

SYMPOSIUM ES4

Nanogenerators and Piezotronics
April 17 - April 21, 2017

Symposium Organizers

Christian Falconi, University of Tor Vergata
Wenzhuo Wu, Purdue University
Rusen Yang, University of Minnesota
Junyi Zhai, Beijing Institute of Nanoenergy and Nanosystems,
Chinese Academy of Sciences

Proceedings Statement

All authors are invited to submit articles based on their 2017 MRS Spring Meeting presentations to the journals in the MRS portfolio (www.mrs.org/publications-news). Papers submitted and accepted for publication in MRS Advances (www.mrs.org/mrs-advances) will be available as symposium collections. Visit the MRS/Cambridge University Press Publications Booth #100 in the Exhibit Hall to learn more, including MRS Advances print options available at special rates during the meeting week only.

* Invited Paper

TUTORIAL

Fundamentals and Applications of Nanogenerators and Piezotronics for Self-Powered Nanotechnologies

Monday Morning, April 17, 2017
8:30 AM – 12:00 PM
PCC North, 200 Level, Room 229 A

Part I: Fundamentals and Applications of Nanogenerators for Energy Harvesting

8:30 AM - 9:15 AM

Rusen Yang

Piezoelectric Nanogenerators for Mechanical Energy Harvesting

Dr. Yang will first discuss the fundamental principles of piezoelectric nanogenerators focusing on the materials and structural aspects, followed by discussions on the designing and developing piezoelectric materials based prototypes that can efficiently harvest mechanical energy. Dr. Yang will then review and discuss the recent advances in material design and processing for enabling novel piezoelectric biomaterials in energy harvesting and conclude by providing an outlook and perspective of the piezoelectric nanogenerators.

9:15 AM - 10:00 AM

Guang Zhu

Triboelectric Nanogenerators as a New Energy Technology and Self-Powered Sensors

Dr. Zhu will first systematically review the theory and physical models for various triboelectric nanogenerators (TENGs). Dr. Zhu will then discuss the latest progress of TENG devices in terms of its viability as a new energy technology and its application for self-powered sensors by harvesting the operational energy from human motion, walking, vibration, mechanical triggering, rotating tire, wind, flowing water, and etc. Dr. Zhu will also discuss the research and application prospects in the field of TENG.

10:00 AM - BREAK

Part II: Piezotronics and Piezo-Phototronics for Adaptive Electronics and Optoelectronics

10:30 AM - 11:15 AM

Wenzhuo Wu

Piezotronics in Nanostructured Piezoelectric Semiconductors

Dr. Wu will first elaborate on the fundamental physics and material science of the piezotronic effect, which serves as the basis for understanding and utilizing the interfacial phenomena and interfacial engineering in piezotronics. There will then be discussion of the latest progress in designing and developing piezotronic technologies with piezoelectric semiconductor nanomaterials

(e.g. 1D and 2D materials) for emerging applications in flexible electronics, smart sensors, and human-machine interface. Finally, Dr. Wu will provide his perspective of this rapidly-advancing field.

11:15 AM - 12:00 PM

Caofeng Pan

Piezo-Phototronics for Novel Optoelectronics

Dr. Pan will first discuss the fundamental principles for piezo-phototronics, which relies on the coupling between piezoelectricity, semiconductor property, and optical excitation in semiconductor materials. Dr. Pan will then discuss the recent progress in developing novel adaptive optoelectronic devices, e.g. photodetector, LEDs, and solar cells, based on the piezo-phototronic effect. Dr. Pan will summarize this session by discussing the prospect and outlook of research and applications of piezo-phototronics.

Instructors

Rusen Yang, University of Minnesota

Guang Zhu, Chinese Academy of Sciences

Wenzhuo Wu, Purdue University

Caofeng Pan, Chinese Academy of Sciences

SESSION ES4.1: Triboelectric Nanogenerators I

Session Chairs: Wenzhuo Wu and Rusen Yang

Monday Afternoon, April 17, 2017

PCC North, 200 Level, Room 229 A

1:30 PM *ES4.1.01

Nanogenerator for Self-Powered Systems and Large-Scale Blue

Energy Zhong Lin Wang^{1,2}; ¹Georgia Institute of Technology, United States; ²Beijing Institute of Nanoenergy and Nanosystems, CAS, China.

2:00 PM ES4.1.02

Hybrid Generators with Cascaded Piezoelectric and Triboelectric Units—Design, Fabrication, Testing and Analysis Xiaoming Tao; Hong Kong Polytech University, Hong Kong.

2:15 PM *ES4.1.03

Triboelectrification of Graphene for Triboelectric Nanogenerators and Tribotronics Sang-Woo Kim; Sungkyunkwan University, Korea (the Republic of).

2:45 PM ES4.1.04

Recyclable, Green Triboelectric Nanogenerator and Its Application as Clearable Self-Powered Motion Sensor Qijie Liang; University of Science and Technology, Beijing, China.

3:00 PM BREAK

SESSION ES4.2: Piezotronics I

Session Chairs: Wenzhuo Wu and Junyi Zhai

Monday Afternoon, April 17, 2017

PCC North, 200 Level, Room 229 A

3:15 PM *ES4.2.01

The Photochemical Properties of Polar Surface Domains on Non-Polar Surfaces Gregory S. Rohrer; Carnegie Mellon University, United States.

3:45 PM *ES4.2.02

Piezo-Phototronics in Opto-Electronics and Its Application in Visible Strain Mapping of Robotics Caofeng Pan; Chinese Academy of Sciences, China.

4:15 PM ES4.2.03

Self-Assembly of Diphenylalanine Peptide with Controlled Polarization for Power Generation Vu D. Nguyen; University of Minnesota, United States.

4:30 PM *ES4.2.04

Ferret—An Open-Source Code for Simulating Thermodynamical Evolution and Phase Transformations in Complex Materials Systems at Mesoscale Serge Nakhmanson; University of Connecticut, United States.

SESSION ES4.3: Piezoelectric Nanogenerators I
Session Chairs: Christian Falconi and Rusen Yang
Tuesday Morning, April 18, 2017
PCC North, 200 Level, Room 229 A

SESSION ES4.6: Poster Session I: Nanogenerators and Piezotronics
Session Chairs: Christian Falconi and Wenzhuo Wu
Tuesday Afternoon, April 18, 2017
8:00 PM - 10:00 PM
Sheraton, Third Level, Phoenix Ballroom

10:30 AM *ES4.3.01

Ferroelectric Polymer for Energy Harvesting and Self-Powered Devices/Sensors Pooi See Lee; Nanyang Technological University, Singapore.

11:00 AM ES4.3.02

Smart Fibers for Textile-Based Micro-Generators and Compliant Energy Storage Xin Lu; Ecole Polytechnique de Montreal, Canada.

11:15 AM *ES4.3.03

Polymer-Based Nanogenerators for Piezoelectric and Triboelectric Energy Harvesting Applications Sohini Kar-Narayan; University of Cambridge, United Kingdom.

11:45 AM ES4.3.04

Ubiquitous Energy Harvesting from Molecular Artificial Crystalline Materials Shenqiang Ren; Temple University, United States.

SESSION ES4.4: Triboelectric Nanogenerators II
Session Chairs: Ya Yang and Yunlong Zi
Tuesday Afternoon, April 18, 2017
PCC North, 200 Level, Room 229 A

1:30 PM *ES4.4.01

Boosted Output Performance of Triboelectric Nanogenerator via Electric Double Layer Effect Jeong Min Baik; Ulsan National Institute of Science and Technology, Korea (the Republic of).

2:00 PM ES4.4.02

Triboelectric Charging at Solid/Liquid Interface for Converting Water Wave Energy—Mechanism, Flexible Device and Applications Guang Zhu; Chinese Academy of Sciences, China.

2:15 PM *ES4.4.03

Triboelectric Nanogenerator for Energy Harvesting and Self-Powered Biomechanical Motion Sensors Yue Zhang; University of Science and Technology Beijing, China.

2:45 PM ES4.4.04

Tribotronics—A New Field by Coupling Triboelectricity and Semiconductor Chi Zhang; Chinese Academy of Sciences, China.

3:00 PM BREAK

SESSION ES4.5: Piezophotonics I
Session Chairs: Xudong Wang and Junyi Zhai
Tuesday Afternoon, April 18, 2017
PCC North, 200 Level, Room 229 A

3:30 PM *ES4.5.01

Piezotronics-Regulated Electrochemical and Catalytic Materials and Devices Xudong Wang; University of Wisconsin, Madison, United States.

4:00 PM *ES4.5.02

Trions and Excitons Modulation in Two-Dimensional MoS₂ by Acoustic Means Kourosh Kalantar-Zadeh; RMIT, Australia.

4:30 PM *ES4.5.03

Achieving Ultrahigh UV Responsivity of Single Nonpolar A-Axial GaN Nanowire with Asymmetric Piezopotential Distribution via Piezo-Phototronic Effect under Optimized Strain Chuan-Pu Liu; National Cheng Kung Univ, Taiwan.

ES4.6.01

Mechanoluminescence Color Conversion from ZnS-Embedded-Polydimethylsiloxane Elastomer Functionalized with Fluorescent Dye Soon Moon Jeong; Daegu Gyeongbuk Institute of Science and Technology, Korea (the Republic of).

ES4.6.02

PCE Improved TENG with Gear Mechanism Based Mechanical Energy Transfer System Wook Kim; Kyung Hee University, Korea (the Republic of).

ES4.6.03

Kinematically Driven Triboelectric Nanogenerator as a Practical Power Source Divij Bhatia; Kyung Hee University, Korea (the Republic of).

ES4.6.04

High-Output Power of the Triboelectric Nanogenerator Made from Recycling Rice Husks Chih-Kai Chang; National Tsing Hua University, Taiwan.

ES4.6.05

Fabrication of a Highly Transparent Nanostructured Triboelectric Nanogenerator for the Application of an Efficient Hybrid Energy Harvester Donghyeon Yoo; Pohang University of Science and Technology (POSTECH), Korea (the Republic of).

ES4.6.06

Self-Recovering Triboelectric Nanogenerator as Active Multifunctional Sensors Qingliang Liao; University of Science and Technology Beijing, China.

ES4.6.07

Optimization of Design Parameters towards Enhancing the Output Performance in Flexible Hybrid Triboelectric and Piezoelectric Nanogenerator Xiya Yang; City University of Hong Kong, China.

ES4.6.08

Ordered PZT Arrays Grown on Silicon Substrates Using Glancing Angle Pulsed Laser Deposition on Self-Assembled Nanotemplates Domingo Mateo-Feliciano; University of South Florida, United States.

ES4.6.09

One-Step Fabrication of the Pattern Assisted Triboelectric Nanogenerator Operated by the Discrete Liquid-Solid Contact Electrification Phenomenon Dongwhi Choi; POSTECH, Korea (the Republic of).

ES4.6.10

Spontaneous Dipole Modulation of Ferroelectric BaTiO₃ NPs-Polymer Composite for Performance Enhancement of Triboelectric Nanogenerators Sung-Ho Shin; Chungnam National Univ, Korea (the Republic of).

ES4.6.11

Performance Enhanced Triboelectric Nanogenerator via Large-Area and Defectless Nanograting Enabled by Multistep Pattern Downscaling Lithography Hee seung Wang; KAIST, Korea (the Republic of).

ES4.6.12

Design of the Piezoelectric Energy Harvesting Modules for Self-Powered Smart Roadways Inki Jung^{1,2}; ¹Korea Institute of Science and Technology, Korea (the Republic of); ²Korea University, Korea (the Republic of).

ES4.6.13

Improving Triboelectric Nanogenerator Performance Using AAO and Nanopatterned PDMS Nghia D. Huynh; Kyung Hee University, Republic of Korea, Korea (the Republic of).

ES4.6.14

Investigation of Aluminum Nitride Films for a Vibration Energy Harvesting Device Kun-Mao Huang; National University of Tainan, Taiwan.

ES4.6.15

Sponge TENG Generating Stable Output in Various Mechanical Energy and Harsh Environments Hwang Heejae; Kyunghee University, Korea (the Republic of).

ES4.6.16

Enhanced Performance of Triboelectric Nanogenerators by Localized Surface Plasmon Resonance Effect with Silver Nanoparticles Songhwa Chae; Kyung Hee University, Korea (the Republic of).

ES4.6.17

Template-Assisted Hydrothermal Growth of Aligned Zinc Oxide Nanowires for Piezoelectric Energy Harvesting Applications Canlin Ou; University of Cambridge, United Kingdom.

ES4.6.18

A Hybridized Power Panel to Simultaneously Generate Electricity from Sunlight, Rain Drops and Wind Around the Clock Li Zheng; Shanghai University of Electric Power, China.

ES4.6.19

A Flexible Energy Harvester Based on a Lead-Free and Piezoelectric BCTZ Nanoparticle-Polymer Composite Changyeon Baek; KAIST, Korea (the Republic of).

ES4.6.20

Eco-Friendly Smart Mobile Pouch Triboelectric Nanogenerator for Self-Powered Wireless Power Transfer Applications Arunkumar Chandrasekhar; Jeju National University, Korea (the Republic of).

ES4.6.21

Wearable Sensory Glove Using TiO₂-ZnO Core-Shell Structures on Flexible Ti-Wires via Chemical Oxidation/Deposition Method Nagamalleswara Rao Alluri; Jeju National University, Korea (the Republic of).

ES4.6.22

Triboelectric-Electromagnetic Hybrid Generator for Harvesting Blue Energy Zhen Wen^{1,2}; ¹Soochow University, China; ²Georgia Institute of Technology, United States.

ES4.6.23

Triboelectric Nanogenerators Based on Metamaterials Kayode Ojetunde; NAWCWD, United States.

ES4.6.24

Machine-Washable Textile Triboelectric Nanogenerators for Effective Human Respiratory Monitoring through Loom Weaving of Metallic Yarns Zhizhen Zhao; Peking University, China.

ES4.6.25

Flexible and Controllable Piezo-Phototronic Pressure Mapping Sensor Matrix by Organic/Inorganic Hybrid LED Array Rongrong Bao; Chinese Academy of Sciences, China.

ES4.6.26

Electric Eel-Skin-Inspired Mechanically-Durable and Super-Stretchable Nanogenerator for Deformable Power Source Ying-Chih Lai^{1,2}; ¹National Chung Hsing University, Taiwan; ²Georgia Institute of Technology, United States.

ES4.6.27

Design and Efficiency of Flexible Capacitive Piezoelectric Sensors Based on GaN Wires Amine El Kacimi^{1,2}; ¹CEA-LETI, France; ²Université Grenoble Alpes, France.

ES4.6.28

Asymmetric Ion Pairing Effect on Triboelectric Power Generation HanJun Ryu; Sungkyunkwan University, Korea (the Republic of).

ES4.6.29

Piezo-Phototronic Enhanced UV Sensing Based on a Nanowire Photodetector Array Xun Han; Beijing Institute of Nanoenergy and Nanosystems, China.

ES4.6.30

A Highly Shape-Adaptive, Stretchable Design Based on Conductive Liquid for Energy Harvesting and Self-Powered Biomechanical Monitoring Fang Yi; Peking University, China.

ES4.6.31

Self-Powered Motion Sensor Using Flow-Less CNT Sheet Nanogenerator Hyelynn Song; Seoul National University, Korea (the Republic of).

ES4.6.32

Fabrication of Flexible Si/ZnO Heterojunction on Si Membrane with Enhanced Photodetection Utilizing Piezo-Phototronic Effect Arijit Sarkar; IIT Kharagpur, India.

ES4.6.33

Ultrasound Driven High Performing Triboelectric Nanogenerator for Biomedical Application Hong Joon Yoon; Sungkyunkwan University, Korea (the Republic of).

ES4.6.34

Triboelectric Nanogenerators and Power-Boards from Cellulose Nanofibrils and Recycled Materials Chunhua Yao; University of Wisconsin-Madison, United States.

ES4.6.35

Graphene Tribotronic Transistors for Tactile Sensing Usman Khan; Sungkyunkwan University, Korea (the Republic of).

ES4.6.36

An Inductor-Free Auto-Power-Management Design Built-In Triboelectric Nanogenerators Yunlong Zi; Georgia Institute of Technology, United States.

ES4.6.37

Hybrid Thermolectric Piezoelectric Generator David Montgomery; Wake Forest University, United States.

SESSION ES4.7: Piezotronics—Theoretical Discussions

Session Chairs: Glenn Martyna and Wenzhuo Wu

Wednesday Morning, April 19, 2017

PCC North, 200 Level, Room 229 A

8:00 AM ES4.7.01

Theoretical Model of Quantum Piezotronics Yan Zhang; University of Electronic Science and Technology of China, China.

8:15 AM *ES4.7.02

Engineering of van der Waals Interactions in Layered and Two-Dimensional Materials Evan J. Reed; Stanford University, United States.

8:45 AM ES4.7.03

Enhanced Flexoelectrocity in Transition Metal Oxide Superlattices Andrew Lubimtsev; University of Tennessee, United States.

9:00 AM ES4.7.04

Electromechanical Fields in Piezoelectric Semiconductor Nanofibers under an Axial Force Chunli Zhang; Department of Engineering Mechanics, Zhejiang University, China.

9:15 AM *ES4.7.05

Strain Engineering and Energy Harvesting Ju Li; Massachusetts Institute of Technology, United States.

9:45 AM ES4.7.06

Computational Modelling of Piezoelectric Nanogenerator and Piezotronic Devices Yongsheng Leng; George Washington University, United States.

10:00 AM BREAK**SESSION ES4.8: Self-Powered Nanosystems**

Session Chairs: Zong-Hong Lin and Chi Zhang

Wednesday Morning, April 19, 2017

PCC North, 200 Level, Room 229 A

10:30 AM *ES4.8.01

Self-Powered Flexible Inorganic Electronic Systems Keon Jae Lee; KAIST, Korea (the Republic of).

11:00 AM ES4.8.02

ITENG in Self-Powered Implantable Medical Electronic Devices Zhou Li; Beijing Institute of Nanoenergy and Nanosystem, CAS, China.

11:15 AM *ES4.8.03

Flexible Electret and Piezoelectret Generators for Wearable Electronics Jun Zhou; Huazhong University of Science and Technology, China.

SESSION ES4.9: Piezoelectric Nanogenerators II

Session Chairs: Wenzhuo Wu and Jun Zhou

Wednesday Afternoon, April 19, 2017

PCC North, 200 Level, Room 229 A

1:30 PM *ES4.9.01

High Power Density Energy Harvesting Materials and Systems Shashank Priya; Virginia Tech, United States.

2:00 PM *ES4.9.02

Zinc Oxide Nanorods for Low Frequency Electrical Energy Harvesters on Flexible Substrates Magnus Willander; Linköping University, Sweden.

2:30 PM BREAK

SESSION ES4.10: Piezoelectric Semiconductors for Electronics and Optoelectronics

Session Chairs: Yong Qin and Wenzhuo Wu

Wednesday Afternoon, April 19, 2017

PCC North, 200 Level, Room 229 A

3:30 PM *ES4.10.01

Strain-Tunable Nanomembrane-Based Quantum-Photonic Devices Oliver G. Schmidt; Leibniz IFW Dresden, Germany.

4:00 PM *ES4.10.02

Flexible Nanowire Nanogenerators and Nanoplate Piezotronic Transistor Yong Qin; Lanzhou University, China.

4:30 PM ES4.10.03

Local Enhancements of Piezoelectricity and Ferroelectricity for Geometrically Strain Relieved Functional Microstructures Bryan D. Huey; University of Connecticut, United States.

4:45 PM ES4.10.04

Tuning the Charge Transportation in TiO₂ Photoelectrochemical Systems via Ferroelectric Polarization Yanhao Yu; University of Wisconsin-Madison, United States.

SESSION ES4.11: Poster Session II: Nanogenerators and Piezotronics

Session Chairs: Rusen Yang and Junyi Zhai

Wednesday Afternoon, April 19, 2017

8:00 PM - 10:00 PM

Sheraton, Third Level, Phoenix Ballroom

ES4.11.01

Polar-Toroidal Phase Transformation in Inhomogeneous Nanoscale Ferroelectric Systems—A Novel Strategy for the Design of Energy Conversion Nanodevices Weijin Chen^{1,2}; ¹Sun Yat-sen University, China; ²Sun Yat-sen University, China.

ES4.11.02

Ferromagnetic Nanowires Grown by Template-Assisted Electrodeposition for Printable Magnetolectric Sensing and Energy Harvesting Devices Chess Boughay; University of Cambridge, United Kingdom.

ES4.11.03

A Highly Stretchable Fiber-Based Triboelectric Nanogenerator for Self-Powered Wearable Electronics Xu He; Georgia Institute of Technology, United States.

ES4.11.04

Stretchable and Multifunctional Graphene E-Skin Qijun Sun; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

ES4.11.05

Hybrid Monolithic Nanomanufacturing of Liquid-Solid Heterojunction Devices for Self-Powered Smart Skin Ruoxing Wang; Purdue University, United States.

ES4.11.06

Enhancement of Piezoelectric Performance of a ZnO Nanogenerator by a Combination of Chemical Doping and Interfacial Modification Yang Zhang; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

ES4.11.07

Single-Thread-Based Wearable and Highly Stretchable Triboelectric Nanogenerators and Their Applications in Cloth-Based Self-Powered Human-Interactive and Sensing Ying-Chih Lai^{1,2}; ¹National Chung Hsing University, Taiwan; ²Georgia Institute of Technology, United States.

ES4.11.08

High-Performance Triboelectric Nanogenerator (TENG) from Chemically Functionalized Natural Cellulose Materials Chunhua Yao; University of Wisconsin-Madison, United States.

ES4.11.09

Self-Powered Anti-Biofouling Using Water Wave Energy Yin Long^{1,2}; ¹University of Wisconsin-Madison, United States; ²University of Electronic Science and Technology of China, China.

ES4.11.10

Solar Cell-Raindrop TENG Hybrid Devices for Energy Harvesting Ruiyuan Liu^{1,2}; ¹Soochow University, China; ²Georgia Institute of Technology, United States.

ES4.11.11

A Nanopillar Arrayed Triboelectric Nanogenerator as a Self-Powered Sensitive Sensor for a Sleep Monitoring System Weixing Song; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

ES4.11.12

Sustainably Powering Wearable Electronics by Harvesting Biomechanical Energy Jie Wang; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

ES4.11.13

Wearable Power-Textiles by Integrating Fabric Triboelectric Nanogenerators and Fiber-Shaped Dye-Sensitized Solar Cells Xiong Pu; Beijing Institute of Nanoenergy and Nanosystems, China.

ES4.11.14

Piezotronic Effect in Strain-Gated Transistor of a-Axis GaN Nanobelt Xingfu Wang; Georgia Institute of Technology, United States.

ES4.11.15

Large-Scale Manufacturing of Solution-Processed Tellurium Nanowires for Stretchable and Wearable Piezoelectric Device Yixiu Wang; Purdue University, United States.

ES4.11.16

Application of Triboelectric Nanogenerator on Self-Powered Low-Level Laser Cure System and Biocide-Free Antifouling Tian Jingjing; Beijing Institute of Nanoenergy and Nanosystems, China.

ES4.11.17

Self-Powered Large-Scale and Pressure-Sensitive Triboelectric Sensor Matrix for Real-Time Tactile Mapping Xiandi Wang; Beijing Institute of Nanoenergy and Nanosystems, China.

ES4.11.18

Versatile Energy Harvesting and Self-Powered Sensors Based on Environment-Friendly Triboelectric Nanogenerators Wei Xu; Department of Applied Physics, The Hong Kong Polytechnic University, China.

- ES4.11.19**
Utilization of Magnetic Assisted Noncontact Triboelectric Nanogenerator for Energy Harvesting Long-Biao Huang; The Hong Kong Polytechnic University, China.
- ES4.11.20**
High Performance Broadband UV/Visible Photodetector of ZnO/ZnSe Core/Shell Nanowire Array and Its Self-Powered Performance Based on Piezophototronic Effect Shuke Yan; University of New Orleans, United States.
- ES4.11.21**
Strain Modulation in Graphene/ZnO Schottky Junction for Enhanced Photosensing Performance Zheng Zhang; University of Science and Technology Beijing, China.
- ES4.11.22**
Sustainable Triboelectric Nanogenerator with Pulsed Output—Converting Rotating Energy via Water Electrification Tachun Kim; Chung-Ang University, Korea (the Republic of).
- ES4.11.23**
Self-Powered Stretchable Triboelectric Fiber Hyeon Jun Sim; Hanyang University, Korea (the Republic of).
- ES4.11.24**
Reversibly Wavelength Tunable Laser Based on Single Band-Gap-Graded Semiconductor Nanowires Minghua Zhuge; Zhejiang University, China.
- ES4.11.25**
Factors Affecting the Bulk Photovoltaic Effect in LiNbO₃ Nadupalli Shankari^{1,2}; ¹Luxembourg Institute of Science and Technology, Luxembourg; ²University of Luxembourg, Luxembourg.
- ES4.11.26**
Theoretical Study and Quantification of the Performance of Triboelectric Nanogenerator Jun Peng; Northwestern University, United States.
- ES4.11.27**
Auxetic Foam Based Triboelectric Nanogenerator with Self Powered Strain Sensing Capabilities to Monitor Human Body Movement Steven L. Zhang; Georgia Institute of Technology, United States.
- ES4.11.28**
Nylon-11 Nanowire Arrays as Efficient Vibrational Energy Harvester Anuja Datta; Department of Materials Science, University of Cambridge, United Kingdom.
- ES4.11.29**
A Universal Anti-Hacking Interface Based on Integration of a Novel Stretchable Keyboard Cover and Advanced Biometric Recognition Wenbo Ding; Georgia Institute of Technology, United States.
- ES4.11.30**
The Smart Actuation System Based on Triboelectric Nanogenerator Xiangyu Chen; Chinese Academy of Sciences, China.
- ES4.11.31**
Transparent and Flexible Self-Charging Power Film and Its Application in a Sliding Unlock System in Touchpad Technology Wei Tang; Chinese Academy of Sciences, China.
- ES4.11.32**
Harvesting Simultaneous Sliding and Vertical Contact-Separation Motion through Portable Triboelectric Nanogenerator Jihoon Chung; Chung-Ang University, Korea (the Republic of).
- ES4.11.33**
Dielectric Design for Enhancement of Triboelectric Nanogenerator via Enhanced Electron Trapping and Storage Effects Jae Won Lee; Ulsan National Institute of Science and Technology, Korea (the Republic of).
- ES4.11.34**
Self-Polarized Polyvinylidene fluoride-Trifluoroethylene P(VDF-TrFE) Film for Wide Range Pressure Detection Kaushik Parida; Nanyang Technological University, Singapore.
- ES4.11.35**
Self-Powered Artificial Electronic Skin for High-Resolution Pressure Sensing Mingyuan Ma; University of Science and Technology Beijing, China.
- ES4.11.36**
Integrated Triboelectric Nanogenerator Array Based on Air-Driven Membrane Structures for Water Wave Energy Harvesting Liang Xu; Chinese Academy of Sciences, China.
- ES4.11.37**
Spring-Assisted Triboelectric Nanogenerator for Efficiently Harvesting Water Wave Energy Tao Jiang; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences; National Center for Nanoscience and Technology (NCNST), China.
- ES4.11.38**
In Vivo Self-Powered Wireless Transmission Using Biocompatible Flexible Energy Harvesters Dong Hyun Kim; KAIST, Korea (the Republic of).
- ES4.11.39**
Self-Powered Hybrid Ionic Microdevices by Flexible Energy Harvester Daniel J. Joe; KAIST, Korea (the Republic of).
- ES4.11.40**
MoS₂ Hybrid Nanocomposites for Flexible Thermoelectric Nanogenerators with Enhanced Performance Yannan Xie; Xiamen University, China.
- ES4.11.41**
Triboelectric Energy Harvester with an Ultra-Thin Tribo-Dielectric Layer by Initiated CVD and Investigation of Underlying Physics in the Triboelectricity Daewon Kim; University of Pennsylvania, United States.
- ES4.11.42**
Service Behavior of Tailorable Multifunctional Triboelectric Nanogenerators Qian Zhang; University of Science and Technology Beijing, China.
- ES4.11.43**
PVDF-TrFE Electroactive Polymer Mechanical-to-Electrical Energy Harvesting—Experimental Bimorph Structure Bill Kaval; Air Force Institute of Technology, United States.

SESSION ES4.12: Piezoelectric Materials and Devices
Session Chairs: Jr Hau He King and Robert Lake
Thursday Morning, April 20, 2017
PCC North, 200 Level, Room 229 A

- 8:00 AM *ES4.12.01**
Flexible Piezoelectrics for Energy Harvesting and Sensing Massimo De Vittorio^{1,2}; ¹Center for Biomolecular Nanotechnologies - Istituto Italiano di Tecnologia, Italy; ²Università del Salento, Italy.
- 8:30 AM ES4.12.02**
High Throughput Piezoelectric Discovery Shyam S. Dwaraknath; Lawrence Berkeley National Laboratory, United States.
- 8:45 AM *ES4.12.03**
Non-Resonant and Low Frequency Piezoelectric Energy Harvesters Susan E. Trolier-McKinstry; The Pennsylvania State University, United States.
- 9:15 AM ES4.12.04**
Scalable Self-Assembled Diphenylalanine Nanotube Bio-Piezoelectric Energy Harvesters Ju-Hyuck Lee^{1,2}; ¹University of California, Berkeley, United States; ²Lawrence Berkeley National Laboratory, United States.
- 9:30 AM *ES4.12.05**
Integration of Freestanding Piezoelectric Films in Biosensors and Photodetectors Wei-Heng Shih; Drexel University, United States.
- 10:00 AM BREAK**

SESSION ES4.13: Piezotronics—2D Materials
Session Chairs: Sang-Woo Kim and Evan Reed
Thursday Morning, April 20, 2017
PCC North, 200 Level, Room 229 A

SESSION ES4.16: Poster Session III: Nanogenerators and Piezotronics
Session Chairs: Zong-Hong Lin and Yunlong Zi
Thursday Afternoon, April 20, 2017
8:00 PM - 10:00 PM
Sheraton, Third Level, Phoenix Ballroom

10:30 AM *ES4.13.01

Coupled Acousto-Optical Phonons in Bulk Semiconductor and 2D Piezoelectric Materials Morten Willatzen; Technical University of Denmark, Denmark.

11:00 AM ES4.13.02

PSS-Induced Sulfur Vacancy Self-Healing for MoS₂ Homo Junction and Piezotronics Xiankun Zhang; University of Science and Technology Beijing, China.

11:15 AM *ES4.13.03

Piezoelectric Characterization of Free-Standing, Monolayer TMDC Materials Horacio D. Espinosa; Northwestern University, United States.

11:45 AM ES4.13.04

Piezo-Catalytic Effect on the Enhancement of the Ultra-High Degradation Activity in the Dark by Single- and Few-Layers MoS₂ Nanoflowers Jyh Ming Wu; National Tsing Hua University, Taiwan.

SESSION ES4.14: Piezophotonics II
Session Chairs: Weiguo Hu and Caofeng Pan
Thursday Afternoon, April 20, 2017
PCC North, 200 Level, Room 229 A

1:30 PM *ES4.14.01

Piezotronic and Piezo-Phototronic Effect in GaN Weiguo Hu; Chinese Academy of Sciences, China.

2:00 PM *ES4.14.02

Kilometers-Long Piezoelectric Polymer Nanoribbon Arrays for Sensing and Energy Generation Mehmet Bayindir; Bilkent University, Turkey.

2:30 PM *ES4.14.03

Hybrid Piezoelectric-Semiconductor Quantum Devices Armando Rastelli; Johannes Kepler University Linz, Austria.

3:00 PM BREAK

SESSION ES4.15: Piezoelectrics—Theory and Technology
Session Chairs: Yongsheng Leng and Junyi Zhai
Thursday Afternoon, April 20, 2017
PCC North, 200 Level, Room 229 A

3:30 PM *ES4.15.01

The Piezoelectronic Family of Devices, from RF Switches to Fast Low Power Transistors Glenn J. Martyna; IBM Research, United States.

4:00 PM *ES4.15.02

2D Materials for Nanogenerators and Piezotronics Max Migliorato; University of Manchester, United Kingdom.

4:30 PM ES4.15.03

Piezoelectric Effect Enhanced Antibacterial Applications Linlin Li; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

ES4.16.01

Wireless Autonomous Self-Propelled Flexible Micromotor Hyacinthe Randriamahazaka; Université Paris Diderot - Paris 7, ITODYS CNRS 7086, France.

ES4.16.02

A Self-Powered Long-Term Sterilization System Based on Water Driven Triboelectric Nanogenerator Hongqing Feng; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

ES4.16.03

Self-Activated Luminescence Textile through Mechanical Strain and Static by Tribo Hye-Jeong Park; Sungkyunkwan University, Korea (the Republic of).

ES4.16.04

High Performance Piezoelectric Power Generation from Atomic-Layered MoS₂ via Sulfur Vacancy Passivation Tae-Ho Kim; Sungkyunkwan University, Korea (the Republic of).

ES4.16.05

Largely Improving the Robustness and Lifetime of Triboelectric Nanogenerators through Automatic Transition between Contact and Noncontact Working States Shengming Li^{1,2}; ¹Tsinghua University, China; ²Georgia Institute of Technology, United States.

ES4.16.06

Triboelectric Nanogenerator and Its Application in Sensor Chang Bao Han; Chinese Academy of Sciences, China.

ES4.16.07

Piezotronic Effect on the Light-Induced Pyroelectric and Photoelectric Performance Based on p-Si/Al₂O₃/n-ZnO Heterojunction Structure Haiyang Zou; Georgia Institute of Technology, United States.

ES4.16.08

Mechanoradicals Created in Porous Aerogel Film Lead to High Performance Piezoelectric Nanogenerators Qifeng Zheng; University of Wisconsin-Madison, United States.

ES4.16.09

Light-Induced Pyroelectric Effect as an Effective Approach for Ultrafast Ultraviolet Nanosensing Zhaona Wang; Beijing Normal University, China.

ES4.16.10

Piezostain-Enhanced Photovoltaic Effects in BiFeO₃/La_{0.7}Sr_{0.3}MnO₃/PMN-PT Heterostructures Haiwu Zheng; Henan University, China.

ES4.16.11

The Output Power Management of Triboelectric Nanogenerator Based on Pulsed Method Gang Cheng; Henan University, China.

ES4.16.12

Asymmetrical Triboelectric Nanogenerator with Controllable Direct Electrostatic Discharge Zongming Su; Peking University, China.

ES4.16.13

High Piezoelectric Perovskite-Structured Nanomaterials and Its Applications to Flexible Energy Harvesters Kwi-II Park; GNTECH, Korea (the Republic of).

ES4.16.14

Stretchable Thin-Film Generator with Dual Working Modes for Body Motion Energy Harvesting Xucxian Chen; Peking University, China.

ES4.16.15

Ultrasensitive and Multifunctional Tactile Sensor Based on Overhang Structured Electrode Hak-Jong Choi; Korea University, Korea (the Republic of).

ES4.16.16

Towards High Power Density Self-Charging Power Cell Ganesh Kumar Veerasubramani; Jeju National University, Korea (the Republic of).

ES4.16.17

All-in-One Shape-Adaptive Self-Charging Power Package for Wearable Electronics Min-Hsin Yeh^{1,2}; ¹Academia Sinica, Taiwan; ²Georgia Institute of Technology, United States.

ES4.16.18

Layered Tungsten Ditelluride and Its Piezoelectric Property Srinivaas Masimukku; National Tsing Hua University, Taiwan.

ES4.16.19

Nanoconfined γ -Phase Ferroelectric Nylon Nanowire for Energy Harvesting Devices Yeonsik Choi; University of Cambridge, United Kingdom.

ES4.16.20

Enhancing the Efficiency of Silicon-Based Solar Cells by the Piezotronic Effect Laipan Zhu; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

SESSION ES4.17: Piezotronics II
Session Chairs: Kailiang Ren and Wenzhuo Wu
Friday Morning, April 21, 2017
PCC North, 200 Level, Room 229 A

8:00 AM *ES4.17.01

Luminescent Ions in Composites and 2D Layered Semiconductor Nanosheets for Piezophotonics Applications Jianhua Hao^{1,2}; ¹Department of Applied Physics, The Hong Kong Polytechnic University, China; ²The Hong Kong Polytechnic University Shenzhen Research Institute, China.

8:30 AM ES4.17.02

Strontium-Doping Effects in Solution Derived Lead-Free Ferroelectric $K_{0.5}Na_{0.5}NbO_3$ Thin Films Barbara Malic^{1,2}; ¹Jozef Stefan Institute, Slovenia; ²Jozef Stefan International Postgraduate School, Slovenia.

8:45 AM *ES4.17.03

ZnO Varistor Based Piezotronic Material Till Froemling; Technical University of Darmstadt, Germany.

9:15 AM ES4.17.04

Temperature Dependence of the Piezotronic and Piezophototronic Effects in A-Axis GaN Nanobelts Xingfu Wang; Georgia Institute of Technology, United States.

9:30 AM *ES4.17.05

Nonvolatile Memory and Optoelectronic Properties of Ferroelectric/Semiconductor Heterostructures Tom Wu; King Abdullah University of Science and Technology (KAUST), Saudi Arabia.

10:00 AM BREAK

SESSION ES4.18: Smart Flexible Electronics
Session Chairs: Zhou Li and Yi Xi
Friday Morning, April 21, 2017
PCC North, 200 Level, Room 229 A

10:30 AM *ES4.18.01

Using Silicon-Based Anisotropic Piezoelectricity for Robust Design of Ultrathin Bendable ICs and Sensors Luigi G. Occhipinti; University of Cambridge, United Kingdom.

11:00 AM ES4.18.02

Hybridized Nanogenerator for Simultaneously Scavenging Solar, Thermal and Mechanical Energies Ya Yang; Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China.

11:15 AM *ES4.18.03

Flexible, Foldable and Multi-Functional Paper-Based Electronics Jr-Hau He; King Abdullah University of Science and Technology, Saudi Arabia.

11:45 AM ES4.18.04

Liquid Metal Droplet Based Tube-Shaped Electrostatic Energy Harvester Haotian Chen; PKU, China.

SESSION ES4.19: Piezoelectric and Triboelectric Nanogenerators
Session Chairs: Weiguo Hu and Ya Yang
Friday Afternoon, April 21, 2017
PCC North, 200 Level, Room 229 A

1:30 PM *ES4.19.01

Piezotronics and Piezophotonics Based Polymer Synthesis and Degradation of Organic Pollutants Hong Liu; Shandong University, China.

2:00 PM ES4.19.02

Self-Powered Electrochemical Sensors for Glucose and Lactate Detection Zong-Hong Lin; National Tsing Hua University, Taiwan.

2:15 PM *ES4.19.03

Alarm System Based on Freestanding Triboelectric Sensor for Latent Fingerprint Detection with High Sensitivity Xia Cao^{1,2}; ¹School of Chemistry and Biological Engineering, University of Science and Technology Beijing, China; ²Beijing Institute of Nanoenergy and Nanosystems, China.

2:45 PM ES4.19.04

Electrospun Poly(L-Lactic Acid) Nanofibers for Nanogenerator and Diagnostic Sensor Applications Kailiang Ren; Beijing Institute of Nanoenergy and Nanosystems, China.

3:00 PM BREAK

SESSION ES4.20: Piezoelectric and Triboelectric Materials and Devices
Session Chairs: Qingliang Liao and Yunlong Zi
Friday Afternoon, April 21, 2017
PCC North, 200 Level, Room 229 A

3:30 PM ES4.20.01

Interface Doping of ZnO Nanowires—Band-Edge Emission Enhancement and Phase Coherent Transport Nan Pan; University of Science and Technology of China, China.

3:45 PM *ES4.20.02

Triboelectric Composite Generators and Impact Sensors via Soft Material 3D Moulding Lucia Beccai; Istituto Italiano di Tecnologia, Italy.

4:15 PM ES4.20.03

Fully Implantable, Self-Powered and Multifunctional Triboelectric Active Sensor for Real-Time Biomedical Monitoring In Vivo Hao Zhang; Institute of Cardiothoracic Surgery at Changhai Hospital, China.

4:30 PM ES4.20.04

Enhance the Performance of Triboelectric Nanogenerators Based on Piezoelectric Materials by Modulate Surface Charge and Dielectric Permittivity Yi Xi; Chongqing University, China.

4:45 PM ES4.20.05

Triboelectric Nanogenerators Based on Spring Steel Plates for Practical Applications Guanlin Liu; Chongqing University, China.