC VIBRATION ENERGY HARVESTERS AT DIFFERENT VELOCITIES OF MAGNETIC INTERACTION**
Michele Rosso[1], Eetu Kohtanen[2], Alberto Corigliano[1], Raffaele Ardito[1], and Alper Erturk[2]
[1]Politecnico di Milano, ITALY and [2]Georgia Institute of Technology, USA

PW-09f **MICROMACHINED FLEXIBLE SILICON SOLAR CELLS AS A POWER SUPPLY FOR SMART CONTACT LENSES**
Erfan Pourshaban, Mohit U. Karkahnis, Adwait Deshpande, Md. Rabiul Hasan, Nathan D. Rock, Aishwaryadev Banerjee, Chayanjit Ghosh, Hanseup Kim, and Carlos H. Mastrangelo
University of Utah, USA

PW-10f **THICKNESS CONTROL OF CANTILEVER BEAM FOR ROBUST AND HIGH-POWER MEMS ENERGY HARVESTER**
Takahito Yokota, Kensuke Kanda, Takayuki Fujita, and Kazusuke Maenaka
University of Hyogo, JAPAN

Fabrication Technologies that Enable all of the Above

PW-11g **POST-PRINTING MECHANICAL PROPERTIES MODIFICATION OF INKJET 3D PRINTED MICROBEAMS BY LOCAL LASER IRRADIATION**
Tymon Janisz, Karolina Laszczyk, Bartosz Kawa, and Rafał Walczak
Wrocław University of Science and Technology, POLAND

Focus Session: Technology in Support of Energy Delivery, Storage and Management for Wearable or Implantable Systems

PW-12i **A NOVEL SILICON ON GLASS ELECTROSTATIC MEMS FOR ENERGY HARVESTING IN LEADLESS PACEMAKERS**
Francisco Ambia, Xavier Leroux, Abdelmounaim Harouri, and Elie Lefeuvre
Université Paris-Saclay – CNRS, FRANCE

General Energy Conversion and Delivery

PW-13j **MISALIGNMENT PARAMETERIZATION OF A 13.56 MHZ INDUCTIVE POWER TRANSFER SYSTEM FOR IN-SITU SOIL SENSING**
John Sanchez[1], Juan M. Arteaga[2], Nunzio Pucci[2], Paul Mitcheson[2], Eric Yeatman[2], Darrin Young[1], Cody Zesiger[3], and Shad Roundy[1]
[1]University of Utah, USA, [2]Imperial College London, UK, and [3]Utah State University, USA

Materials for Energy Conversion

PW-14k **IMPROVEMENT OF POTASSIUM-ION SiO_2 ELECTRET POTENTIAL BY CONTROLLING FLOWRATE IN OXIDATION PROCESS**
Refaldi I.D. Putra, Takahiro Ozawa, Hiroaki Honma, Katsuyuki Fukutani, and Hiroshi Toshiyoshi
University of Tokyo, JAPAN

Micro Energy Storage: Batteries, Supercapacitors, Micro Fuel Cells

PW-15l **A RECTIFICATION FREE SELF-CHARGING SUPERCAPACITOR POWER CELL**
Kumar Shrestha, Sudeep Sharma, Gagan Bahadur Pradhan, Sanghyun Lee, and Jae Yeong Park
Kwangwoon University, KOREA

PW-16l **FLEXIBLE SN-BASED COMPOSITE ANODE WITH HIGH CYCLE STABILITY FOR MICRO LITHIUM-ION BATTERIES**
Bingmeng Hu, Ruizhi Zhu, and Xiaohong Wang
Tsinghua University, CHINA

Zero- and Ultra-Low- Power Sensors and Systems

PW-17n **AN AUTONOMOUS SENSING SYSTEM FOR MONITORING DISSOLVED CARBON DIOXIDE OF NATURAL WATER FOR GEOCHEMICAL APPLICATIONS**
Paola Tinivelli, Carlo Cardellini, Giacomo Clementi, Livio Fanò, Maurizio Mattarelli, Igor Neri, Cristiano Turrioni, and Francesco Cottone
University of Perugia, ITALY

PW-18n **DESIGN OF MAGNETIC PROOF MASS FOR BROADENING SPATIAL RESOLUTION ENERGY HARVESTER FROM CURRENT CARRYING WIRE**
Zeynel Guler and Nathan Jackson
University of New Mexico, USA

PW-19n **TRANSFER OF ACOUSTIC WIRELESS POWER AND DATA THROUGH A METAL WALL USING A COMMON LINK WITH HIGHER RESONANCE MODES**
Bibhu Kar[1], Thomas Schaechtle[1,2], Stefan J. Rupitsch[1], and Ulrike Wallrabe[1]
[1]University of Freiburg, GERMANY and [2]Fraunhofer Institute for Highspeed Dynamics, Ernst-Mach-Institute (EMI), GERMANY

Late News

PW-20o **DIRECT MEASUREMENT OF THE SURFACE POTENTIAL OF MICRO-PATTERNED SELF-ASSEMBLED ELECTRETS FOR MEMS VIBRATIONAL ENERGY HARVESTERS**
Kosuke Kawashima[1], Reiki Sugimoto[1], Ruichen Li[1], Hideyuki Kayaguchi[2], Keisuke Kurihara[2], Hisao Ishii[2], Yuya Tanaka[3], and Daisuke Yamane[1]
[1]Ritsumeikan University, JAPAN, [2]Chiba University, JAPAN, and [3]Gunma University, JAPAN

PW-21o **A MAGNETIC ACTUATOR USING PLD-MADE FEPT THICK FILM AS A PERMANENT MAGNET AND MEMBRANE MATERIAL FOR BI-DIRECTIONAL MICROPUMPS**
Chao Qi[1], Keita Nagai[1], Ming Ji[1], Yu Miyahara[2], Naohiro Sugita[1], Tadahiko Shinshi[1], Masaki Nakano[2], and Chiaki Sato[1]
[1]Tokyo Institute of Technology, JAPAN and [2]Nagasaki University, JAPAN

PW-22o **ENABLING IOT WIRELESS DISTANT CHARGING: 7.9-mW INTEGRATED POWER RECEIVER AT 30 CM**
Adrien Ameye[1,2], Baptiste Alessandri[3], Sébastien Boisseau[1], Nicolas Decroix[1,2], Pierre Gasnier[1], Nicolas Garraud[1], and Adrien Badel[2]
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