## PROCEEDINGS OF SPIE

# Optical Data Storage 2016

Ryuichi Katayama Thomas D. Milster Editors

28 August 2016 San Diego, California, United States

Sponsored and Published by SPIE

Volume 9959

Proceedings of SPIE 0277-786X, V. 9959

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

Optical Data Storage 2016, edited by Ryuichi Katayama, Thomas D. Milster, Proc. of SPIE Vol. 9959, 995901 · © 2016 SPIE · CCC code: 0277-786X/16/\$18 · doi: 10.1117/12.2256404

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 SPIEDigitalLibrary.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 *Optical Data Storage 2016*, edited by Ryuichi Katayama, Thomas D. Milster, Proceedings of SPIE Vol. 9959 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic) ISBN: 9781510603097

ISBN: 9781510603103 (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

Copyright © 2016, 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. 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/16/\$18.00.

Printed in the United States of America.

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



**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 six-digit CID article numbering system structured as follows:

- The first four 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**

**Authors** 

9959 OB

9959 OC

HOLOGRAPHIC DATA STORAGE I

9959 03 Cavity enhanced image recording for holographic data storage [9959-3]

9959 05 Effect of wavelength change in microholographic recording [9959-13]

EMERGING AND ELEMENTAL TECHNOLOGIES I

9959 08 Advanced technology of GaN based tunable violet laser with external cavity for holographic data storage [9959-8]

HOLOGRAPHIC DATA STORAGE II

Interaction of angular plane wave spectra of Bragg and non-Bragg orders in

based on a computer-generated hologram [9959-11]

photorefractive lithium niobate [9959-12]

Numerical evaluation of shift multiplexing using a spherical wave in a holographic memory

## **Authors**

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abeywickrema, Ujitha, 0C Banerjee, Partha, 0C Dejima, Norihiro, 08 Higashiura, Atsushi, 08 Higuchi, Yu, 08 Katayama, Ryuichi, 05 Kota, Akash, 0C Miller, Bo E., 03 Mori, Naoki, 08 Nobukawa, Teruyoshi, 0B Nomura, Takanori, 0B Omori, Masaki, 08 Takashima, Yuzuru, 03

## **Conference Committee**

#### **Program Track Chairs**

**Shizhuo Yin**, The Pennsylvania State University (United States) **Ruyan Guo**, The University of Texas as San Antonio (United States)

#### Conference Chairs

Ryuichi Katayama, Fukuoka Institute of Technology (Japan)
Thomas D. Milster, College of Optical Sciences, The University of Arizona (United States)

#### Conference Program Committee

Mark R. Ayres, Akonia Holographics, LLC (United States)

Min Gu, RMIT University (Australia)

Luping Shi, Tsinghua University (China)

**Kenichi Shimada**, Hitachi, Ltd. (Japan) **Yuzuru Takashima**, College of Optical Sciences, The University of

Arizona (United States)

**Din Ping Tsai**, Research Center for Applied Sciences - Academia Sinica (Taiwan)

#### Session Chairs

- Holographic Data Storage I
   Yuzuru Takashima, The University of Arizona (United States)
- 2 Emerging and Elemental Technologies I Thomas D. Milster, College of Optical Sciences, The University of Arizona (United States)
- Holographic Data Storage II
   Ryuichi Katayama, Fukuoka Institute of Technology (Japan)
- 4 Emerging and Elemental Technologies II **Luping Shi**, Tsinghua University (China)

## Introduction

This proceedings volume is a collection of papers based on the invited and contributed presentations at the Optical Data Storage (ODS) 2016 conference, which was held on 28 August 2016 at the San Diego Convention Center as part of the SPIE Optics + Photonics 2016.

The ODS had been held as a stand-alone conference from 1973 to 2012. However, because of the decrease in the number of researchers in the field of optical data storage, it has been held as part of larger conferences since 2013. This was the third time for ODS to be held in the SPIE Optics + Photonics.

ODS 2016 was basically a success. Although 2 papers were cancelled before the conference, a total of 14 papers (8 invited papers and 6 contributed papers) were presented orally. The average number of attendees for each session in this year was almost the same as those in the past two years. There were some high-quality presentations about holographic data storage as well as emerging and elemental technologies. It is highly expected that holographic data storage will be put into practical use in the professional archival storage market in the near future, and that emerging and elemental technologies will explore novel applications in which improved function and performance are realized utilizing the features of light, unlike other storage modalities.

We are very happy that a total of 5 papers are contained in this proceedings volume. They represent important and interesting achievements in the current field of optical data storage. We hope that the readers find this proceedings volume stimulating and exciting as well as helpful for their future research and development.

We are planning to have the ODS 2017 as part of SPIE Optics + Photonics 2017, which will be officially announced later. To further activate ODS, we would like to enhance the range of attendees and discussions by incorporating related technologies, inviting researchers in the big data industry, etc. Reconsidering the conference name might also be a good idea.

Finally, we would like to express our sincere gratitude to the committee members, session chairs, all of the presenters and attendees of the ODS 2016, and the SPIE staff for their great contributions.

Ryuichi Katayama Thomas D. Milster