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Post Deadline Submissions: 10 April 2009

[Paper Submissions](#)

## The Optical Data Storage Topical Meeting

Lake Buena Vista, Florida, USA | 11-13 May 2009

The 24th ODS topical meeting provides an excellent forum for exchanging information on the status, advances, and future directions in the field of optical data storage.

Third generation high density recording systems using blue-violet lasers have been introduced to the commercial market.

Technology for fourth generation products - holographic, volumetric, near field, super resolution and hybrids - will be a main focus at ODS 2009. Hot new concepts such as small form factor optical disc, optical card device, and others will also be explored.

Contributions are encouraged from a variety of areas spanning basic theory and modeling to manufacturing and testing methods including optical drive systems, sub-systems and components, coding and channels, media development and design, and industrial and consumer applications. Invited talks in many of these areas will round out the 3 day program.

### Program Committee:

<b>General Co-Chair:</b>	<b>Kevin Curtis</b> Inphase Technologies, USA
<b>General Co-Chair:</b>	<b>Luping Shi</b> Data Storage Institute, Singapore
<b>Program Co-Chair:</b>	<b>In-Ho Choi</b> LG Electronics, Inc., Korea
<b>Program Co-Chair:</b>	<b>Robert McLeod</b> University of Colorado, USA
	<b>Sumio Ashida</b> Toshiba Corporation, Japan
	<b>Vjayakumar Bhagavatula</b> Carnegie Mellon University, USA
	<b>Lambertus Hesselink</b> Stanford University, USA
	<b>Tzuan-Ren Jeng</b> Industrial Technology Research Institute, Taiwan
	<b>Rie Kojima</b> Panasonic Corporation, Japan
	<b>Kyung-Geun Lee</b> Samsung Electronics Co., Ltd., Korea
	<b>Masud Mansuripur</b> University of Arizona, USA
	<b>Hiroyuki Minemura</b> Hitachi, Ltd., Japan

### Advisory Committee:

<b>Co-Chair:</b>	<b>Tim Rausch</b> Seagate Research, USA
<b>Co-Chair:</b>	<b>Kimihiko Saito</b> Sony Corporation, Japan
	<b>Bernard Bell</b> Optical Wizards, USA
	<b>Chong Tow Chong</b> Data Storage Institute, Singapore
	<b>Der-Ray Huang</b> Industrial Technology Research Institute, Taiwan
	<b>Ryuichi Katayama</b> NEC Corporation, Japan
	<b>Jooho Kim</b> Samsung Electronics Co., Ltd., Japan
	<b>Seiji Kobayashi</b> Sony Corporation, Japan
	<b>Takeshi Maeda</b> Hitachi, Ltd., Japan
	<b>Tom Milster</b> University of Arizona, USA
	<b>Naoyasu Miyagawa</b> Panasonic Corporation, Japan
	<b>Michael O'Neill</b> Cellular Biogengineering, Inc., USA

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**Susanna Orlic**

Technical University of Berlin, Germany

**Longfa Pan**

Tsinghua University, China

**Kenji Tanaka**

Sony Corporation, Japan

**Paul Wehrenberg**

Apple Computer, Inc. USA

**yuki Yamatsu**

Sony Corporation, Japan

**Young-Pil Park**

Yonsei University, Korea

**Barry Schechtman**

Information Storage Industry Consortium,  
USA

**Tuviah Schlesinger**

Carnegie Mellon University, USA

**Takeshi Shimano**

Hitachi Maxell Ltd., Japan

**Yun Sup Shin**

LG Electronics, Inc., Korea

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National Taiwan University, Taiwan

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Paper Submissions

## Topics

- Scope**
- Committee
- Invited Speakers

### Topics of Interest Include:

- » Coding and Signal Processing
- » Components
- » Drive Technology
- » High Density, High Speed
- » Holographic
- » Media
- » Modeling
- » Near Field
- » Other
- » Super Resolution
- » Systems and Applications
- » Testing

### Announcements:

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USA



 **Topics**
[Scope](#) | [Committee](#) | [Invited Speakers](#)
**Topic Speakers:****Engineering the 300 GB HDS Disk & Drive**

Ken E. Anderson, InPhase Technologies, USA

**Development of Deformable Mirror for Spherical Aberration Compensation**

Sunao Aoki, Sony Corporation, Japan

**Spintronics: Macroscopic Quantum Phenomena in Nanometer-Scale Magnets, and Implementations of Quantum Information Processing in the Solid State**

David Awschalom, University of California – Santa Barbara, USA

**DRM/Fair Use for Optical Recording**

Jim Burger, Dow Lohnes, PLLC, USA

**5 Dimensional Optical Storage Using Gold Nanorods**

James W.M. Chon, Swinburne University of Technology, Australia

**Patterning Nano-Domains with Orthogonal Functionalities: Solventless Synthesis of Self-Sorting Surfaces**

Karen Gleason, Massachusetts Institute of Technology, USA

**Advanced Light Sources for ODS**

Shibin Jiang, AdValue Photonics, USA

**Dynamic Polarization Selective Recording Using Surface Plasmon Phenomenon**

Jooho Kim, Samsung Electronics Co., Ltd, Japan

**Advances in Two-Color Materials for High Density Optical Data Storage**

Robert McLeod, University of Colorado at Boulder, USA

**Volumetric Optical Storage with Microholograms**

Susanna Orlic, Technical University of Berlin, Germany

**IBM's Racetrack Memory Project**

Stuart Parkin, IBM Research, USA

**Nanomaterials for ODS**

Yasuo Tomita, University of Electro-Communications, Japan

**The Physics of Light Transmission through Subwavelength Apertures and Aperture Arrays**

John Weiner, National Institute of Standards and Technology, USA

Announcements:

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Paper Submissions

## Featured Tutorials

### 1. Holographic Recording

Kevin Curtis, InPhase Technologies, USA

#### Course Description

This short course addresses the fundamental principles and design issues pertaining to digital holographic data storage (HDS). The fundamental principles of holography, including formation of and diffraction from thick diffraction gratings, are explained.

The system architecture of phase conjugate polytopic-angle based systems is presented and their key design issues explained. The monocular architecture version of angle-polytopic is also explained. Write strategies and record scheduling for achieving high capacity in HDS systems are described. For angle multiplexing based systems, the servo systems and tolerances are discussed. These include thermal compensation and disk position and tilts.

The data channel for HDS systems is particularly different than conventional optical storage systems. The key issues such as over-sampled detection, interleaving, and error correction are presented.

HDS media testing and test equipment are described.

#### Instructor Biography

**Kevin Curtis** is Chief Technology Officer and founder of InPhase Technologies in Longmont, Colorado. In this role, Kevin manages and provides the technical direction for the advanced research and development of InPhase's holography-based technologies and products for storage.

Prior to founding InPhase, Kevin was a member of the technical staff at Bell Laboratories where he directed the efforts of the holographic storage program upon which InPhase was founded. This included business development and raising the Series A investments to start InPhase. Kevin has worked at Caltech, Northrop and Bell Labs on holographic optical systems for over 17 years.

Dr. Kevin Curtis received his B.S., M.S., and Ph.D. degrees in electrical engineering in 1990, 1992 and 1994, respectively, all from the California Institute of Technology, Pasadena, California. He has authored 90+ publications and talks and has over 50 U.S. Patents awarded on holographic storage.

### 2. How future storage technologies could benefit from existing or emerging nano-tools and techniques

Masud Mansuripur, University of Arizona, College of Optical Sciences, USA

#### Course Description

Certain ideas and techniques are being developed outside the field of optical/magnetic/electronic recording, but the storage community could benefit from these developments once it becomes sufficiently familiar with the new concepts and methodologies. Developments in the areas of nano- and bio-photonics, fluorescence microscopy, quantum-dots, optical tweezers, micro- and nano-fluidics, femtosecond lasers, etc., have the potential to influence future generations of data storage systems.

#### Instructor Biography

**Masud Mansuripur** received his PhD in Electrical Engineering from Stanford University in 1981. He worked at Xerox Palo Alto Research Center, was a member of the technical staff at Xerox Research Centre of Canada, and was on the faculty of Boston University before joining the University of Arizona (Tucson) in 1988, where he is currently Professor and Chair of Optical Data Storage in the College of Optical Sciences. Dr. Mansuripur's published books include: "Introduction to Information Theory"

Announcements:

**Postdeadline Submissions:**  
**10 April 2009**

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## *ODS 2009 Program-At-A-Glance*

	<b>11 May 2009 Monday</b>	<b>12 May 2009 Tuesday</b>	<b>13 May 2009 Wednesday</b>
<b>8:30am – 10:15am</b>	Microholographic MA	High Density, Super Resolution, Nano-Photonics TuA	Media and Components WA
<b>10:30am – 11:00am</b>	<b>BREAK</b>		
<b>11:00am – 12:00pm</b>	Spintronics MB	Digital Rights Management TuB	Holographic Recording II WB
<b>12:00pm – 1:30pm</b>	<b>LUNCH BREAK</b>		
<b>1:30pm – 3:00pm</b>	Near Field MC	Holographic Recording I TuC	Media and Components II WC
<b>3:00pm – 3:30pm</b>	<b>BREAK</b>		
<b>3:30pm – 5:00pm</b>	<p style="text-align: center;"><b>3:30pm-4:15pm</b> <b>Holographic Recording</b> Kevin Curtis, InPhase Technologies, USA</p> <p style="text-align: center;"><b>4:15pm-5:00pm</b> <b>How future storage technologies could benefit from existing or emerging nano-tools and techniques</b> Masud Mansuripur, University of Arizona, College of Optical Sciences, USA</p>	<p style="text-align: center;"><b>3:30pm-4:15pm</b> <b>Microholographic Recording</b> Robert McLeod, University of Colorado at Boulder, USA</p> <p style="text-align: center;">Susanna Orlic, Berlin University of Technology, Germany</p> <p style="text-align: center;"><b>4:15pm-5:00pm</b> <b>Heat Assisted Magnetic Recording(HAMR)</b> Bill Challener, Seagate Technologies, USA</p>	Post deadline Session
<b>6:00pm – 6:30pm</b>	Poster Session (Same Room As Reception)		
<b>6:30pm – 8:00pm</b>	Welcome Reception		
<b>8:00pm – 10:00pm</b>		Panel Session “The Future of Content Distribution”	

# Advance Program

**Monday, 11 May 2009**

**8:30 AM - 10:15 AM**

**Session MA:** MICROHOLOGRAPHIC  
**Session Co-Chairs:** Lambertus Hesselink, *Stanford University, Stanford, CA, USA*  
 Hisayuki Yamatsu, *Sony Corporation, Atsugi-shi, Kanagawa, Japan*

**MA1 8:30 AM - 9:00 AM (Invited)**

**Volumetric Optical Storage with Microholograms**, S. Orlic, E. Dietz, T. Feid, S. Frohmann, H. Markoetter and J. Rass, *Technical University Berlin, Berlin, Germany*

Research activities and development paths toward a fully functional optical drive system based on the microholographic storage approach are presented. Setups for microlocalized write/read operation and a media tester for characterization of recording materials are developed. Recent progress in dynamic multilayer recording is reported.

**MA2 9:00 AM - 9:30 AM (Invited)**

**Advances in Two-Color Materials for High Density Optical Data Storage**, R. R. McLeod, *University of Colorado at Boulder, Boulder, CO, USA*

ABSTRACT NOT AVAILABLE

**MA3 9:30 AM - 9:45 AM**

**Microholographic Recording Using Single-Sided Optics with Electrical Beam Control**, R. Katayama, M. Natsumeda and Y. Komatsu, *NEC Corporation, Kawasaki, Japan*

A single-sided optics for microholographic recording along with an optical recording medium having a quarter-wave layer and a reflective layer has been proposed and experimentally demonstrated by using liquid crystal elements for electrical beam control.

**MA4 9:45 AM - 10:00 AM**

**Increasing Microholographic Storage Density in Photopolymer with a Secondary Unimolecular Termination Agent**, M. W. Grabowski and R. R. McLeod, *University of Colorado at Boulder, Boulder, CO, USA*

Deriving a new photopolymerization model incorporating a unimolecular termination agent we show a spatial scale dependence on recording fidelity. Larger scale structures narrow, while smaller structures are unaffected, potentially increasing microholographic storage density.

**MA5 10:00 AM - 10:15 AM**

**High Density Microholographic Data Storage with Aberration Distorted Holograms**, E. Dietz, S. Frohmann, A. Guenther, J. Rass and S. Orlic, *Technical University Berlin, Berlin, Germany*

We investigate the impact of SA onto the performance of microholographic data storage by observing the spatial distribution and diffraction efficiency of microgratings at different aberration degrees. Results obtained on transversal and longitudinal localization of aberration-distorted microholograms are presented.

**10:30 AM – 11:00 AM**

**COFFEE BREAK**

**11:00 AM - 12:00 PM**

**Session MB:** SPINTRONICS  
**Session Co-Chairs:** Masud Mansuripur, *University of Arizona, Tucson, AZ, USA*

**MB1 11:00 AM - 11:30 AM (Invited)**

**Spintronics: Macroscopic Quantum Phenomena in Nanometer-Scale Magnets, and Implementations of Quantum Information Processing in the Solid State**, G. Fuchs, *University of California - Santa Barbara, Santa Barbara, CA, USA*

ABSTRACT NOT AVAILABLE

**MB2 11:30 AM - 12:00 PM (Invited)**

**IBM's Racetrack Memory Project**, S. Parkin, *IBM Research, San Jose, CA, USA*

ABSTRACT NOT AVAILABLE

**12:00 PM – 1:30 PM**

**LUNCH BREAK**

**1:30 PM - 3:00 PM**

**Session MC:** NEAR FIELD  
**Session Co-Chairs:** Kimihiro Saito, *Sony Corporation, Tokyo, Japan*  
 Tim Rausch, *Seagate Technology, Pittsburgh, PA, USA*

**MC1 1:30 PM - 2:00 PM (Invited)**

**The Physics of Light Transmission through Subwavelength Apertures and Aperture Arrays**, J. Weiner, *Universidade de Sao Paulo, Sao Carlos, Brazil*

The passage of light through apertures much smaller than the wavelength of the light has proved to be a surprisingly subtle phenomenon. This report describes how modern developments in nanofabrication, coherent light sources, and numerical vector fields simulations have led to the upending of early predictions from scalar diffraction theory and classical electrodynamics.

**MC2 2:00 PM - 2:15 PM**

**Optical Antennas and Their Potential Applications to 10 Terabit/in<sup>2</sup> Recording**, H. Wang, C. T. Chong and L. Shi, *Data Storage Institute, Singapore*

We investigated different types of optical antennas, studied the polarization status of light in the near field of resonant optical antennas and proposed to use rectangular boundary bowtie aperture optical antenna for ten terabit/in<sup>2</sup> recording.

**MC3 2:15 PM - 2:30 PM**

**Integrated Near Field Transducer Heat Assisted Magnetic Recording Head: Design and Recording Demonstration**, A. Itagi, W. A. Challener, C. Peng, D. C. Karns, Y. Peng, X. Yang, X. Zhu, N. Gokemeijer, Y. T. Hsia, G. Ju, R. Rottmayer, M. Seigler, T. Rausch and E. Gage, *Seagate Technology, Pittsburgh, PA, USA*

We present a spin stand recording demonstration with an integrated near field transducer heat assisted magnetic recording head. An areal density of ~240 Gbit/in<sup>2</sup> at 15.5 dB ACSN was obtained on FePt media spinning at 2700 rpm. The head design is discussed.

**MC4 2:30 PM - 2:45 PM**

**Sub-Surface Imaging System for Blue Ray Disk**, S.-H. Yang and T. D. Milster, *University of Arizona, Tucson, AZ, USA*

Sub-surface imaging system using a solid immersion lens (SIL) is introduced. Aberration caused by cover layer of Blue ray disk is minimized with truncated SIL and diffractive optical element (DOE). Sub-surface imaging simulation is achieved by using rigorous coupled wave technique, partial coherence and vector

**MC5 2:45 PM - 3:00 PM**

**Tilt Detection and Stable Approach Methods for Near Field Recording**, T. Kwon, D.-H. Son, B.-S. Kwak, J.-K. Seo, I.-H. Choi and B. H. Min, *LG Electronics Inc., Kyunggi-Do, Korea*

We present advanced methods to improve the performance of near field system. Using the RF signal, a near field system detects tilt error and finds the best tilt condition. The 2-step approach process shortens the pull-in time and decreases the possibility of collision.

**3:00 PM – 3:30 PM****COFFEE BREAK****3:30 PM - 5:00 PM****Session TUT1: TUTORIAL I****TUT1.1 3:30 PM - 4:15 PM (Tutorial)**

**Holographic Recording**, K. Curtis, *InPhase Technologies, Longmont, CO, USA*

This tutorial addresses the fundamental principles and design issues pertaining to digital holographic data storage (HDS). The fundamental principles of holography, including formation of and diffraction from thick diffraction gratings, are explained.

The system architecture of phase conjugate polytopic-angle based systems is presented and their key design issues explained. The molecular architecture version of angle-polytopic is also explained. Write strategies and record scheduling for achieving high capacity in HDS systems are described. For angle multiplexed based systems, the servo systems and tolerances are discussed. These include thermal compensation and disk position and tilts.

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HDS media testing and test equipment are described.

**Kevin Curtis** is Chief Technology Officer and founder of InPhase Technologies in Longmont, Colorado. In this role, Kevin manages and provides the technical direction for the advanced research and development of InPhase's holography-based technologies and products for storage.



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Dr. Kevin Curtis received his B.S., M.S., and Ph.D. degrees in electrical engineering in 1990, 1992, and 1994, respectively, all from the California Institute of Technology, Pasadena, California. He has authored 90+ publications and talks and has over 50 U.S. Patents awarded on holographic storage.

**TUT1.2 4:15 PM - 5:00 PM (Tutorial)**

**How Future Storage Technologies Could Benefit from Existing or Emerging Nano-Tools and Techniques**, M. Mansuripur, *University of Arizona, Tucson, AZ, USA*

Certain ideas and techniques are being developed outside the field of optical/magnetic/electronic recording, but the storage community could benefit from these developments once it becomes sufficiently familiar with the new concepts and methodologies. Developments in the areas of nano- and bio-photonics, fluorescence microscopy, quantum-dots, optical tweezers, micro- and nano-fluidics, femtosecond lasers, etc., have the potential to influence future generations of data storage systems.

**Masud Mansuripur** received his PhD in Electrical Engineering from Stanford University in 1981. He worked at Xerox Palo Alto Research Center, was a member of technical staff at Xerox Research Centre of Canada, and was on faculty of Boston University before joining the University of Arizona (Tucson) in 1988, where he is currently Professor and Chair of Optical Data Storage in the College of Optical Sciences. Dr. Mansuripur's published books include: "Introduction to Information Theory" (Prentice Hall, 1987), "The Physical Principles of Magneto-Optical Recording" (Cambridge University Press, 1995), and "Classical Optics and its Applications" (Cambridge University Press, 2002; Japanese expanded edition, 2005; 2<sup>nd</sup> English edition, 2009). A Fellow of the Optical Society of America (OSA), he has published over 250 articles in the areas of optical recording, macro-molecular data storage, magnetism and magnetic materials, radiation pressure, and nano-photonics.

**6:00 PM - 6:30 PM**

**Session MP: POSTER SESSION**

**MP1 Media Related Characteristics of the Solid Immersion Lens System**, H. Yoo, K. Kim and J. Kim, *Seoul National University, Seoul, Korea*

Previous research on the important characteristics for real SIL system including media layer is introduced and investigated more advance way. And several comparison results of tolerance ability between Opti- and Hyper-SIL systems are reported.

**MP2 Readout System of Multi-Level Read-Only Disc Using Readout Signal Wave-Shape Modulation**, H. Wang, *Tsinghua University, Beijing, China*

This paper presents the readout system of multi-level read-only disk using readout signal wave-shape modulation (SWSM). The experimental results show the good performance of this readout system.

**MP3 Investigation on Mechanism of Multiple Holographic Recording in Photopolymers**, Q. Zhai, S. Tao and T. Zhang, *Beijing University of Technology, Beijing, China*

The dynamics of refractive index modulation under uniform exposure after a short holographic recording in photopolymer is studied, and exposure scheme for multiplexed holographic recordings with equalized diffraction efficiency has been proposed.

**MP4 Readout System of the Multi-Level Read-Only Disc Using Signal Waveform Modulation**, M. Yan, J. Pei, L. Pan and Y. Tang, *Tsinghua University, Beijing, China*

The readout system of a novel ML-RLL read-only disc using signal waveform modulation is proposed. The DVD platform, sync pattern detection for timing recovery and two-stage RF detection are used in the readout system.

**6:30 PM – 8:00 PM**

**WELCOME RECEPTION**

**Tuesday, 12 May 2009**

**8:30 AM - 10:30 AM**

**Session TuA: HIGH DENSITY, SUPER-RESOLUTION, NANO-PHOTONICS**  
**Session Co-Chairs:** Robert R. McLeod, *University of Colorado at Boulder, Boulder, CO, USA*  
 Kenji Tanaka, *Sony Corporation, Tokyo, Kanagawa, Japan*

**TuA1 8:30 AM - 9:00 AM (Invited)**

**5 Dimensional Optical Storage using Gold Nanorods**, J. W. M. Chon, *Swinburne University of Technology, Hawthorne, Victoria, Australia*

The five-dimensional (3 spatial, 1 wavelength and 1 polarization) optical recording requires media to be orthogonally recordable in each dimension. Surface plasmon resonance of gold nanorods meet such criteria, and five dimensional recording is presented.

**TuA2 9:00 AM - 9:15 AM**

**Demonstration of Readout-Signal Quality Improvement by Homodyne Detection**, H. Mikami, T. Kurokawa, K. Watanabe and H. Miyamoto, *Hitachi, Ltd., Tokyo, Japan*

Significant improvement of readout-signal quality by homodyne detection was experimentally demonstrated with newly proposed signal stabilization scheme, which indicates up to 16-layer recordable disc can be reliably read out with less than 8% jitter.

**TuA3 9:15 AM - 9:30 AM**

**Plasmonic Optical Data Storage**, M. Mansuripur, *University of Arizona, Tucson, AZ, USA*, A. R. Zakharian, *Corning, Inc., Corning, NY, USA*, S.-H. Oh, *University of Minnesota, Minneapolis, MN, USA*, R. J. Jones, *University of Arizona, Tucson, AZ, USA*, A. Lesuffleur, N. C. Lindquist, H. Im, *University of Minnesota, Minneapolis, MN, USA*, A. Kobaykov, *Corning, Inc., Corning, NY, USA* and J. V. Moloney, *University of Arizona, Tucson, AZ, USA*

A femtosecond laser pulse is focused to diffraction limit over a small region (bit-cell) of an optical disk which contains plasmonic nanostructures. The digital information stored in bit-cells modifies the spectrum of the femtosecond light pulse, which is subsequently detected using an optical spectrum analyzer.

**TuA4 9:30 AM - 10:00 AM (Invited)**

**Improvement of Optical Resolution and Mechanical Robustness for Near-Field Recording System**, N. Park, Y.-C. Rhim, K.-S. Park, H.-S. Yang, Y.-P. Park, *Yonsei University, Seoul, Korea*, J.-K. Seo and I. H. Choi, *LG Electronics, Seoul, Korea*

Near-field optics applied annular aperture technique is optimized to improve near-field optical imaging performance. By introducing an annular aperture that has three annular zones with binary transmittance and different phase retardation, decreased focused spot size, reduced sidelobe intensity and extended focal depth are achieved.

**TuA5 10:00 AM - 10:15 AM**

**A Multilayered Blu-ray Disc Readout Technique with an Optical Longitudinal Filter for Reducing Interlayer Crosstalk in a Three-Beam Optical System**, T. Ide, S. Kimura, E. Tatsu, T. Kurokawa, K. Watanabe, Y. Anzai and T. Shintani, *Hitachi, Ltd., Tokyo, Japan*

A Multilayered Blu-ray Disc (BD) readout technique—using an optical longitudinal filter (OLF) and differential push-pull (DPP)—to reduce interlayer crosstalk was demonstrated. DPP signal fluctuation was suppressed to one-third (6% to 2%), and satisfactory readout jitters (about 8%) were obtained for a triple-layered BD.

**TuA6 10:15 AM - 10:30 AM**

**In-situ Raman Scattering Spectroscopy for Super Resolution Optical Disk**, M. Kuwahara, T. Shima and J. Tominaga, *National Institute of Advanced Industrial Science and Technology, Ibaraki, Japan*

We report on the development of a combined Raman scattering spectroscopy and disk property measurement system. We have evaluated SRR optical disks using the system, and simultaneously obtained Raman scattering spectrum (stokes and anti-stokes) and the CNR as a function of readout laser power.

**10:30 AM – 11:00 AM**

**COFFEE BREAK**

**11:00 AM - 12:00 PM**

**Session TuB:** DIGITAL RIGHTS MANAGEMENT, CODING  
**Session Co-Chairs:** Seiji Kobayashi, *Sony Corporation, Kanagawa, Japan*  
 Paul J. Wehrenberg, *Apple Computer, Inc., Palo Alto, CA, USA*

**TuB1 11:00 AM - 11:30 AM (Invited)**

**DRM/Fair Use for Optical Recording**, J. Burger, *Dow Lohnes, PLLC, Washington, DC, USA*

What DRM is, what systems are used on DVD and Blu-ray, how they were selected, and, the "Fair Use" impact. Also whether those systems are "effective." What effective means in commercial video distribution.

**TuB2 11:30 AM - 11:45 AM**

**IPI Noise Reduction by Fuzzy Rules and Data Compression using Wavelet Transform Method in a Holographic Data Storage System**, J. H. Kim, *Yonsei University, Seoul, Korea*

Study of holographic data storage system is a very important division of optical data storage system. We propose overall holographic data storage system in order to reduce IPI noise and increase storage in limited capacity.

**TuB3 11:45 AM - 12:00 PM**

**A Rate 7/8 Run-length and Level Modulation Code for Multilevel Read-Only Optical Disc**, H. Liu, J. Pei, X. Liu and L. Pan, *Tsinghua University, Beijing, China*

A new modulation coding method for signal waveform modulation multilevel disc is presented. The proposed code uses run-length and signal level to satisfy the channel constraints. The density ratio and information bits per 400nm are 1.67 and 2.08 respectively.

**12:00 PM – 1:30 PM**

**LUNCH BREAK**

**1:30 PM - 3:00 PM**

**Session TuC:** HOLOGRAPHIC RECORDING I

**Session Co-Chairs:** Ryuichi Katayama, *NEC Corporation, Kanagawa, Japan*  
Susanna Orlic, *Technical University Berlin, Berlin, Germany*

**TuC1 1:30 PM - 2:00 PM (Invited)**

**Engineering the 300 GB HDS Disk & Drive**, K. E. Anderson, *InPhase Technologies, Longmont, CO, USA*

ABSTRACT NOT AVAILABLE

**TuC2 2:00 PM - 2:15 PM**

**High Density Recording using Monocular Architecture for 500GB Consumer System**, K. Shimada, T. Ishii, *Hitachi, Ltd., Yokohama, Kanagawa, Japan*, T. Ide, *Hitachi, Ltd., Kokubunji, Tokyo, Japan*, S. Hughes, A. Hoskins and K. Curtis, *InPhase Technologies, Longmont, CO, USA*

Monocular architecture is an attractive candidate for a consumer drive. A raw data density of 663Gbits/inch<sup>2</sup> was achieved using this architecture with a blue laser and a high NA objective lens.

**TuC3 2:15 PM - 2:30 PM**

**415 Gbit/in.<sup>2</sup> Recording in Coaxial Holographic Storage using Low-Density Parity-Check Codes**, K. Tanaka, M. Hara, K. Tokuyama, K. Hirooka, Y. Okamoto, H. Mori, A. Fukumoto, and K. Okada, *Sony Corporation, Tokyo, Japan*

We apply LDPC codes into the coaxial holographic system and investigate its fundamental characteristics. Moreover, by applying optimal code and optimizing optical conditions, we successfully improve the recording density, achieving the raw data density of 415 Gbit/in.<sup>2</sup>.

**TuC4 2:30 PM - 2:45 PM**

**Beam-Shaping Random Phase Mask for Holographic Storage**, F. Przygodda, J. Knittel, H. Trautner, O. Malki and H. Richter, *Deutsche Thomson OHG, Villingen-Schwenningen, Germany*

A binary phase mask with beam shaping characteristics improves the overlap of reference and object beam in a holographic storage system. Simulations have shown a significant improvement of the data page image quality.

**TuC5 2:45 PM - 3:00 PM**

**A Single Beam Data Writing Process for Holographic Data Storage**, S. Martin, D. Bade, I. Naydenova and V. Toal, *Dublin Institute of Technology, Dublin, Ireland*

A concept is described that could allow Holographic Data Storage with angular multiplexing using, uniquely, only one data writing beam; pre-recorded 'seed' gratings are illuminated with one writing beam in order to produce a data grating.

**3:00 PM – 3:30 PM**

**COFFEE BREAK**

**3:30 PM - 5:00 PM**

**Session TUT2: TUTORIAL II**

**TUT2.1 3:30 PM - 4:15 PM (Tutorial)**

**Microholographic Recording**, R. McLeod, *University of Colorado at Boulder, Boulder, CO, USA* and S. Orlic, *Berlin University of Technology, Berlin, Germany*

This tutorial will cover the use of focused lasers to record small, isolated holograms in thick media. Architectural choices include recording schemes and multiplexing, the arrangement of read/write heads, direct versus homodyne detection, recording laser and modulation methods and servo methods such as stamped cover layers and servo-writers. Possible material systems will be reviewed including holographic photopolymers, photochromic, thermoplastic and inorganic materials. Demonstrated performance in the various groups world-wide will be summarized. Finally, modeling methods will be discussed and potential performance suggested.

**Susanna Orlic**, Professor of Experimental Physics at the Faculty of Mathematics and Natural Sciences of the Berlin University of Technology, heads the research group on Optical Technologies at the Institute of Optics and is responsible for programs in quantum optics and photonics. She received the Diploma degree from the Department of Applied Physics at the Belgrade University of Technology and the Dr. rer. Nat. degree from the Physics Department of the Berlin University of Technology. Her specific research topics are optical memories and information processing, holography, nonlinear optical patterning and recognition, optical sensing and image processing, optical computing and interconnects. She initiated a European network on Optical Data Storage and Processing and is engaged in diverse committees on strategic research and education planning in photonics for the 21<sup>st</sup> century at the European level. Currently, she is coordinating a European R&D project

on next generation optical data storage and a German consortium on intelligent optical sensing and image processing technology. Being strongly application-oriented, her projects interface science and industry and are in close cooperation with a series of European and U.S. research institutions and companies that are manufacturers as well as users of optical technologies. She is chair and program committee member of several world conferences on optics and photonics.

**Robert McLeod** is an Assistant Professor of Electrical and Computer Engineering, University of Colorado at Boulder. Dr. McLeod's research group at the University of Colorado specializes in metrology, modeling and applications of volume photopolymers including data storage, integrated optics and imaging. He has held research and management positions at Lawrence Livermore National Lab., Siros Technologies (a holographic data storage startup) and JDS Uniphase. He holds graduate degrees from Montana State University (MSEE 1985), University of California (MS Applied Science 1989) and the University of Colorado (Ph.D. 1995).

**TUT2.2 4:15 PM - 5:00 PM (Tutorial)**

**Heat Assisted Magnetic Recording (HAMR)**, B. Challener, *Seagate Technologies, Pittsburg, PA, USA*

This tutorial will be an introduction to heat assisted magnetic recording: how it solves the superparamagnetic problem, what are the optical, thermal, and magnetic requirements of the head and media, and approaches taken by various research groups. The design of near field transducers will be considered in detail including the primary criteria that have been used to guide the development of near field transducers at Seagate. Recent results of HAMR with an integrated head and high coercivity FePt media will be presented.

**Bill Challener** has worked on heat assisted magnetic recording at Seagate for the last eight years and in the optical data storage industry for fifteen years prior to that. In 2007 he was a recipient of the INSIC Technical Achievement Award for his work on HAMR. His doctorate in physics is from University of California Berkeley.

**8:00 PM - 10:00 PM**

**Panel: THE FUTURE OF CONTENT DISTRIBUTION**

**Moderator:** Lambertus Hesselink, *Stanford University, Stanford, CA, USA*

Lambertus Hesselink, *Stanford University, Stanford, CA, USA*

**Holographic Data Storage**, L. Hesselink, *Stanford University, USA*

ABSTRACT NOT AVAILABLE

Changsheng Xie, *Huazhong University of Science and Technology, Wuhan, China*

**The Status of New Video Disc (NVD) Format in China**, C. Xie, *Huazhong University of Science & Technology, China*

ABSTRACT NOT AVAILABLE

Bryan Ekus, *Media-Tech, Orlando, FL, USA*

**Media Manufacturing Efforts in US and Europe**, B. Ekus, *Media-Tech, USA*

ABSTRACT NOT AVAILABLE

## Wednesday, 13 May 2009

**8:30 AM - 10:00 AM**

**Session WA: MEDIA AND COMPONENTS**

**Session Co-Chairs:** Tom D. Milster, *University of Arizona, Tucson, AZ, USA*

**WA1 8:30 AM - 9:00 AM (Invited)**

**Patterning Nano-Domains with Orthogonal Functionalities: Solventless Synthesis of Self-Sorting Surfaces**, S. G. Im, B.-S. Kim, K. W. Bong, S. H. Baxamusu, W. E. Tenhaeff, P. S. Doyle and K. Gleason, *Massachusetts Institute of Technology, Cambridge, MA, USA*

Vapor deposited functional polymer thin films can undergo rapid covalent functionalization. Utilizing two functional layers displaying orthogonal reactivity enables sorting of aqueous mixtures of dyes and nanoparticles, such as quantum dots, onto selective areas of nanopatterned surfaces.

**WA2 9:00 AM - 9:30 AM (Invited)**

**Advanced Light Sources for ODS**, S. Jiang, *AdValue Photonics, Tucson, AZ, USA*

Current development on fiber lasers and other new light sources will be presented and their potential applications for ODS will be discussed.

**WA3 9:30 AM - 9:45 AM**

**Development of UV-curable Resin for Blu-ray Disc Protective Layer**, H. Kondo, *Sony Chemical & Information Device Corporation, Kanuma, Tochigi, Japan*, H. Kominami, *Sony Corporation, Kanuma, Tochigi, Japan* and Y. Nakata, *Sony Chemical & Information Device Corporation, Kanuma, Tochigi, Japan*

The coatings for the protective layer of Blu-ray disc are designed to achieve the requirements of the specification. The newly developed UV-curable resin was spin coated as a cover and hard coat layer on the production line and has good mechanical.

**WA4 9:45 AM - 10:00 AM**

**Predicting the Reliability of Data on DVD-R Discs**, B. M. Lunt and D. Wells, *Brigham Young University, Provo, UT, USA*

Data on recorded optical discs has a limited lifetime. The ECMA-379 test standard may be over optimistic. Analysis of parity, jitter and ECC parameters on DVD-R discs produced multiple models useful in predicting disc failure.

**10:30 AM – 11:00 AM**

**COFFEE BREAK**

**11:00 AM - 12:00 PM**

**Session WB:** HOLOGRAPHIC RECORDING II

**Session Co-Chairs:** Kevin Curtis, *InPhase Technologies, Longmont, CO, USA*  
Ding Ping Tsai, *National Taiwan University, Taipei, Taiwan, R.O.C.*

**WB1 11:00 AM - 11:30 AM (Invited)**

**Photonic Nanocomposite Materials for Holographic Data Storage**, Y. Tomita, *University of Electro-Communications, Tokyo, Japan*

The recording mechanism of a holographic grating in inorganic or organic nanoparticle-polymer composites is described. The diffraction and multiple recording properties of a volume hologram in a nanoparticle-polymer composite film are also described.

**WB2 11:30 AM - 11:45 AM**

**Optical Properties of Photopolymerisable Nanocomposites Containing Zeolite Nanoparticles**, I. Naydenova, T. Babeva, E. Leite, N. Pandey, *Dublin Institute of Technology, Dublin, Ireland*, T. Yovcheva, *Plovdiv University, Plovdiv, Bulgaria*, S. Mintova, *Université de Caen, Caen, France* and V. Toal, *Dublin Institute of Technology, Dublin, Ireland*

Acrylamide-based photopolymerisable nanocomposites containing three different types of nanozeolites – Si-MFI, AIPO and BEA, were studied. The influence of the porous nanoparticles on the average refractive index, optical scattering, holographic recording properties and shrinkage were characterised.

**WB3 11:45 AM - 12:00 PM**

**Improvement in Temperature Tolerance of Coaxial Holographic Data Storage**, T. Ito, K. Tanaka, H. Mori, T. Tanaka, K. Ishioka, A. Fukumoto and K. Okada, *Sony Corporation, Tokyo, Japan*

Tuning the magnification and wavelength of the readout reference beam expands the temperature tolerance of the coaxial holographic data storage. High diffraction efficiency and signal-to-noise ratio were obtained at a media temperature range of  $>+10^{\circ}\text{C}$

**12:00 PM – 1:30 PM**

**LUNCH BREAK**

**1:30 PM - 2:45 PM**

**Session WC:** MEDIA AND COMPONENTS II

**Session Co-Chairs:** Tuvia E. Schlesinger, *Carnegie Mellon University, Pittsburgh, PA, USA*

**WC1 1:30 PM - 2:00 PM (Invited)**

**Development of Deformable Mirror for Spherical Aberration Compensation**, S. Aoki, *Sony Corporation, Tokyo, Japan*

By using conventional MEMS processes, we have successfully developed a high accuracy and easily controllable deformable mirror with simple structure. Furthermore, we have obtained the reflective film of low stress which was a challenge.

**WC2 2:00 PM - 2:15 PM**

**Study on the Scanning System for Deep Focused Beam by Axicon**, S. Hong, J. Yeo, *Seoul National University, Seoul, Korea*, T. D. Milster, *University of Arizona, Tucson, AZ, USA* and J. Kim, *Seoul National University, Seoul, Korea*

An improvement on the prior beam-scanning imaging system is achieved by a lens system and an advanced scanning system is proposed through the quantitative analysis on the aberration of an axicon lens.

**WC3 2:15 PM - 2:30 PM**

**Development of a Plastic Objective Lens for BD/DVD/CD Compatibility**, K. Kaneda, T. Yasui, K. Takahashi and Y. Asoma, *Sony Corporation, Tokyo, Japan*

We have developed a single plastic diffractive objective lens compatible with BD/DVD/CD systems. This objective lens has a self NA control function and shows favorable reading characteristics.

**WC4 2:30 PM - 2:45 PM**

**Photopolymerizable Glass with High Refractive Index Species: Overview of Emerging Implementations**, M. L. Calvo, O. Martinez-Matos, J. A. Rodrigo, T. Alieva, M. P. Hernandez-Garay, *Universidad Complutense de Madrid, Madrid, Spain*, E. A. Marti, *Benemerita Universidad Autonoma de Puebla, Puebla, Mexico*, and P. Cheben, *National Research Council, Ottawa, Canada*

We present an overview of the main properties and the emerging implementations corresponding to a photopolymerizable glass modified with high refractive index species (HRIS) incorporated at molecular level.

**3:30 PM – 5:00 PM**

**POST DEADLINE SESSION**

**END OF PROGRAM**