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RPPR Final Report
as of 27-Aug-2018

Agency Code:

Proposal Number: 72615EGCF **Agreement Number: W911NF-18-1-0026**
INVESTIGATOR(S):

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Organization: **Materials Research Society**
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Country: USA
DUNS Number: 107328510 EIN: 311037979
Report Date: 30-Sep-2018 Date Received: 22-Aug-2018
Final Report for Period Beginning 01-Jan-2018 and Ending 30-Jun-2018
Title: Soft Materials, Sensors, Electronics, Displays and Actuators: Functional Components for Soft Machines and Robots (Symposium SM01) - 2018 MRS Spring Meeting
Begin Performance Period: 01-Jan-2018 **End Performance Period:** 30-Jun-2018
Report Term: 0-Other
Submitted By: Donna Gillespie Email: gillespie@mrs.org
Phone: (724) 779-2732

STEM Degrees: 0 **STEM Participants:** 0

Major Goals: The organizers worked to create a unique symposium with the following specific objectives: To provide a forum where the materials scientists working in the diverse areas of critical importance to the emergent field of soft machines/robotics can form connections and address key challenges; To assemble a quorum of pioneering scientists from academia and industry to deliver invited presentations on their field-shaping research; and To build momentum within the community to support the inclusion of new additions of this symposium at future MRS meetings.

Accomplishments: The symposium brought together a diverse set of communities (chemists, mechanical engineering, physicists, and materials scientists) and attracted a large number of attendees. It highlighted a range of cutting-edge research in the area of soft robotics and machines that will help frame the future directions of this rapidly growing area.

A vital component to the success of this goal was supporting the invited speakers, the leaders of the field, with travel and registration grants. The quality and diversity of their presentations reflect the interdisciplinary nature of soft robotics and the importance of this emerging field. Perhaps more telling was the high attendance rates recorded by MRS; the average oral session was 78 with a peak attendance of 140. It should also be noted that ~75 presentations were given by graduate students who represent the future of soft robotics.

Training Opportunities: Graduate students represent the future of soft robotics. Their considerably large presence at the symposium, which provided them the opportunity to share their research activity in the field with young scientists of similar interests, is a contribution of SM01 to soft robotics that will continue to give as these individuals advance past graduate research to industrial/academic positions.

RPPR Final Report
as of 27-Aug-2018

Results Dissemination: The symposium SM01: “Soft Materials, Sensors, Electronics, Displays and Actuators: Functional Components for Soft Machines and Robots” will bring together a diverse set of communities (chemists, mechanical engineers, physicist, materials scientists etc.) generating product that will be managed using the following tools/archives (with the assistance of MRS):

The Technical Program was published on the MRS website as follows:
2017 MRS Spring Meeting Call for Papers (published and stored):
http://www.mrs.org/spring-2018-call-for-papers/call-for-papers-detail/?code=SM01.

Technical Program: mid-January 2018
Program & Exhibit Guide: Early April 2018
Meeting Scene preview: last week of March 2018

Program information was published through the MRS e-media as follows:
Materials360® newsletter. For example, program results from the Spring 2017 meeting can be found at: http://www.mrs.org/materials360/

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: Co PD/PI
Participant: Stephen Morin PhD
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
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International Travel:
National Academy Member: N
Other Collaborators:

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Article Title: Design and Characterization of Edible Soft Robotic Candy Actuators
Authors: Aditya N. Sardesai, Xavier M. Segel, Matthew N. Baumholtz, Yiheng Chen, Ruhao Sun, Bram W. Schorl
Keywords: biomaterial elastic properties
Abstract: One of the goals of soft robotics is the ability to interface with the human body. Traditionally, silicone materials have dominated the field of soft robotics. In order to shift to materials that are more compatible with the body, developments will have to be made into biodegradable and biocompatible soft robots. This investigation focused on developing gummy actuators which are biodegradable, edible, and tasty. Creating biodegradable and edible actuators can be both sold as an interactive candy product and also inform the design of implantable soft robotic devices. First, commercially available gelatin-based candies were recast into pneumatic actuators utilizing molds. Edible robotic devices were pneumatically actuated repeatedly (up to n=8 actuations) using a 150 psi power inflator. To improve upon the properties of actuators formed from commercially available candy, a novel gelatin-based formulation, termed the “Fordmula” was also developed and used to create functional actuators.
Distribution Statement: 1-Approved for public release; distribution is unlimited.
Acknowledged Federal Support: **N**

RPPR Final Report
as of 27-Aug-2018

Report to Army Research Office (ARO)

Materials Research Society (MRS) 2018 Spring Meeting, Phoenix, AZ, April 2nd – April 6th

Symposium SM01: Soft Materials, Sensors, Electronics, Displays and Actuators—Functional Components for Soft Machines and Robots

Organizers:

Stephen A. Morin (University of Nebraska – Lincoln)

Ozge Akbulut (Sabanci University)

Robert F. Shepherd (Cornell University)

Adam A. Stokes (The University of Edinburgh)

Objectives:

Soft machines and robots require a range of components with functionalities that cannot be achieved using traditional, rigid constructs. These components include: soft, tough materials of high elasticity, soft sensors, displays, electronics, antennas, and actuators, and adaptive, stimuli-responsive materials and structures. The properties needed from these technologies are rarely satisfied by one type of material; rather, the required function is only achieved by combining different materials, which span a diverse range of properties (e.g., mechanical, optical, electronic, thermal, etc.), together into hierarchical structures, composites, or assemblies. This process bridges the disciplines (chemistry, physics, mechanical and electrical engineering, etc.) of materials science, presenting a number of key challenges: (i) mitigating the mechanical and thermal mismatch between different materials during synthesis and operation, (ii) predicting the behavior of inherently non-linear mechanical systems, (iii) balancing the necessary performance characteristics of materials with the limitations of chemical and/or mechanical compatibility, and (iv) choosing appropriate modes (chemical, electrical, pneumatic, or combinations thereof) of power, communication, and control for systems that lay outside traditional engineering space. Strategies that overcome these challenges and enable the design, fabrication, integration, control, and operation of such functional, hybrid materials are critical to realizing the core technologies necessary to soft machines and robots.

Overcoming these key challenges is of critical importance to the field of soft robotics and the envisioned applications. ***The major objectives of Symposium SM01, pursuant these challenges, included***:

1. SM01 was to cover the state of the art in the emergent and fast-moving area of soft robotics by surveying contributions from the various subsets of the field and bringing together a unique collection of invited speakers who represent critical areas.
2. SM01 was to provide a unique forum for the diverse set of scientists working in soft robotics to share ideas, results, and make connections, thus giving these researchers the opportunity to shape the future of bioinspired soft robots and machines.
3. SM01 was to engage the broader material science community in the challenges and potential of soft robotics as an emergent, interdisciplinary field.

4. SM01 was to build momentum within the community to support the inclusion of new editions of this symposium at future MRS meetings.

As illustrated by SM01, advances in numerous areas (e.g., soft materials, actuators, and sensors) make it easier to imagine a world filled with soft devices built to carry out a range of tasks, but they also illuminate a grand challenge for the community: Unlocking the promise of soft machines/robots requires methods that enable the facile combination of several soft components to yield functional systems.

Highlights:

SM01 included 118 presentations (68 poster presentations and 50 oral presentations) with 11 invited speakers spread over the three days of the symposium. The presentations were divided into the following unique topical sessions:

1. Soft Robots and Machines
2. Soft Actuators
3. Soft Robotic Sensors, Electronics, Power and Displays
4. Soft Materials for Soft Robotics
5. Soft Robotic Applications
6. Systems Integration
7. Innovations in Fabrication
8. Soft Robotic Control

Highlights from these sessions include presentations by: (i) Prof. George Whitesides (Harvard University, presenting on topic 1) who kicked of the symposium and uniquely framed the field of soft robotics from a materials perspective; (ii) Prof. Rebecca Kramer-Bottiglio (Yale University, presenting on topic 2) who shared her groups recent advances in the area of active robotic "skins;" (iii) Prof. Christoph Keplinger (University of Colorado – Boulder, presenting on topic 2) who discussed a new class of actuators, "hydraulically amplified self-healing electrostatic transducers," recently published in *Science*; (iv) Prof. Michael Dickey (North Carolina State University, presenting on topic 3) who gave a detailed talk on reconfigurable soft electronics based on liquid metals; (v) Prof. Jeong-Yun Sun (Seoul National University, presenting on topic 4) who discussed new classes of elastomer materials based on ionogels; (vi) Prof. Connor Walsh (Harvard University, presenting on topic 5) who shared the exciting application space soft robotics may occupy in human-robot interactions and in physical rehabilitation/assist devices; (vii) Prof. Panagiotis Polygerinos (University of Arizona, presenting on topic 6) who covered the strategies of integration in soft robotics necessary for wearable applications; and (viii) Dr. Ryan Truby (Harvard University, presenting on topic 7) who provided a detailed presentation on embedded 3D printing and how it can be used to fabricated soft systems for soft robots with integrated actuation, sensing, and power delivery.

The quality and diversity of these presentations, as well as the some 110 not listed, reflect the interdisciplinary nature of soft robotics and the importance of this emergent field, but perhaps more telling of this fact was the *high attendance rates* recorded by MRS: the average oral session

attendance was 78 with a peak attendance of 140. Furthermore, of the 15 posters recognized with "Best Poster" awards from the *entire* meeting ***3 came from Symposium SM01***, this result highlights the quality and importance of the research being conducted in the field of soft robotics from the perspective of the meeting chairs and, by extension, MRS (as it is the meeting chairs who judge/select the winners of this prestigious recognition). It is worth mention that one of these posters from SM01 was a submission from a group of high school students who worked on creating eatable robots based on candy.

Contributions to the Discipline:

We worked to create a unique symposium, which had not appeared at previous MRS meetings, that would lead to meaningful bridges between critical fields, thereby propelling soft robotics/machines towards its ultimate potential. The symposium received **more than 175** abstracts and, as noted in the highlight section, those abstracts that survived the selection process, ultimately presenting at the meeting, were **highly attended and competitive in the poster competitions**. Considering this symposium was the first of its type at an MRS national meeting, these numbers are very encouraging, and indicative of the momentum soft robotics is gaining within the general material science community. Though it will take time to quantify, potential collaborations were discussed and formed throughout the meeting, and it is the opinion of the organizers that these collaborations will lead to important advances in the field. It should be further noted that many (~75) presentations were given by graduate students, who represent the future of soft robotics. Their considerably large presence at the symposium, which provided them the opportunity to share their research activity in the field with young scientists of similar interests, is a contribution of SM01 to soft robotics that will continue to give as these individuals advance past graduate research to industrial/academic positions.

Future directions for this topic:

The positive trajectory of soft machines/robotics as an emergent field is indicated by its growth in the primary academic literature, industry activities, start-up ventures, federal programs (e.g., NSF EFRI C3 SoRo), and support for and success of symposiums like SM01 at MRS S18. It is clear that continued advancement of soft robotics through interdisciplinary research will carry it beyond the academic/industrial laboratory into a range of application spaces including, for example, biomedical, human-robot interaction, packaging, rehabilitation, surgical assist, etc. The organizers have already begun the process of working with a new group of co-organizers for a follow-up symposium (similar to SM01, but with unique aspects based on what we learned this past meeting) for future MRS Spring meetings. We are hopeful that soft robotics will become a regular topic at MRS to help drive the field forward more rapidly through better networking and collaboration fostered by conference activities.

List of those supported with ARO funds:

We requested $6,000 to cover the registration costs of invited speakers from academia who have agreed to present at our symposium. Registration was $660 per attendee and we had six

presenters. We also provided $200 dollars of additional travel support to cover, for example, a one-night stay at an MRS preferred hotel. The speakers supported are listed below.

Invited speakers:

1) Michael Dickey, North Carolina State University, USA.
2) Ryan Turby, Harvard University, USA.
3) Carmel Majidi, Carnegie Mellon University, USA.
4) Jamie Paik, École polytechnique fédérale de Lausanne, Switzerland.
5) Conor Walsh, Harvard University, USA.
6) George Whitesides, Harvard University, USA.

SYMPOSIUM SM01

Soft Materials, Sensors, Electronics, Displays and Actuators—
Functional Components for Soft Machines and Robots
April 3 - April 5, 2018

Symposium Organizers
Ozge Akbulut, Sabanci University
Stephen Morin, University of Nebraska – Lincoln
Robert Shepherd, Cornell University
Adam Stokes, The University of Edinburgh

Symposium Support
Army Research Office

MRS Invitation to Publish
All authors are invited to submit articles based on their 2018 MRS Spring Meeting presentations to 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

SESSION SM01.01: Soft Robots and Machines
Session Chairs: Stephen Morin and Robert Shepherd
Tuesday Morning, April 3, 2018
PCC West, 100 Level, Room 104 AB

10:45 AM *SM01.01.01
Soft Robotics George M. Whitesides; Harvard University, United States.

11:15 AM *SM01.01.02
Integrated Soft Robotic Systems Based on Modular Actuation, Sensing and Control Cagdas Onal; WPI, United States.

11:45 AM SM01.01.03
Effective Mechanical and Electrical Connections Between Stretchable and Flexible Electronics Kunal Mondal; NC State University, United States.

SESSION SM01.02: Soft Actuators
Session Chairs: Stephen Morin and Robert Shepherd
Tuesday Afternoon, April 3, 2018
PCC West, 100 Level, Room 104 AB

1:30 PM *SM01.02.01
Robotic Skins that Turn Inanimate Objects into Multifunctional Robots Rebecca Kramer-Bottiglio; Yale University, United States.

2:00 PM SM01.02.02
Photothermal Triggering of Magnetically Actuated Shape Memory Polymer Composites Using Bifunctional Magnetic Particles Jessica A. Liu; North Carolina State University, United States.

2:15 PM SM01.02.03
High-Speed, Largely Deformable Shape Memory Alloy (SMA) Microactuators Hyun-Taek Lee; Seoul National University, Korea (the Republic of).

2:30 PM BREAK

3:30 PM *SM01.02.04
Hydraulically Amplified Self-Healing ELectrostatic (HASEL) Transducers—A New Class of Self-Sensing, High-Performance Artificial Muscles Christoph Keplinger; University of Colorado-Boulder, United States.

4:00 PM SM01.02.05
Environmentally Responsive Origami Composites Richard Vaia; Air Force Research Laboratory, United States.

4:15 PM SM01.02.06
Actuating Polymer Sheets into Gaussian Shapes Using Light Amber M. Hubbard; North Carolina State University, United States.

4:30 PM SM01.02.07
Redox-Responsive Soft Actuators Jonathan C. Barnes; Washington University in St. Louis, United States.

4:45 PM SM01.02.08
High Performing Skin-Effect Actuators Made by Electrodepositing $NiOOH/Ni(OH)_2$ on Nano/Micro-Porous Polycarbonate Membranes Runni Wu; The University of Hong Kong, China.

SESSION SM01.03: Poster Session: Soft Robotic Sensors, Electronics, Power and Displays I
Session Chairs: Stephen Morin, Robert Shepherd and Adam Stokes
Tuesday Afternoon, April 3, 2018
5:00 PM - 7:00 PM
PCC North, 300 Level, Exhibit Hall C-E

SM01.03.01
Reversible Self-Bending Soft Hydrogel by Using pH Responsive Microbilayer with Mechanically Optimized Designs Cheolgyu Kim; KAIST, Korea (the Republic of).

SM01.03.02
Soft, Moldable Thermoplastic Elastomers Thomas E. Kodger; Wageningen University and Research, Netherlands.

SM01.03.03
Thermo-Responsive Lignin—A Renewable Feedstock for Shape Memory Applications Ngoc A. Nguyen; Oak Ridge National Laboratory, United States.

SM01.03.04
Dynamically Tunable Dry Adhesion Through Stiffness Tuning Wanliang Shan; University of Nevada, Reno, United States.

SM01.03.06
A Robust, Air-Stable and Recyclable Hydrogel Toward Stretchable Electronic Device Applications Chien-Chung Shih; NTU, Taiwan.

SM01.03.07
Wavelength-Selective Photothermal Shape Recovery of Gold Nanosphere and Nanorod Polymer Composites Joseph B. Tracy; North Carolina State University, United States.

SM01.03.08
Switchable Fibrillar Adhesives Under Different Degrees of Saturation Hosain Bagheri; Arizona State University, United States.

SM01.03.09
Quantifying Tactile Perceptions of *Softness*—Indentation Depth, Contact Area and Young's Modulus Charles Dhong; University of California, San Diego, United States.

SM01.03.10
3D Printed Elastomers and Silicone Nanocomposites for Actuated Machine Parts and Robotics Rigoberto C. Advincula; Case Western Reserve University, United States.

SM01.03.11
A 3D-Printed Hydrogel-Elastomer Hybrid Structure with Improved Mechanical Integrity Yuexing Zhan; Center for Advanced Structural Materials (CASM) and Department of Mechanical and Biomedical Engineering, Shenzhen Research Institute of City University of Hong Kong, China.

SM01.03.12
Transparent Soft Actuators for Application in Haptics and Soft Robotics Nripan Mathews; Nanyang Technological University, Singapore.

SM01.03.13
A Self-Adaptive, Omnidirectional Photonic Tracking System Based on Smart Hydrogels Xiaoshi Qian; University of California, Los Angeles, United States.

SM01.03.14
A Facile All-Solution-Processed Surface Treatment for Sticky Super-Hydrophobicity Mei Chen; Peking University, China.

SM01.03.15
Temperature and Electric Field-Responsive Flexible Smart Film with Full Broadband Optical Modulation Xiao Liang; Peking University, China.

SM01.03.16
A Self-Healable Supramolecular Material Meijin Liu; City University of Hong Kong, Hong Kong.

SM01.03.17
A Simple Fabrication Method for Fluidic Channel Based on Nitrocellulose Membrane Using Printing Technique Kyuhong Yi; Korea Electronics Technology Institute, Korea (the Republic of).

SM01.03.18
Thermo-Reversible Silicone Elastomer with Remotely Controlled Self-Healing Elisa Ogliani; Technical University of Denmark, Denmark.

SM01.03.19
Magnetically Actuating Graphene for Origami-Inspired Devices Tanner Pearson; Cornell University, United States.

SM01.03.20
Electroluminescent Soft Elastomer Actuators with Tunable Luminance and Strain Ye Rim Lee; Korea University, Korea (the Republic of).

SM01.03.21
Designs of Electroactive Soft Actuators Toward Various Actuation Motions Dohyeon Park; Pohang University of Science and Technology (POSTECH), Korea (the Republic of).

SM01.03.22
Multifunctional Boron Nitride Nanotube Polydimethylsiloxane Composite—Synthesis, Characterization and Applications Peter M. Knapp; University of Illinois at Urbana-Champaign, United States.

SM01.03.23
Electroluminescence Efficiency of Dielectric Elastomer Actuators Using Electrodes of Eutectic Gallium Indium Jongyeop An; Korea University, Korea (the Republic of).

SM01.03.24
Feasibility Study of Possible Fabrication Approaches for Multi-Layer Stacked Dielectric Elastomer Actuators with Compliant Electrodes Mert Corbaci; Rochester Inst of Technology, United States.

SM01.03.26
4D Printing of Liquid Crystal Elastomers Taylor H. Ware; The University of Texas at Dallas, United States.

SM01.03.27
Programmable Soft Microrobots for Adaptive Locomotion Hen-Wei Huang; ETH Zurich, Switzerland.

SM01.03.28
Programmable Deformations of Microchannel Networks for Soft Robotics Abhiteja Konda; University of Nebraska-Lincoln, United States.

SM01.03.29
Mechanically Programmed Electroactive Linear Actuators Based on Plain Paper/Ionogel Hybrid Nanocomposites Tommaso Santaniello; CIMaINa - Università degli Studi di Milano - Physics Department, Italy.

SM01.03.30
Design of Switchable Adhesion Actuator for Soft Climbing Robots Jie Yin; Temple University, United States.

SM01.03.31
A Combustion-Powered, Flapping-Wing Micro Air Vehicle—The Firefly Cameron Aubin; Cornell University, United States.

SM01.03.32
Block Copolymer Structural Color Strain Sensor Taehyun Park; Yonsei University, Korea (the Republic of).

SESSION SM01.04: Soft Sensors, Electronics and Displays
Session Chairs: Ozge Akbulut and Adam Stokes
Wednesday Morning, April 4, 2018
PCC West, 100 Level, Room 104 AB

8:00 AM *SM01.04.01
Patterning and Shape Reconfiguring Liquid Metals for Soft Electronics Michael Dickey; North Carolina State University, United States.

8:30 AM SM01.04.02
Tunable Mechanical Metamaterials Through Hybrid Kirigami Structures Michael D. Bartlett; Iowa State University, United States.

8:45 AM SM01.04.03
Stretchable Heat Exchangers for Thermal Management of Soft Robotics and Wearable Electronics Konrad Rykaczewski; Arizona State University, United States.

9:00 AM SM01.04.04
Bioinspired Materials for Hybrid Electronics and Biodegradable Soft Robots Florian Hartmann[1, 2]; [1]Johannes Kepler University, Austria; [2]Johannes Kepler University, Austria.

9:15 AM SM01.04.05
Detecting Spatial Defects in Colored Patterns with Coupled Self-Oscillating Gels Yan Fang; University of Pittsburgh, United States.

9:30 AM SM01.04.06
Autonomous, Multi-Site Self-Healing of Damage in Soft-Matter Electronics Eric Markvicka; Carnegie Mellon University, United States.

9:45 AM SM01.04.07
Soft, Self-Healable and Sensitive Electronic Skins for Emerging Healthcare and Robotics Applications Benjamin C. Tee; National University of Singapore, Singapore.

10:00 AM BREAK

10:30 AM *SM01.04.08
Cutting the Cord—Integrated Sensing, Actuation and Robust Electronics for Soft Robot Autonomy Carmel Majidi; Carnegie Mellon University, United States.

11:00 AM SM01.04.09
A Skin-Like Sensing Array with a Single Conductive Layer and a Reduced Number of Wires Aaron D. Mazzeo; Rutgers University, United States.

11:15 AM SM01.04.10
3D Printing of Flexible and Stretchable Electronic Devices via Direct-Writing of Liquid Metals Dishit P. Parekh; North Carolina State University, United States.

11:30 AM SM01.04.11
Development of Liquid Metal Based-Soft Electronics Using Laser Sintering Shanliangzi Liu[1, 2]; [1]Purdue University, United States; [2]Yale University, United States.

11:45 AM SM01.04.12
Synthetic Cellular-Structured Ionic Polymer Composite for Ultrasensitive Sensor Skin Over Wide Spectrum of Pressures Vipin Amoli; Hanyang University, Korea (the Republic of).

SESSION SM01.05: Soft Materials for Soft Robotics I
Session Chairs: Stephen Morin and Robert Shepherd
Wednesday Afternoon, April 4, 2018
PCC West, 100 Level, Room 104 AB

1:30 PM *SM01.05.01
Self-Powered and Transparent Attachable Ionic Communicators Based on Self-Cleanable Triboelectric Nanogenerators Jeong-Yun Sun; Seoul National University, Korea (the Republic of).

2:00 PM SM01.05.02
Adaptive Fluid-Infused Porous Film with Tunable Transparency and Wettability Yuhang Hu; University of Illinois at Urbana Champaign, United States.

2:15 PM SM01.05.03
Photoresponsive Polymer Elastomers Based on Hexaarylbiimidozoles Mingqiang Zhu; Huazhong University of Science & Technology, China.

2:30 PM BREAK

SESSION SM01.06: Soft Robotic Applications
Session Chairs: Ozge Akbulut and Adam Stokes
Wednesday Afternoon, April 4, 2018
PCC West, 100 Level, Room 104 AB

3:30 PM *SM01.06.01
Wearable Assistive Technology Optimized for the Needs of Individuals with Residual Capacity Conor Walsh; Harvard School of Engineering, United States.

4:00 PM SM01.06.02
Optomechanical Human Eye Model Based on Soft and Rigid Materials to Provide a Test Bench for Pupillometer Devices Simon Regal[1, 2]; [1]Ecole des Mines de Saint-Etienne, France; [2]IDMED, France.

4:15 PM SM01.06.03
Acoustic Manipulation with Soft Material-Based Parabolic Reflectors Xiyue Zou; Rutgers University, United States.

SESSION SM01.07: Poster Session: Soft Robotic Sensors, Electronics, Power and Displays II
Session Chairs: Ozge Akbulut and Adam Stokes
Wednesday Afternoon, April 4, 2018
5:00 PM - 7:00 PM
PCC North, 300 Level, Exhibit Hall C-E

SM01.07.01
Ultra-Sensitive, Low Driving Voltages, Flexible UV-Specific Photodetectors Based on F8T2:ZnO Nanocomposite Erjin Zheng; University of Washington, United States.

SM01.07.02
Effective Controlling of Nano-Crystallite Networks in Semiconducting Films for Soft Electronics Guoyan Zhang; Georgia Institute of Technology, United States.

SM01.07.03
Aerosol Jet Printing of Flexible, Stable and Hysteresis-Free Carbon Nanotube Thin-Film Transistors Changyong Cao; Michigan State University, United States.

SM01.07.04
Tunable Electrical Conductivity and Piezoresistivity of Embossed Cellulose-Based Substrates Tongfen Liang; Rutgers University, United States.

SM01.07.05
Strain-Sensing Behavior of CNS/PDMS Nanocomposites Under Monotonic and Cyclic Loadings S Kumar; Masdar Institute, United Arab Emirates.

SM01.07.06
Long Side-Chain Thermoset Thiolene-Based Semicrystalline Polymer Composites for Ultra-Sensitive Temperature Sensors in Flexible E-Skins Jesse Grant; The University of Texas at Dallas, United States.

SM01.07.07
Variable Stiffness Fabric for Kinesthetic Actuation Siew Ting Melissa Tan[1, 2]; [1]Nanyang Technological University, Singapore; [2]Institute of Materials Research and Engineering, Singapore.

SM01.07.08
Reversible Self-Assembly of Soft 3D Architectures Actuated by Responsive Polymers Cheng Zhang; The University of Missouri, United States.

SM01.07.09
Programmable Self-Morphing Polymer Gel Controlled by Swellable Guest Medium Heng Deng; University of Missouri, United States.

SM01.07.10
Healable and Flexible Transparent Heaters Naveen Tiwari; Nanyang Technological University Singapore, Singapore.

SM01.07.11
Carbon Nanotube Fiber-Based Torsion Sensors—Effect of Twist on Their Piezoresisitivity Jude Anike; The Catholic University of America, United States.

SM01.07.12
Directly Printed, Self-Similar Fiber-Based Nanogenerator for Stretchable Piezoelectric Sensors YongAn Huang; Huazhong University of Science and Technology, China.

SM01.07.13
Characterization of a Hydrogen-Fueled Flexible Micro Fuel Cell Seyed Reza Mahmoodi; Stevens Institute of Technology, United States.

SM01.07.14
Posedness of Hyperelastic Indentation Problem Yuexing Zhan; Center for Advanced Structural Materials (CASM) and Department of Mechanical and Biomedical Engineering, Shenzhen Research Institute of City University of Hong Kong, China.

SM01.07.15
Printed Paper Actuator—A Low-Cost Reversible Actuation and Sensing Method for Shape Changing Interfaces Guanyun Wang; Carnegie Mellon University, United States.

SM01.07.16
Geometric Design for a Highly Sensitive and Mechanically Robust Capacitive Type Strain Sensor with Multimodal Signal Decoupling Jong-Sung Lee; Seoul National University, Korea (the Republic of).

SM01.07.17
Soft and Voltage Stabilized Silicone Elastomers Anne L. Skov; DTU, Denmark.

SM01.07.18
Proton Conducting Polyoxometalate/Polypyrrole Nano Films and Their Humidity Sensing Performance Jun Miao[1, 2]; [1]Southern University of Science and Technology, China; [2]University of Macau, China.

SM01.07.19
Regulating Sensing Property of Spiropyran by Conjugated Functional Group Through a Triazole Linkage Juhyen Lee; Sungkyunkwan University, Korea (the Republic of).

SM01.07.20
A Study on the Fabrication of a Strain Gauge Using 3D Printing Technique IlGu Kim; KETI, Korea (the Republic of).

SM01.07.21
Deeper Insight into the Dielectric Breakdown of Elastomers Justina Vaicekauskaite; Technical University of Denmark, Denmark.

SM01.07.22
Synthesis and Properties of Optically Clear Silicone Resin with Silicon Nanoparticles Bok Ryul Yoo; KIST, Korea (the Republic of).

SM01.07.23
CNT/Cellulose Hybrid Films as Multifaceted Flexible Conductor Jaeok Ko[1, 2]; [1]Korea Research Institute of Chemical Technology, Korea (the Republic of); [2]Sungkyunkwan University Advanced Institute of NanoTechnology, Korea (the Republic of).

SM01.07.24
Bending-Insensitive Capacitive-Type Touch Sensor with AgNW/PEDOT:PSS Stretchable Top Electrode and Structured Rubber Dielectric Layers Dong-Joon Won; POSTECH, Korea (the Republic of).

SM01.07.25
Highly Stretchable, Transparent Ionic Skin as Strain Sensor and Touch Panel Jilong Wang; Texas Tech University, United States.

SM01.07.26
Soft Electronics on Asymmetrical Porous Conducting Membranes by Molecular Layer-by-Layer Assembly Sumin Kang; INHA University, Korea (the Republic of).

SM01.07.27
Indium-Gallium-Zinc-Oxide-Based Schottky Diodes on a Deformable Softening Polymer Substrate Edgar Guerrero; University of Texas at Dallas, United States.

SM01.07.28
Wireless Ultraflexible Magnetic Sensor Matrix System Integrated with Organic Driver and Amplifier Circuits Masaya Kondo[1, 2, 3]; [1]Institute of Scientific and Industrial Research, Japan; [2]Graduate School of Engineering, Osaka University, Suita, Japan; [3]Advanced Photonics and Biosensing Open Innovation Laboratory, National Institute of Advanced Industrial Science and Technology (AIST), Japan.

SM01.07.29
Pneumatic Balloon Actuator Integrated with Electronic Skin for Soft Robotic Application Takafumi Yamaguchi; Osaka Prefecture University, Japan.

SM01.07.30
Surface Strain Regulation of Thin-Film Conductors for Stretchable Electronics Zhiyuan Liu; Nanyang Technological University, Singapore.

SM01.07.31
A Self-Powered Dynamic Displacement Monitoring System Based on Triboelectric Accelerometer Wenbo Ding; Georgia Institute of Technology, United States.

SM01.07.32
Stretchable, Thermally Conductive Three Phase Elastomeric Composites with Hybrid Liquid-Solid Metal Fillers for Thermal Management of Soft Robotics and Wearable Electronics Konrad Rykaczewski; Arizona State University, United States.

SM01.07.34
Soft Electronics Innervated Fully Soft Bodied Adaptive Robot Cunjiang Yu; University of Houston, United States.

SM01.07.35
All-Rubbery Electronic Materials Based Stretchable Electronics, Sensors and Smart Skins Cunjiang Yu; University of Houston, United States.

SESSION SM01.08: Systems Integration
Session Chairs: Ozge Akbulut and Stephen Morin
Thursday Morning, April 5, 2018
PCC West, 100 Level, Room 104 AB

8:15 AM *SM01.08.01
Soft Pneumatic Actuator Skin for Wearable and Interactive Communication Platform Jamie Paik; EPFL, Switzerland.

8:45 AM *SM01.08.02
The Softer Side of Robots and Their Wearable Applications Panagiotis Polygerinos; Arizona State University, United States.

9:15 AM SM01.08.03
Electroactive Soft Actuators with Monolithically Integrated Gold Nanocomposite Electrodes Paolo Milani; CIMaINa - Università degli Studi di Milano - Physics Department, Italy.

9:30 AM SM01.08.04
3D Printed Soft Robotic Actuation with Fingers Designed with Mechanical Meta-Material Manpreet Kaur; Simon Fraser University, Canada.

9:45 AM SM01.08.05
Manufacture, Modeling and Design of Novel Soft Electromechanical Structures James O. Hardin[1,2]; [1]UES Inc, United States; [2]Air Force Research Laboratory (AFRL), United States.

10:00 AM BREAK

SESSION SM01.09: Innovations in Fabrication
Session Chairs: Stephen Morin and Robert Shepherd
Thursday Morning, April 5, 2018
PCC West, 100 Level, Room 104 AB

10:30 AM *SM01.09.01
Embedded 3D Printing of Autonomous and Somatosensory Soft Robots Ryan L. Truby[1,2]; [1]Harvard University, United States; [2]Harvard University, United States.

11:00 AM SM01.09.02
Covalent Lamination of Thermoplastic Sheets to Silicone Films for Pop-up Structures, Soft Actuators and Miniaturized Soft Robotics Jay M. Taylor; University of Nebraska-Lincoln, United States.

11:15 AM SM01.09.03
3D-Printable Soft Composite Actuator Aslan Miriyev; Columbia University, United States.

11:30 AM SM01.09.04
Printing Ferromagnetic Domains for Untethered Fast-Transforming Soft Materials Yoonho Kim; Massachusetts Institute of Technology, United States.

11:45 AM SM01.09.05
3D-Printing of Mutiphasic Magnetoactive Elastomers with Programmable Shape Changes Sangchul Roh; North Carolina State University, United States.

SESSION SM01.10: Soft Materials for Soft Robotics II
Session Chairs: Stephen Morin and Robert Shepherd
Thursday Afternoon, April 5, 2018
PCC West, 100 Level, Room 104 AB

1:30 PM SM01.10.01
***Moldless* Fabrication of Soft Robotic Systems with Pneumatic and Stimuli Responsive Modes of Actuation** Stephen A. Morin; University of Nebraska – Lincoln, United States.

1:45 PM SM01.10.02
Molecular Braille—Human Ability to Discriminate Surface Chemistry by Touch Cody W. Carpenter; University of California, San Diego, United States.

2:00 PM SM01.10.03
Developing Design Rules for Galinstan/PDMS Dispersions to Enhance Soft Robotics Amanda Koh; U.S. Army Research Laboratory, United States.

2:15 PM SM01.10.04
Highly Tough and Under Water-Healable Elastomer for Modular Skin-Electronics Jiheong Kang; Stanford University, United States.

2:30 PM BREAK

SESSION SM01.11: Soft Robotic Control
Session Chairs: Ozge Akbulut and Adam Stokes
Thursday Afternoon, April 5, 2018
PCC West, 100 Level, Room 104 AB

3:30 PM SM01.11.01
Multifunctional Smart Electronic Glove for Prosthetic Controls Min Ku Kim; Purdue University, United States.

3:45 PM SM01.11.02
Wireless Gesture Decoding and Actuation of Haptic Sensations with Stretchable Hybrid Electronics Rachel Miller; University of California, San Diego, United States.

4:00 PM SM01.11.03
Multi-Responsive Tactile Hydrogels as Soft Robotic Materials Ximin He; University of California, Los Angeles, United States.

4:15 PM SM01.11.04
Origami-on-Demand Using Targeted Variable Stiffness Raymond A. Bilodeau[2,1]; [1]Yale University, United States; [2]Purdue University, United States.

4:30 PM SM01.11.05
Directional Transportation of Non-Polar Molecules in Organogel Films Mohammad A. Ali; University of Illinois at Urbana-Champaign, United States.

SESSION SM01.12: Poster Session: Soft Robotic Sensors, Electronics, Power and Displays III
Thursday Afternoon, April 5, 2018
5:00 PM - 7:00 PM
PCC North, 300 Level, Exhibit Hall C-E

SM01.12.01
Design and Characterization of Edible Soft Robotic 'Candy' Actuators Holly Golecki; The Haverford School, United States.

SM01.12.03
One Step Growth of Few-Layer MoS_2 on Pencil for Different Flexible Electronic Components and Broadband Photodetector on Paper Substrate Parikshit Sahatiya; IIT Hyderabad, India.

SM01.12.04
Helical Structured Fiber-Type Interconnect for Stretchable Electronics Janghoon Woo; Yonsei University, Korea (the Republic of).

SM01.12.05
Real-Time Magnetically Actuated Polymeric Micro-Blinds for Transmittance Control Moonkyu Kwak; Kyungpook National University, Korea (the Republic of).