

PROCEEDINGS OF SPIE

Behavior and Mechanics of Multifunctional Materials XVII

Aimy Wissa
Mariantonieta Gutierrez Soto
Russell W. Mailen
Editors

13–14 March 2023
Long Beach, California, United States

Sponsored and Published by
SPIE

Volume 12484

Proceedings of SPIE 0277-786X, V. 12484

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

Behavior and Mechanics of Multifunctional Materials XVII, edited by Aimy Wissa,
Mariantonieta Gutierrez Soto, Russell W. Mailen, Proc. of SPIE Vol. 12484,
1248401 · © 2023 SPIE · 0277-786X · doi: 10.1117/12.2682947

Proc. of SPIE Vol. 12484 1248401-1

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 *Behavior and Mechanics of Multifunctional Materials XVII*, edited by Aimy Wissa, Mariantonieta Gutierrez Soto, Russell W. Mailen, Proc. of SPIE 12484, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510660755
ISBN: 9781510660762 (electronic)

Published by

SPIE

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

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2023 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

v *Conference Committee*

PROGRAMMABLE MATERIALS I

- 12484 02 **Sequential logic in soft, multistable, and electroactive materials** [12484-1]
- 12484 03 **Complex sequential deformation using bistable mechanisms in series** [12484-2]
- 12484 04 **Photo-responsive liquid crystal elastomer logic gates processing optical information** [12484-3]
- 12484 05 **Impact-responsive layer based on encapsulated solid/liquid non-Newtonian polymers**
[12484-32]

MECHANICS OF MULTIFUNCTIONAL MATERIALS

- 12484 06 **Game theoretic simulations and entropy dynamics framework for modeling complex material interactions** [12484-6]
- 12484 07 **Finite difference modeling of heat diffusion on diffusion-limited aggregation generated fractal structures** [12484-7]
- 12484 08 **Piezoelectric ring-stack actuator characterization and modeling for high-bandwidth application** [12484-8]

MANUFACTURING OF MULTIFUNCTIONAL MATERIALS

- 12484 09 **On the electro-magnetic properties of combined carbon nanotube and carbon-coated iron nanoparticle-modified polymer composites** [12484-10]
- 12484 0A **An exploration of 3D printed freeform kerf structures** [12484-12]
- 12484 0B **Additive manufacturing of highly flexible impact wave propagation sensor** [12484-14]

ACTUATION MATERIALS

- 12484 0C **A novel deployable structure devised from a Kresling-Scissor interface** [12484-16]

PROGRAMMABLE MATERIALS II

- 12484 OE **The novel design of an energy dissipation device by bistability for structural bracing** [12484-23]
- 12484 OF **Design optimization of magneto-active elastomer unimorph actuator for shape programming**
[12484-22]
- 12484 OG **Design approach to electroelastic composites** [12484-24]

SENSING MATERIALS

- 12484 OH **Responsive and sensing composites for impact mitigation and damage detection in soft body armors** [12484-28]

DATA-CENTRIC AND AI-ENABLED MULTIFUNCTIONAL MATERIALS

- 12484 OI **Machine learning predictions and benchmarking of non-linear mechanical behavior of polymer composites** [12484-29]
- 12484 OJ **Statistical reconstruction of heterogenous microstructures based on 2D images** [12484-30]

Conference Committee

Symposium Chairs

Anastasia Muliana, Texas A&M University (United States)
Wieslaw M. Ostachowicz, The Szewalski Institute of Fluid-Flow Machinery (Poland)

Symposium Co-chairs

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

Conference Chair

Aimy Wissa, Princeton University (United States)

Conference Co-chairs

Mariantonieta Gutierrez Soto, The Pennsylvania State University (United States)
Russell W. Mailen, Auburn University (United States)

Conference Program Committee

Amir Ameli, Washington State University Tri-Cities (United States)
Gregory P. Carman, University of California, Los Angeles (United States)
Constantin Ciocanel, Northern Arizona University (United States)
Marcelo J. Dapino, The Ohio State University (United States)
Mohammad H. Elahinia, The University of Toledo (United States)
Nakhiah C. Goulbourne, University of Michigan (United States) and The National Science Foundation (United States)
Ryan L. Harne, The Pennsylvania State University (United States)
Darren J. Hartl, Texas A&M University (United States)
Daniel J. Inman, University of Michigan (United States)
Kwang Jin Kim, University of Nevada, Las Vegas (United States)
Dimitris C. Lagoudas, Texas A&M University (United States)
Hyeong Jae Lee, Jet Propulsion Laboratory (United States)
Donald J. Leo, The University of Georgia (United States)
Jiangyu Li, University of Washington (United States)
Christopher S. Lynch, University of California, Riverside (United States)
Hani E. Naguib, University of Toronto (Canada)
William S. Oates, Florida State University (United States)
Zoubeida Ounaies, The Pennsylvania State University (United States)

Reza Rizvi, York University (Canada)
Ralph C. Smith, North Carolina State University (United States)
Vishnu Baba Sundaresan, The Ohio State University (United States)