

PROCEEDINGS OF SPIE

Electroactive Polymer Actuators and Devices (EAPAD) XXVI

John D. Madden
Editors

25–27 March 2024
Long Beach, California, United States

Sponsored and Published by
SPIE

Volume 12945

Proceedings of SPIE 0277-786X, V. 12945

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Electroactive Polymer Actuators and Devices (EAPAD) XXVI, edited by
John D. W. Madden, Proc. of SPIE Vol. 12945, 1294501
© 2024 SPIE · 0277-786X · doi: 10.1117/12.3034034

Proc. of SPIE Vol. 12945 1294501-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:
Author(s), "Title of Paper," in *Electroactive Polymer Actuators and Devices (EAPAD) XXVI*, edited by John D. Madden, Proc. of SPIE 12945, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X
ISSN: 1996-756X (electronic)

ISBN: 9781510671966
ISBN: 9781510671973 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2024 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIE. DIGITAL LIBRARY

SPIDigitalLibrary.org

Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

vii *Conference Committee*

EAPS: REACHING FOR HIGH PERFORMANCE

- 12945 02 **Resonance-optimized dielectric elastomer pump demonstrator: a dynamic systems approach (Invited Paper)** [12945-3]
- 12945 03 **Design and manufacturing of high-strain P(VDF-TrFE-CTFE) actuators** [12945-4]

ARTIFICIAL MUSCLE AND THE BODY

- 12945 04 **Characterizing the response of piezoelectric-polymer composite haptic actuators and their interaction with skin** [12945-9]
- 12945 05 **An artificial urinary sphincter based on dielectric elastomer technology** [12945-6]
- 12945 06 **In vitro testing of an artificial muscle for the treatment of incontinence** [12945-7]
- 12945 07 **Rotary haptic device solutions using a conical dielectric elastomer actuator** [12945-10]

EAP-IN-ACTION DEMONSTRATION SESSION

- 12945 08 **Tactile fingertips and synthetic muscle in robotics for human-like grip** [12945-205]

EAP FOR SOFT ROBOTICS

- 12945 09 **Self-sensing investigation of a dielectric elastomer actuator array** [12945-14]
- 12945 0A **Development and experimental evaluation of a compact 3D bending module actuated by rolled dielectric elastomer actuators** [12945-15]

MATERIALS, FABRICATION, AND CHARACTERIZATION I

- 12945 0B **Thermoplastic-polymer-based negative stiffness biasing mechanism for high stroke dielectric elastomer actuator systems** [12945-18]

- 12945 0C **Influence of stretch-dependent permittivity on power generation output of dielectric elastomer** [12945-19]
- 12945 0D **Yield increase of DE actuators using novel repair process** [12945-21]

IONIC AND THERMAL ACTUATORS

- 12945 0E **Comparative study of the influence of the ionic coatings on the performances of air-operating coiled carbon nanotubes yarn actuators (Invited Paper)** [12945-22]
- 12945 0F **On the time response properties predicted from the exact transfer function of a multiphysics model of IPMC sensors** [12945-23]
- 12945 0G **Dynamic/static ionic composite sensor** [12945-25]

MATERIALS, FABRICATION, AND CHARACTERIZATION II

- 12945 0H **Highly anisotropic carbon fiber electrodes for DEAs and their dynamic non-monotonic conductive properties** [12945-26]
- 12945 0I **Fully inkjet-printed dielectric elastomer actuators** [12945-27]
- 12945 0J **Frequency response of fiber reinforced DEAs** [12945-28]
- 12945 0K **Multilayer dielectric elastomer actuators: processing and characterization in an out-of-plane actuator configuration** [12945-29]
- 12945 0L **Selective laser-cutting for sheet-to-sheet manufacturing process of dielectric elastomer transducers** [12945-30]
- 12945 0M **Transparent stretchable compliant electrodes for hydrophobic substrates using PEDOT:PSS/PDMS composite ink** [12945-50]

SIMULATION

- 12945 0N **Finite element modeling and numerical investigation of the effects of miniaturization on the performance of dielectric elastomer actuators** [12945-31]
- 12945 0O **Unveiling design criteria of hollow fibers dielectric elastomer actuators: a computational and experimental study** [12945-33]

SENSORS AND STRAIN

- 12945 OP **Deformation mapping in dielectric elastomer actuators using electrical impedance tomography** [12945-35]
- 12945 OQ **Influence of stacking on the stability of a multi-layer capacitive dielectric elastomer sensor for strain detection** [12945-36]
- 12945 OR **Shielded fringe field compression sensors for open ocean applications** [12945-37]
- 12945 OS **Printed stretchable dielectric sensor grids for pressure monitoring in orthopedics** [12945-38]
- 12945 OT **Electromechanical characterization of piezoresistive carbon-elastomer composites** [12945-39]

POSTER SESSION

- 12945 OU **Carbon based printed electrodes for DEAs: study of pad, inkjet, and stencil printing** [12945-43]
- 12945 OV **Inversing the actuation cycle of dielectric elastomer actuators for a facial prosthesis** [12945-44]
- 12945 OW **Dielectric elastomer actuator with electro adhesion for a vibration excitation of a conductive structure** [12945-45]
- 12945 OX **Impact of moisture absorption on the performance of a polyurethane-based dielectric elastomer actuator** [12945-47]
- 12945 OY **Advancing dielectric elastomers in soft robotics: project BROADCAST's multidisciplinary approach** [12945-49]
- 12945 OZ **A novel method for developing a tube-shaped IPMC actuator** [12945-52]

Conference Committee

Symposium Chairs

Haiying Huang, The University of Texas at Arlington (United States)
Hani Naguib, University of Toronto (Canada)

Symposium Co-chairs

Asha Hall, DEVCOM Army Research Laboratory (United States)
Jae-Hung Han, KAIST (Korea, Republic of)

Conference Chair

John D. W. Madden, The University of British Columbia (Canada)

Conference Co-chairs

Stefan S. Seelecke, Saarland University (Germany)
Anne Ladegaard Skov, Technical University of Denmark (Denmark)

Conference Program Committee

Barbar J. Akle, Lebanese American University (Lebanon)
Iain A. Anderson, The University of Auckland (New Zealand)
Yoseph Bar-Cohen, Jet Propulsion Laboratory (United States)
Ray H. Baughman, The University of Texas at Dallas (United States)
Holger Böse, Fraunhofer-Institut für Silicatforschung ISC (Germany)
Eric Cattan, Université Polytechnique Hauts-de-France (France)
Hyouk Ryeol Choi, Sungkyunkwan University (Korea, Republic of)
Marco Fontana, Scuola Superiore Sant'Anna (Italy)
Edwin W. H. Jager, Linköping University (Sweden)
Giedrius Janusas, Kaunas University of Technology (Lithuania)
Martin Kaltenbrunner, Johannes Kepler Universität Linz (Austria)
Christoph Keplinger, Max-Planck-Institut für Intelligente Systeme
(Germany)
Kwang Jin Kim, University of Nevada, Las Vegas (United States)
Soo Jin Adrian Koh, Max-Planck-Institut für Intelligente Systeme
(Germany)
Gabor M. Kovacs, CTsystems AG (Switzerland)
Maarja Kruusmaa, Tallinn University of Technology (Estonia)
Jinsong Leng, Harbin Institute of Technology (China)
Tiefeng Li, Zhejiang University (China)
Jürgen Maas, Technische Universität Berlin (Germany)

Paul Motzki, Zentrum für Mechatronik und Automatisierungstechnik
gGmbH (Germany)
Il-Kwon Oh, KAIST (Korea, Republic of)
Qibing Pei, University of California, Los Angeles (United States)
Cédric Plesse, CY Cergy Paris Université (France)
Maurizio Porfiri, NYU Tandon School of Engineering (United States)
Aaron D. Price, Western University (Canada)
Gianluca Rizzello, Saarland University (Germany)
Jonathan M. Rossiter, University of Bristol (United Kingdom)
Herbert R. Shea, Ecole Polytechnique Fédérale de Lausanne
(Switzerland)
Jun Shintake, The University of Electro-Communications (Japan)
Anuvat Sirivat, The Petroleum and Petrochemical College (Thailand)
Geoffrey M. Spinks, University of Wollongong (Australia)
Ji Su, NASA Langley Research Center (United States)
Kentaro Takagi, Toyohashi University of Technology (Japan)
Rocco Vertechy, Università degli Studi di Bologna (Italy)
Thomas Wallmersperger, TU Dresden (Germany)
Jian Zhu, The Chinese University of Hong Kong, Shenzhen (China)