

PROCEEDINGS OF SPIE

# ***Metamaterials, Metadevices, and Metasystems 2018***

**Nader Engheta**  
**Mikhail A. Noginov**  
**Nikolay I. Zheludev**  
*Editors*

**19–23 August 2018**  
**San Diego, California, United States**

*Sponsored and Published by*  
SPIE

**Volume 10719**

Proceedings of SPIE 0277-786X, V. 10719

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

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](http://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 *Metamaterials, Metadevices, and Metasystems 2018*, edited by Nader Engheta, Mikhail A. Noginov, Nikolay I. Zheludev, Proceedings of SPIE Vol. 10719 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510620094

ISBN: 9781510620100 (electronic)

Published by

**SPIE**

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

Telephone +1 360 676 3290 (Pacific Time) Fax +1 360 647 1445

[SPIE.org](http://SPIE.org)

Copyright © 2018, Society of Photo-Optical Instrumentation Engineers.

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 copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at [copyright.com](http://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. The CCC fee code is 0277-786X/18/\$18.00.

Printed in the United States of America Vm7 i ffUb '5gg: WJUH' q' bWZi bXYf' JW bgY Z'ca 'GD-9.

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

**SPIE. DIGITAL LIBRARY**

[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**Paper Numbering:** *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article 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	<i>Authors</i>
ix	<i>Conference Committee</i>

---

## METASURFACE OPTICS

---

10719 07	<b>Huygens' metasurface made of core-shell spherical nanoparticles [10719-4]</b>
----------	--

---

## METADEVICES AND METASYSTEMS I

---

10719 0F	<b>Reconfigurable passband filter using a controllable variable inductance [10719-13]</b>
----------	---

---

## STRONG COUPLING

---

10719 0K	<b>Spontaneous emission of light by a dipole coupled to a plasmonic nanoresonator [10719-18]</b>
10719 0L	<b>Coupling effects in dense arrays of 3D optical metamaterials [10719-19]</b>

---

## TOPOLOGICAL METAMATERIALS AND METASURFACES

---

10719 0S	<b>Topologically protected embedded eigenstates, leaky modes, and Jordan modes (Invited Paper) [10719-26]</b>
10719 0U	<b>Advanced multi-objective and surrogate-assisted optimization of topologically diverse metasurface architectures [10719-28]</b>

---

## DIELECTRIC NANO-OPTICS

---

10719 15	<b>All-dielectric metasurface lenses for focal plane arrays operating in mid-wave infrared spectrum [10719-39]</b>
----------	--

---

## MID-IR TO THZ

---

10719 1H	<b>Confined terahertz surface waves on meta-surfaces and Goubau lines [10719-50]</b>
----------	--

---

## PLASMONIC METAMATERIALS AND PHENOMENA

---

10719 1Q **Accumulation layer surface plasmons (Invited Paper)** [10719-59]

---

## DIELECTRIC META-OPTICS

---

10719 1V **Dielectric zero-index metamaterial filled photonic crystal defect waveguide: design and analysis** [10719-64]

---

## MATERIAL COMPONENTS

---

10719 23 **Finite-difference time-domain numerical study of ultrashort pulse propagation across sub-micron scale distances in Al:ZnO/ZnO at the epsilon near-zero spectral point** [10719-72]

---

## FUNDAMENTAL PHENOMENA II

---

10719 29 **Coupled mode formulation by reciprocity in waveguides based on double and single negative metamaterial media** [10719-77]

---

## METADEVICES AND METASYSTEMS II

---

10719 2D **Coupling between metallic structure and phonon polaritons for sensing applications** [10719-82]

10719 2E **Determining attenuation and propagation constants of microstrip line in long-wave infrared** [10719-83]

10719 2F **High efficient metasurface for broadband achromatic focusing in visible spectrum** [10719-84]

---

## HYPERBOLIC METAMATERIALS

---

10719 2K **Large-area outcoupling of quantum dot emission on multilayer hyperbolic metamaterials** [10719-88]

10719 2L **Mode coupling in graphene-based hyperbolic metamaterial waveguides** [10719-90]

---

## STRUCTURED LIGHT

---

10719 2P **Vortex beam generation using all dielectric metasurface** [10719-93]

**POSTER SESSION**

---

- 10719 2V **A hybrid method for scattering by multiple bodies** [10719-98]
- 10719 2W **Dynamic coherent light scattering by the cement with carbon nanotubes during hydration process** [10719-99]
- 10719 2Y **Reconfigurable dual-band to single-band filter based on a composite right/left-handed resonator** [10719-101]
- 10719 33 **Propagation properties of Fibonacci hypercrystal based on metamaterials** [10719-106]
- 10719 34 **Study of conductivity of the poly(3-hexylthiophene-2, 5-diyl) polymer (P3HT) in resonant Fabry-Perot cavities** [10719-107]
- 10719 35 **Toward plasmonic control of light propagation in an optical fiber** [10719-108]
- 10719 38 **Time resolved terahertz spectroscopy of optically pumped multilayered graphene on silicon substrate** [10719-111]
- 10719 39 **Epsilon-near-zero copper-dielectric composite for terahertz frequency range** [10719-112]
- 10719 3C **Fractal plasmonic metamaterial with tunable properties in the near-infrared** [10719-117]