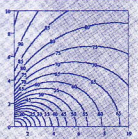
Non-Profit Org.
U.S. Postage Paid
Society of
Photo-Optical
Instrumentation
Engineers

SPIE Society of Photo-Optical Instrumentation Engineers
P.O. Box 10 • Bellingham, WA 98227-0010

Advance Program

ISOM/ODS'99

Joint International Symposium on Optical Memory and Optical Data Storage 1999



11–15 July 1999
Sheraton Kauai Resort, Koloa, Hawaii

Sponsored by
IEEE/Lasers and Electro-Optics Society
OSA—Optical Society of America
SPIE—The International Society for Optical Engineering
JSAP—The Japan Society of Applied Physics

In cooperation with
IEICE—The Institute of Electronics, Information and Communication Engineers
MSJ—The Magnetics Society of Japan
OITDA—Optoelectronic Industry and Technology Development Association

Postdeadline Paper Deadline
21 June 1999

Housing Deadline
9 June 1999

Registration Deadline
2 July 1999

ISOM/ODS Committees

Joint ISOM/ODS 1999 Steering Committee

(ISOM): **K. Goto** (Japan), *Chair;* **I. Fujimura** (Japan); **T. Murakami** (Japan); **Y. Okino** (Japan)

(ODS): **M. Mansuripur** (USA), *Chair;* **T. Ohta** (Japan), *Chair*

Joint ISOM/ODS 1999 Technical Program Committee

(ISOM): **S. Kubota** (Japan), *Chair;* **K. Itoh** (Japan); **J. Saito** (Japan); **S. Tanaka** (Japan); **K. Hirao** (Japan); **Y. Honguh** (Japan); **S. Hosaka** (Japan); **M. Irie** (Japan); **H. Iwasaki** (Japan); **I. Morimoto** (Japan); **K. Nakagawa** (Japan); **T. Ohta** (Japan); **M. Ohtsu** (Japan); **N. Ohyama** (Japan); **T. Suhara** (Japan); **H. Sukeda** (Japan); **A. Takahashi** (Japan); **K. Tanaka** (Japan); **T. Tani** (Japan); **S. Sumi** (Japan); **H. Ukita** (Japan); **S. Yagi** (Japan); **F. Yamada** (Japan); **K. Yamada** (Japan); **M. Yamamoto** (Japan); **Y. Yamanaka** (Japan); **F. Yokogawa** (Japan); **H. Yoshida** (Japan); **D. Campbell** (USA); **M. Chen** (USA); **F. Gan** (China); **D.-R. Huang** (Taiwan); **A.-L. Jung** (China); **G. Knight** (USA); **M. Mansuripur** (USA); **H.-P. D. Shieh** (Taiwan); **D.-H. Shin** (Korea); **S.-C. Shin** (Korea); **H. van Houten** (Netherlands); **P. Wehrenberg** (USA)

(ODS): **R. Katayama** (Japan), *Chair;* **D. Stinson** (USA), *Chair;* **B. Bernacki** (USA); **W. Challener** (USA); **M. de Haan** (USA); **K. Goto** (Japan); **R. Hajjar** (USA); **J. Hogan** (USA); **T. Hurst** (USA); **B. Jacobs** (Netherlands); **G. Kino** (USA); **S. Kobayashi** (Japan); **J. Saito** (Japan); **D.-H. Shin** (Korea); **H. Sukeda** (Japan); **T.-K.Yoo** (Korea)

Joint ISOM/ODS 1999 Advisory Committee

(ISOM): **Y. Mitsuhashi** (Japan), *Chair;* **M. Onoe** (Japan); **Y. Sakurai** (Japan)

(ODS): **S. Kubota** (Japan), *Chair;* **T. Milster** (USA), *Chair;* **P. Wehrenberg** (USA), *Chair;* **B. Bell** (USA); **H. Birecki** (USA); **J. Kwiecien** (USA); **G. Sincerbox** (USA); **Y. Tsunoda** (Japan)

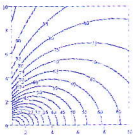
Table of Contents

Important Dates:

Postdeadline Paper Deadline
21 June 1999

Housing Deadline
9 June 1999

Registration Deadline
2 July 1999



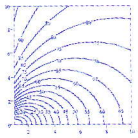
Foreword

The joint International Symposium on Optical Memory and Optical Data Storage 1999 will be held on the "garden isle" of Kauai, Hawaii, 11–15 July 1999. This will be the ninth International Symposium on Optical Memory (ISOM) and the fifteenth topical meeting on Optical Data Storage. Reflecting the international nature of the interest and work in optical data storage, these two conferences are held jointly every third year. The unparalleled setting of this year's conference provides an outstanding opportunity to share the latest information in this dynamic field with your international colleagues. In addition to the technical sessions, on Sunday 11 July 1999 a series of Short Courses will be presented on the latest developments in the field of optical data storage.

The official conference language will be English.

Scope

This conference provides a forum for exchange of information on the status, future directions, and advances of optical systems, materials, designs, and applications in optical storage technology. Contributions in data storage related fields such as scanning probe and holographic technologies are encouraged. What better place than Hawaii to explore further the eruption of new results and challenges from the frontiers of optical data storage research and development?



Invited Papers and Posters

MA1 ▪ Deep UV mastering with a write compensation technique realizing over 20 GB/layer capacity disc, M. Takeda, M. Furuki, T. Ishimoto, K. Kondo, M. Yamamoto, S. Kubota, Sony Corp. (Japan)

MA2 ▪ Recent developments in optical disc mastering technology, G. J. Verhaart, ODME International B.V. (Netherlands)

MC1 ▪ Optical pickup employing a hologram-laser-photodiode unit, Y. Kurata, S. Yoshida, Sharp Corp. (Japan)

MD1 ▪ Optical disc system for digital video recording, T. Narahara, S. Kobayashi, M. Hattori, Y. Shimpuku, Sony Corp. (Japan); G. van den Enden, J. A. Kahlman, M. van Dijk, R. van Woudenberg, Philips Research Labs. (Netherlands)

TuA1 ▪ 0.04 μm domain expansion readout for the MAMMOS, H. Awano, M. Sekine, M. Tani, N. Kasajima, N. Ota, Hitachi Maxell Ltd. (Japan); K. Mitani; S. Sumi, Sanyo Electric Co. Ltd. (Japan)

TuA2 ▪ L/G recording with 0.45 μm track pitch in CAD-MSR disk, Y. Murakami, Sharp Corp. (Japan); S. Maeda, Hitachi, Ltd. (Japan); A. Takahashi, Sharp Corp. (Japan); Y. Tanaka, T. Watanabe, Sony Corp. (Japan)

TuB1 ▪ DVD copy protection issues: technology, consensus, and implementation, P. J. Wehrenberg, Apple Computer, Inc. (USA)

TuB2 ▪ IPR protection features for optical disks to promote superdistribution, M. Yoshioka, Fujitsu Ltd. (Japan)

TuC1 ▪ Rewritable holographic memory, W. Liu, A. Adibi, D. Psaltis, California Institute of Technology (USA)

WA1 ▪ Overview and the future phase-change optical disk technology, T. Ohta, Matsushita Electric Industrial Co., Ltd. (Japan)

WA2 ▪ AgInSbTe materials for high-speed phase-change recording, H. J. Borg, Philips Optical Storage (Netherlands); P. W. Blom, B. A. Jacobs, B. Tieke, Philips Research Labs. (Netherlands); A. E. Wilson, I. P. Ubbens, Philips Optical Storage (Netherlands); G. Zhou, Philips Research Lab. (Netherlands)

WB1 ▪ Analysis of thermomagnetic recording by using magnetic field microscopy, H. Nemoto, Hitachi Ltd. (Japan); H. Saga, Y. Honda, Hitachi, Ltd. (Japan)

WC1 ▪ Optical disk recording using a GaN blue laser diode, I. Ichimura, F. Maeda, K. Osato, K. Yamamoto, Y. Kasami, Sony Corp. (Japan)

ThA1 ▪ Recent advances in optical media manufacturing technology, B. J. Bartholomeusz, Multi Media Masters & Machinery (USA)

ThA2 ▪ Ten-year overview and future prospects of write-once organic recordable media, E. Hamada, Taiyo Yuden Co., Ltd. (Japan)

ThB1 ▪ Signal processing for 15/27 GB read-only disk system, F. Yokogawa, S. Miyanabe, M. Ogasawara, H. Kuribayashi, Y. Tomita, K. Yamamoto, Pioneer Electronic Corp. (Japan)

ThC1 ▪ Optical near-field aperture storage technology (ONFAST) for high-density high-performance data storage applications, A. Partovi, Lucent Technologies/Bell Labs. (USA)

ThD1 ▪ New technique for readout of super density data storage beyond the diffraction limit, J. Tominaga, National Institute for Advanced Interdisciplinary Research (Japan)

Invited Posters

TuD1 ▪ Multilayer phase-change optical disk, K. Nagata, K. Nishiuchi, N. Yamada, Matsushita Electric Industrial Co., Ltd. (Japan)

WD1 ▪ Dual-level optical discs, J. M. Bruneau, MPO Disque Compact (France); A. Fargeix, B. Bechevet, CEA-LETI (France); F. X. Pirot, MPO Disque Compact (France); B. Valon, CEA-LETI (France)

The Continuing Education Unit®

SPIE awards CEUs (Continuing Education Units) to registrants who successfully complete short courses offered in this program. The CEU is a nationally recognized unit of measure for continuing education and training programs that meet certain criteria. (IACET: registration #1001635).

Three Short Courses are planned for Sunday 11 July.

Impact of Short-Wavelength Lasers on Optical Data Storage

Short-wavelength lasers support high-areal-density recording and reading in optical data storage applications. This course provides an overview of the fundamentals of short-wavelength laser technology. It begins by exploring short-wavelength lasers, such as the GaN diode and the all-solid-state deep UV laser. The advantages in forming a submicron spot combined with a diffraction-limited high numerical aperture (NA) objective lens are described. Then, the lens design for a catadioptric solid immersion lens, which is a high NA aspheric lens, is explained. Also, consideration for deep-UV photoresist and vibration isolation requirements for mode cleanness, thermal stability and low noise in terms of the laser source are outlined. The course also covers other potential applications of the deep UV such as a confocal scanning microscope inspection tools for the semiconductor manufacturing process. Finally, the status of short-wavelength laser commercialization is summarized.

BENEFITS/LEARNING OBJECTIVES

This course will enable you to:

- identify the benefits of short wavelength lasers in optical data storage
- identify the components of short wavelength lasers
- understand the role of short wavelength lasers in several applications
- describe how short wavelength lasers support higher density recording and reading in optical data storage
- explain why short wavelength lasers are needed
- define basics of short wavelength lasers and high NA objective lenses
- differentiate between short wavelength lasers
- recognize the status of short wavelength laser commercialization.

INTENDED AUDIENCE

Engineers, scientists and managers who need to understand basic concepts of short wavelength lasers. Some prior background on optical data storage technology is helpful.

INSTRUCTOR

Shigeo Kubota is at Sony Corporation in Tokyo, Japan. Dr. Kubota is a general manager and a chief research scientist in Kubota Optoelectronics Laboratory, Research Center with several patents and publications on optical data storage, solid state lasers and nonlinear optical materials.

SC01: $175/$215 CEU .35 Sun: 8:30 am to 12:30 pm

Near-Field Optical Data Storage

Near-field optical systems are used to reduce spot size and increase density in optical data storage. This course introduces the basic concepts associated with near-field optical systems used in optical data storage. Both solid immersion lenses (SILs) and aperture-type probes are discussed. Discussion topics include: geometrical and physical optics considerations, light distribution within the recording layers, aberration characteristics, tolerances, servos, mechanical considerations, recording performance and limitations, components, simulation methods and future systems. Phase-change recording is considered in detail.

BENEFITS /LEARNING OBJECTIVES

This course will enable you to:

- describe the characteristics of solid immersion lenses (SILs) and aperture-type probes used in optical recording
- predict the performance and sensitivities of SILs used for optical recording
- describe calculation methods used for near-field simulation
- list components used for aperture-type and SIL recording
- list future components and systems useful for near-field optical recording.

INTENDED AUDIENCE

Engineers, scientists and managers who need to understand basic concepts of near-field optical data storage. Some prior background of optics and optical data storage is helpful.

INSTRUCTOR

Tom D. Milster is an Associate Research Professor at the Optical Sciences Center at the University of Arizona in Tucson, Arizona. His research program centers around studying the physical optics of high performance optical systems, including optical data storage systems and lithography. He has been researching optical data storage systems since 1986.

SC02: $175/$215 CEU .35 Sun: 1:30 to 5:30 pm

Short Courses

DVD Technologies

DVD represents a major evolutionary step in the removable media path pioneered by CD. This course gives an overview of the DVD Specifications and related technology which define DVD-Read Only Disc and DVD-Rewritable Disc as put forth by the DVD Forum, and earlier the DVD-Consortium.

BENEFITS/LEARNING OBJECTIVES

This course will enable you to:

- understand the physical characteristics of the media
- understand the optical pickup units and optical writing heads
- understand the channel coding
- understand the block encoding
- be introduced to defect management, volume and file structure, and the DVD-Video application
- be able to identify and explain aspects of the Specifications which have important implications for usage of this technology by the entertainment and computer industries
- be aware of various product design tradeoffs and future development challenges.

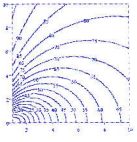
INTENDED AUDIENCE

Engineers, scientists, and managers who need to understand the basic structure of DVD, and who want to understand why DVD has evolved in this fashion.

INSTRUCTOR

Paul Wehrenberg is Manager of Advanced Mass Storage and Optical Standards at Apple Computer. He has a Ph.D. in Physics, and extensive experience, patents pending and granted, and multiple publications in coherent optical processing and optical data storage.

SC03: $175/$215 CEU .35 Sun: 6:00 to 10:00 pm



Agenda of Sessions

Monday 12 July

8:30-10:00 am	MA	Mastering/Replication
10:00-10:30 am		Coffee Break
10:30 am-Noon	MB	Servo
Noon-1:30 pm		Lunch Break
1:30-3:00 pm	MC	Heads
3:00-3:30 pm		Coffee Break
3:30-5:00 pm	MD	Systems
5:30-7:00 pm	ME	Postdeadline Papers

Tuesday 13 July

8:30-10:00 am	TuA	MO Media
10:00-10:30 am		Coffee Break
10:30 am-Noon	TuB	Applications
Noon-1:30 pm		Lunch Break
1:30-3:00 pm	TuC	Alternative and Holographic Storage
3:00-3:30 pm		Coffee Break
3:30-6:00 pm	TuD	Poster Session I
6:00-6:30 pm		Break
6:30-8:30 pm		Reception

Wednesday 14 July

8:00-10:00 am	WA	Phase-Change Media
10:00-10:30 am		Coffee Break
10:30 am-12:15 pm	WB	Testing and Evaluation
12:15-1:30 pm		Lunch Break
1:30-3:00 pm	WC	Blue Lasers
3:00-3:30 pm		Coffee Break
3:30-6:00 pm	WD	Poster Session II
6:00-7:30 pm		Dinner Break
7:30-9:30 pm	WE	Panel Discussion

Thursday 15 July

8:30-10:00 am	ThA	General Media
10:00-10:30 am		Coffee Break
10:30 am-Noon	ThB	Coding and Channels
Noon-1:30 pm		Lunch Break
1:30-3:15 pm	ThC	Near-Field
3:15-3:45 pm		Coffee Break
3:45-5:15 pm	ThD	Super-Resolution

Abstracts

Room: Poipu Ballroom

Monday -Thursday 12-15 July 1999

International Symposium on Optical Memory and Optical Data Storage

Monday 12 July

Opening Remarks ▪ Mon. 8:10 am

Masud Mansuripur, Optical Sciences Ctr./ Univ. of Arizona (USA); **Kenya Goto,** Tokai Univ. (Japan)

MA ▪ Mastering/Replication

Presiders: **Douglas G. Stinson,** Quinta (USA); **Masanobu Yamamoto,** Sony Corp. (Japan)

8:30 am (Invited)

MA1 ▪ Deep UV mastering with a write compensation technique realizing over 20 GB/layer capacity disc, M. Takeda, M. Furuki, T. Ishimoto, K. Kondo, M. Yamamoto, S. Kubota, Sony Corp. (Japan) ..... [3864-01]

We analyzed RF signal jitter of the 20GB capacity disc with CD size, recorded by a deep UV mastering process, and confirmed the effectiveness of write compensation using a pit edge shift technique.

9:00 am (Invited)

MA2 ▪ Recent developments in optical disc mastering technology, G. J. Verhaart, ODME International B.V. (Netherlands) ..... [3864-02]

Optical, mechanical and process developments in mastering technology. Approaches for mastering 20 GB media and beyond. Recent achievements in mastering for high densities.

9:30 am

MA3 ▪ Very small track mastering for higher-density optical disc memory, S. Morita, M. Nishiyama, M. Hayashi, H. Konishi, T. Akiyama, Nikon Corp. (Japan) ..... [3864-03]

Smaller width grooves are very convenient for higher density optical discs. We have tried very small track mastering and obtained a groove width of less than 0.1μm.

9:45 am

MA4 ▪ Near-field optical head on disk mastering process, S. Imanishi, T. Ishimoto, Y. Aki, T. Kondo, M. Yamamoto, Sony Corp. (Japan) ..... [3864-04]

Using an air-suspended pad and PZT control, the gap between a SIL and a glass master can be regulated below half of a wavelength in a gap error of 10nmPP.

10:00 to 10:30 am ..... Coffee Break

MB ▪ Servo

Presiders: **Daniel Abramovitch,** Hewlett-Packard Labs. (USA); **Fumihiko Yokogawa,** Pioneer Electronic Corp. (Japan)

10:30 am

MB1 ▪ Fast-access optical drive, J. Wals, J. Dovic, A. J. Niessen, M. Rieck, R. M. Rijs, Philips Research Labs. (Netherlands) ..... [3864-05]

An average seek time of 11 ms for 120-mm optical discs is presented using a split optical head and a linear motor capable of accelerations over 60 G.

10:45 am

MB2 ▪ Track center servo and radial tilt servo system for DVD-RAM disc, S. Yamada, S. Nishiwaki, A. Nakamura, T. Ishida, H. Yamaguchi, Matsushita Electric Industrial Co., Ltd. (Japan) ..... [3864-06]

A track center servo and tilt servo system with detection of track center and disc radial tilt from CAPA on a DVD-RAM disc.

11:00 am

MB3 ▪ Development of tilt servo system using 4-axis lens actuator for disc tilt compensation, Y. Motegi, M. Nagasato, Y. Ishibashi, H. Someya, N. Kikuiri, Toshiba Corp. (Japan) [3864-07]

Tilt servo system using newly developed 4-axis lens actuator has been developed as a disc tilt compensation method for next generation optical disk drives.

11:15 am

MB4 ▪ Recording laser power control method based on wobble signal amplitude detection, C. Inokuchi, T. Akagi, S. Nishiwaki, K. Nagashima, A. Miyazaki, H. Yamaguchi, Matsushita Electric Industrial Co., Ltd. (Japan) ..... [3864-08]

How fingerprints affect to writing data was studied. According to the analysis, recording power control method based on wobble signal amplitude was also studied.

11:30 am

MB5 ▪ Crosstalk cancellation with a quadrant cell detector, R. S. Upton, F. Akhavan, T. D. Milster, W. L. Bletscher, J. K. Erwin, A. M. Nicol, S. Flores, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-09]

Crosstalk levels of -20.8dB are experimentally demonstrated for double density tracks on CD-RW media by using QPD cancellation with a single focused spot.

11:45 am

MB6 ▪ Lens shift correction for DVD-RAM tracking servo, T. Shihara, K. Watanabe, S. Kadowaki, H. Ishibashi, Matsushita Electric Industrial Co., Ltd. (Japan) ..... [3864-10]

We developed a new servo technology for DVD-RAM reproduction applicable for a 12.7mm height DVD-ROM drive. Lens shift is measured and corrected using 'CAPA' marks.

Noon to 1:30 pm ..... Lunch Break

MC ▪ Heads

Presider: **Tom D. Milster,** Optical Sciences Ctr./Univ. of Arizona (USA)

1:30 pm (Invited)

MC1 ▪ Optical pickup employing a hologram-laser photodiode unit, Y. Kurata, S. Yoshida, Sharp Corp. (Japan) ..... [3864-11]

Many functions of optical components are integrated into one unit. We describe the principle and the developments of the hologram pickup.

2:00 pm

MC2 ▪ Flat intensity lens with high optical efficiency and small spot size for use in optical disc, F. Tawa, S. Hasegawa, A. Futamata, T. Uchiyama, Fujitsu Labs. Ltd. (Japan) .... [3864-12]

We have developed one simple optical element that converts the Gaussian distribution into the flat intensity distribution by refraction without optical energy loss or aberrations.

2:15 pm

MC3 ▪ Optical head with coaxial dual beam crosstalk canceller, K. Kasazumi, K. Yamamoto, M. Kato, Matsushita Electric Industrial Co., Ltd. (Japan) ..... [3864-13]

We demonstrates a practical configuration of the optical head with crosstalk canceller using coaxial dual beams which are orthogonally polarized, and some experimental results.

2:30 pm

MC4 ▪ Super-resolution by spatial filtering of high-order Laguerre-Gaussian mode vertical cavity surface emitting lasers, R. A. Flynn, O. Kibar, S. C. Esener, Univ. of California/San Diego (USA) ..... [3864-14]

VCSELs with high-order Laguerre-Gaussian mode profiles are superresolved for spots up to ~50% smaller than the classical diffraction limit of equivalent fundamental Gaussian modes with better than 10:1 signal-to-noise ratio between main and side lobe intensities.

2:45 pm

MC5 ▪ Is a round focus spot better than an oval shaped spot?

I. Q. Prikryl, Hewlett-Packard Co. (USA) ..... [3864-15]

Advantages and disadvantages associated with the different shapes of the focused spot are discussed for optical drives working with 4.7GB optical disks.

3:00 to 3:30 pm ..... Coffee Break

MD ▪ Systems

Presiders: **Kunimaro Tanaka,** Teikyo Heisei Univ. (Japan); **Bruce E. Bernacki,** Iomega Corp. (USA)

3:30 pm (Invited)

MD1 ▪ Optical disc system for digital video recording, T. Narahara, S. Kobayashi, M. Hattori, Y. Shimpuku, Sony Corp. (Japan); G. van den Enden, J. A. Kahlman, M. van Dijk, R. van Woudenberg, Philips Research Labs. (Netherlands) ..... [3864-16]

We present a real-time digital video recording system (channel modulation, error correction and format) based on high-NA land/groove phase-change recording through a thin cover layer.

4:00 pm

MD2 ▪ Progress in optically assisted Winchester (OAW) recording, J. E. Davis, A. A. Fennema, K. L. Wong, G. G. Szita, B. C. Chiou, Quinta Corp. (USA) ..... [3864-17]

The annualized areal density growth rate of Optically Assisted Winchester technology has been approximately 300%, compared to the rate of 60-95% for conventional magnetic recording. The improvements to the design of the media, optical head, and systems that have enabled these density gains, as well as remaining technical challenges, will be discussed.

4:15 pm

MD3 ▪ High-frequency wobbles: a write clock generation method for rewritable DVD that enables near drop-in compatibility with DVD-ROMs, D. Abramovitch, D. K. Towner, C. Perlov, J. N. Hogan, M. Fischer, C. Wilson, I. Cokgor, C. Taussig, Hewlett-Packard Labs. (USA) ..... [3864-18]

The work is a write clock generation scheme for rewritable DVD which eliminates a major issue for drop-in compatibility with DVD-ROMs.

4:30 pm

MD4 ▪ Synchronous trigger detection for pulse laser readout on super-resolution erasable optical disks, G. Yin, H. D. Shieh, National Chiao Tung Univ. (Taiwan) ..... [3864-19]

Synchronized detection is developed to suppress adverse effect of light modulation by pulse readout, and yield much improved CNR on super-resolution erasable optical disks.

4:45 pm

MD5 ▪ Experiments of novel optical floppy disk drive using phase-change optical medium and quasi near-field optical head, K. Goto, Y. Kim, Y. Hasegawa, Tokai Univ. (Japan) ..... [3864-20]

Phase change type optical floppy disk and the head are developed. The head has no objective lens. They are a quasi-near field optical disk system.

5:00 to 5:30 pm ..... Break

Mon. 5:30-7:00 pm

ME ▪ Postdeadline Papers

Presiders: **Douglas G. Stinson,** Quinta (USA); **Seiji Kobayashi,** Sony Corp. (Japan)

Tuesday 13 July

TuA ▪ MO Media

Presiders: **Ben A. Jacobs,** Philips Research Labs. (Netherlands); **Norio Ota,** Hitachi Maxell Ltd. (Japan)

8:30 am (Invited)

TuA1 ▪ 0.04 micrometer domain expansion readout for the MAMMOS, H. Awano, M. Sekine, M. Tani, N. Kasajima, N. Ota, Hitachi Maxell Ltd. (Japan); K. Mitani, N. Takagi, S. Sumi, Sanyo Electric Co. Ltd. (Japan) ..... [3864-21]

The MO readout signal of 0.04 μm very tiny domain for the MAMMOS disk is successfully expanded to the saturated signal level.

9:00 am (Invited)

TuA2 ▪ L/G recording with 0.45 μm track pitch in CAD-MSR disk, Y. Murakami, Sharp Corp. (Japan); S. Maeda, Hitachi, Ltd. (Japan); A. Takahashi, Sharp Corp. (Japan); Y. Tanaka, T. Watanabe, Sony Corp. (Japan) ..... [3864-22]

L/G recording with a narrow track pitch of 0.45 μm was studied in an improved CAD-MSR disk. We confirmed over 9.3 Gbyte user-capacity could be available in a 120 mm single-side disk with red laser optics.

9:30 am

TuA3 ▪ Applying an objective lens of 0.7 NA to a CAD-MSR disk, Y. Tanaka, T. Watanabe, M. Shinoda, T. Shimouma, Sony Corp. (Japan); Y. Murakami, A. Takahashi, Sharp Corp. (Japan) ..... [3864-23]

Practical availability of 10 GB user capacity per 120 mm was confirmed with the combination of a CAD-MSR and an objective lens of 0.7-numerical aperture.

9:45 am

TuA4 ▪ Over 15 GB capacity DWDD-MO recording using a DVD dimensional optical head, S. Kai, A. Fukumoto, K. Aratani, S. Yoshimura, K. Tsutsui, M. Arai, Y. Takeshita, Sony Corp. (Japan) ..... [3864-24]

Sufficient low error rate and system tolerances were obtained for an areal recording density of 12 Gb/in^2 with DWDD MO-disk and land/groove recording method.

10:00 to 10:30 am ..... Coffee Break

TuB ▪ Applications

Presiders: **Takaya Tanabe,** Nippon Telegraph and Telephone Corp. (Japan); **Henryk Birecki,** Hewlett Packard Co.

10:30 am (Invited)

TuB1 ▪ DVD copy protection issues: technology, consensus, and implementation, P. J. Wehrenberg, Apple Computer, Inc. (USA) ..... [3864-25]

Content scrambling and water marking for copy protection of DVD-Video are being developed through a multi-industry effort. Key transmission and transformation depend on nuances of optical data storage technology and strongly affect optical storage system design.

11:00 am (Invited)

TuB2 ▪ IPR protection features for optical disks to promote superdistribution, M. Yoshioka, Fujitsu Ltd. (Japan) .... [3864-26]

This paper describes the concept of superdistribution as a solution to the IPR protection and shows how it can be implemented with optical disks hardware and software.

11:30 am

TuB3 ▪ Evaluation of DVD-R for archival applications, M. D. Martin, J. J. Hyon, Jet Propulsion Lab. (USA) ..... [3864-27]

This paper presents the results of DVD-R hardware, software and media evaluations and describes the production of a sample archive collection using DVD-R technology.

11:45 am

TuB4 ▪ High-speed optical library system using DVD-RAM, T. Tanabe, T. Ura, M. Yamamoto, Nippon Telegraph and Telephone Corp. (Japan) ..... [3864-28]

This system reads and writes data at approximately 6MB/s using parallel control methods that minimize the data flow overhead.

Noon to 1:30 pm ..... Lunch Break

TuC ▪ Alternative and Holographic Storage

Presiders: **Glenn T. Sincerbox,** Univ. of Arizona (USA); **Soon G. Kim,** Korea Institute of Science and Technology (Korea)

1:30 pm (Invited)

TuC1 ▪ Rewritable holographic memory, W. Liu, A. Adibi, D. Psaltis, California Institute of Technology (USA) ..... [3864-29]

We will describe recent advances in material developments and phase-conjugate architectural designs that can have strong impact in the commercialization of rewritable holographic memories.

2:00 pm

TuC2 ▪ Partial response equalization for grayscale volume holographic data storage, V. Vadde, B. Vijaya Kumar, Carnegie Mellon Univ. (USA) ..... [3864-30]

We investigate partial response equalization for grayscale holographic storage. We rigorously simulate 3-level grayscale holographic storage and quantify the storage density gains possible through partial response equalization.

2:15 pm

TuC3 ▪ Multilayer holographic data multiplexing with random encoded reference beam, V. B. Markov, J. E. Millerd, J. D. Trolinger, MetroLaser Inc. (USA) ..... [3864-31]

The results of experimental study and theoretical analysis of high-density data multiplexing by using volume hologram recording with random encoded reference beam are presented.

2:30 pm

TuC4 ▪ High-density erasable three-dimensional optical bit data storage in a photorefractive polymer using two-photon excitation, D. Day, M. Gu, A. Smallridge, Victoria Univ. of Technology (Australia) ..... [3864-32]

We report on a new method for high-density erasable/rewritable three-dimensional optical bit data storage in a photorefractive polymer under two-photon excitation.

2:45 pm

TuC5 ▪ Crescent geometry for an optical ribbon recorder, T. D. Milster, Optical Sciences Ctr./Univ. of Arizona; D. P. Gregg, K. C. Wilson, Infolux, Inc. (USA) ..... [3864-33]

A new scanning geometry is presented that can potentially produce a real recording data rate of 1 Gbit/sec on thin optical ribbon with a sixteen-element laser array.

3:00 to 3:30 pm ..... Coffee Break

TuD ▪ Poster Session I

Presiders: **Seiji Kobayashi,** Sony Corp. (Japan); **Yuan-Sheng Tyan,** Eastman Kodak Co. (USA)

3:30-3:35 pm: Invited Poster presentation

3:35-4:30 pm: Two-minute presentations of poster topics

4:30-6:00 pm: Poster viewing

(Invited)

TuD1 ▪ Multilayer phase-change recording, K. Nagata, K. Nishiuchi, N. Yamada, Matsushita Electric Industrial Co., Ltd. (Japan) ..... [3864-34]

We introduce a one-side dual-layer technique enabling to double the storage capacity of rewritable phase-change optical disk.

TuD2 ▪ New 3.5-inch magneto-optical disk system: 1.3 GB GIGAMO—technology, reliability, and performance, K. Itoh, Fujitsu Ltd. (Japan); H. Yoshimura, Sony Corp. (Japan); K. Ogawa, Fujitsu Ltd. (Japan) ..... [3864-35]

GIGAMO is a new 3.5" MO system which world-first utilizes the Magnetic Super Resolution to realize 1.3 GB capacity and complete downward compatibility. Technology, reliability and its high speed performance will be presented.

TuD3 ▪ Investigation of crystallization behavior of sputter-deposited nitrogren-doped amorphous $Ge_2Sb_2Te_5$ thin films, H. Seo, T. Jeong, J. Park, C. Yeon, D. C. Lee, LG Corporate Institute of Technology (Korea); S. J. Kim, H. Lim, S. Y. Kim, Ajou Univ. (Korea) ..... [3864-36]

The crystallization behavior of amorphous $Ge_2Sb_2Te_5$-(N) phase-change thin films was studied and a kinetic model based on the cascaded crystallization was proposed.

TuD4 ▪ Polarization effect on signal from optical ROM using SIL, K. Otaki, H. Osawa, H. Ooki, J. Saito, Nikon Corp. (Japan) ..... [3864-37]

Influence of polarization disturbance to the signal intensity from embossed mark using Solid Immersion Lens is discussed.

TuD5 ▪ Experimental study of image formation in a magneto-optical apertureless scanning near-field microscope, H. Wioland, O. Bergossi, S. Hudlet, P. Royer, Univ. de Technologie de Troyes (France) ..... [3864-38]

We present a magneto-optical apertureless Scanning Near-field Optical Microscope in transmission. Different parameters and artefacts which influence the image formation are analyzed.

TuD6 ▪ Characteristics of R-MSR on groove recording, T. Kawano, N. Uchida, A. Okamuro, Mitsubishi Chemical Corp. (Japan) ..... [3864-39]

Characteristics of R-MSR on groove recording were studied. CNR over 49.5dB could be obtained on 0.38μm. Cross talk was lower than conventional 8X disk.

TuD7 ▪ Rewritable optical disk with a new addressing method for increasing recording density and random accessibility, S. Suh, D. Kim, I. Jong, J. Park, J. Kim, LG Electronics Inc. (Korea) ..... [3864-40]

A rewritable disk format with new addressing method which uses a phase modulated wobble signal is proposed. It has increased recording density and random accessibility.

TuD8 ▪ Quality discrimination method for write-once optical disk, H. Kim, W. Yeo, D. Bae, LG Electronics Inc. (Korea) ..... [3864-41]

Our new quality discrimination method for write-once optical disk can do the whole and non-destructive inspection simultaneously so that the error rate of disks is reduces. Also, our new method is able to apply into CD-R fabrication process and duplication process.

TuD9 ▪ Automated analysis of data mark microstructure in high-density optical discs, D. A. Chernoff, D. L. Burkhead, Advanced Surface Microscopy, Inc. (USA) ..... [3864-42]

AFM images are analyzed and calibrated to provide accurate measurements of pit geometry and track pitch. Robust statistics relate pit geometry to process variables and to electrical performance.

TuD10 ▪ Effects of magnetic properties and layers thickness on the readout performance of MAMMOS disks, J. Kim, K. Hong, W. Choi, T. Yoo, D. C. Lee, LG Corporate Institute of Technology (Korea) ..... [3864-43]

The effects of magnetic properties of magnetic films on the readout performance, and the thickness tolerance of each layers in MAMMOS disks were investigated.

TuD11 ▪ Suppression of jitter bump for GeSbTe phase-change optical disk, T. Jeong, H. Seo, C. Yeon, J. Park, D. C. Lee, LG Corporate Institute of Technology (Korea) ..... [3864-44]

The jitter bump is fairly suppressed by adding oxygen-doped GeSbTe film between recording and dielectric layer. The mechanism of jitter bump is also analyzed.

TuD12 ▪ Initialization process by induction heating for phase-change optical disks, W. Yeo, H. Kim, C. Kim, LG Electronics Inc. (Korea) ..... [3864-45]

The feasibility of induction heating method is studied for initialization process and proven promising technology for reduction of process time. The induction heating can be adopted to initialization process.

TuD13 ▪ Terminal attractor optical associative memory for pattern recognition, X. Lin, M. Mori, Electrotechnical Lab. (Japan); J. Ohtsubo, Shizuoka Univ. (Japan); M. Watanabe, Electrotechnical Lab. (Japan) ..... [3864-46]

The terminal attractor optical associative memory is proposed for pattern recognition. The experimental results show that it can eliminate spurious states and increase memory capacity.

TuD14 ▪ New way to improve the reliability of high speed and mass data recording optical disk array, C. Wang, H. Jia, D. Xu, Tsinghua Univ. (China) ..... [3864-47]

A high speed and mass data recording optical disk array is developed and a new way - Floating Parity Group to improve the system reliability is proposed and implemented.

TuD15 ▪ Model of photochromic mask layer for optical storage, Y. Zhang, D. Xu, L. Pan, Tsinghua Univ. (China) ..... [3864-48]

Presents two models: photochemical model and simplified mathematical model. More aspects are considered in photochemical model. Mathematical model is used to evaluate the MTF.

TuD16 ▪ Optical storage properties of novel azo dye-doped polymer thin films, G. Wang, L. Hou, F. Gan, Shanghai Institute of Optics and Fine Mechanics (China) ..... [3864-49]

A new azo dyedoped polymer film has sufficiently high absorption and acceptable reflectivity, and also high reflectivity contrasts at lower writing powers and writing pulse-widths.

TuD17 ▪ Characteristic of super-RENS disks with various thickness of thermal protective layers, A. Sato, Minolta Co., Ltd. (Japan); J. Tominaga, T. Nakano, National Institute for Advanced Interdisciplinary Research (Japan); H. Fuji, Sharp Co. (Japan); N. Atoda, National Institute for Advanced Interdisciplinary Research (Japan) ..... [3864-50]

Super-RENS disks with various thickness of thermal protective layers were experimentally investigated. A computer simulation with FDTD technique was also carried out.

TuD18 ▪ Transmitted signal properties of super-RENS disks, T. Nakano, National Institute for Advanced Interdisciplinary Research (Japan);A. Sato, Minolta Co., Ltd. (Japan); J. Tominaga, N. Atoda, National Institute for Advanced Interdisciplinary Research (Japan) ..... [3864-51]

We experimentally investigate transmitted signal properties of Super-RENS disks, which have different gaps between Sb and recording layers.

TuD19 ▪ Improvement of performance of a tracking servo system for an optical disk drive, K. Arai, H. Okumura, H. Tokumaru, NHK Science and Technical Research Labs. (Japan); K. Ohishi, Nagaoka Univ. of Technology (Japan) ..... [3864-52]

Simulation results of a tracking servo system consisting of feedback control system and a precompensator for feedforward control will be presented.

TuD20 ▪ Performance comparison of detectors for DVD channel impaired by bloom and transition noise, S. Gopalaswamy, N. Kee, B. Farhang-Boroujeny, National Univ. of Singapore ..... [3864-53]

A novel and simple non-Viterbi detector is shown to perform comparable to Viterbi detectors with targets of memory-4 in the DVD read channel impaired by bloom and transition noise.

TuD21 ▪ Equalizer design based on diffraction analysis, Y. Honguh, Toshiba Corp. (Japan) ..... [3864-54]

A design procedure is described that determines the optimum equalizer characteristics based on the scalar diffraction model. Disk tilt and crosstalks are considered in the model.

TuD22 ▪ Super-resolution rewritable optical disk having a mask layer composed of thermo-chromic organic dye, M. Hatakeyama, T. Ando, K. Tsujita, K. Oishi, I. Ueno, Victor Co. of Japan, Ltd. (Japan) ..... [3864-55]

A super-resolution rewritable Ag-In-Sb-Te optical disk, having a thermo-chromic organic dye mask layer, which allows increasing in both linear density and track density, is developed.

TuD23 ▪ Optical disk readout analysis using an extended point-spread function, K. Toyota, S.Hineno, Y. Matsumoto, N. Nishi, K. Saito, Sony Corp. (Japan) ..... [3864-56]

We present analyses of DPD and signal from pits on a groove using an extended point spread function considering shapes of detectors and groove conditions.

TuD24 ▪ Jitter simulation of readout signal including adjacent track mark profile variations of optical disks, Y. Park, S. Jo, Soong Sil Univ. (Korea) ..... [3864-57]

Using the disk mark model including adjacent tracks, read signal and jitter were simulated to determine the allowable mark profile variations for a given jitter.

TuD25 ▪ High-density holographic memory and its applications to optical pattern recognition, T. Chao, H. Zhou, G. F. Reyes, Jet Propulsion Lab. (USA) ..... [3864-58]

A grayscale optical correlator using a holographic memory system for storing large bank of optimum correlation filters has been developed and demonstrated for real-time optical pattern recognition.

TuD26 ▪ Tilt servo using modal wavefront actuator, H. Lee, Industrial Technology Research Institute (Taiwan) ..... [3864-59]

We report on the aberrations correction by using an piezoelectric modal wavefront actuator. The innovate device has the advantages of high bandwidth, linear control, simple drive line, high spatial wavefront resolution.

Wednesday 14 July

WA ▪ Phase-Change Media

Presiders: **David A. Strand,** Energy Conversion Devices, Inc. (USA); **Takeo Ohta,** Matsushita Electric Industrial Co., Ltd. (Japan)

8:00 am (Invited)
WA1 ▪ Overview and the future phase-change optical disk technology, T. Ohta, Matsushita Electric Industrial Co., Ltd. (Japan) ..... [3864-60]

Review of key technologies of phase-change optical disk and a proposal of the radial mark width of 100 nm to 330 nm multilevel blue laser recording.

8:30 am (Invited)
WA2 ▪ AgInSbTe materials for high-speed phase-change recording, H. J. Borg, Philips Optical Storage (Netherlands); P. W. Blom, B. A. Jacobs, B. Tieke, Philips Research Labs. (Netherlands); A.E. Wilson, I. P. Ubbens, Philips Optical Storage (Netherlands); G. Zhou, Philips Research Lab. (Netherlands) ..... [3864-61]

AgInSbTe-based media exhibit increased data rates at decreased laser spot size, making these materials excellent candidates for recording at blue wavelength and high NA.

9:00 am
WA3 ▪ Large capacity and high-data-rate phase-change discs, Y. Kuroda, Y. Kasami, M. Ono, S. Takagawa, K. Seo, M. Yamada, O. Kawakubo, Sony Corp. (Japan) ..... [3864-62]

We developed a new phase change disc on which 50Mbps and 9.2GB information was written and readout at 640 nm wavelength with a 0.85NA lens.

9:15 am
WA4 ▪ 16.8 GB double-decker phase-change disc, K. Kurokawa, M. Naito, K. Yasuda, T. Kashiwagi, O. Kawakubo, Sony Corp. (Japan) ..... [3864-63]

We developed a double-decker phase change disc on which a 16.8GB user data was written and readout using 0.85NA lens at 660 nm laser wavelength.

9:30 am
WA5 ▪ High-data-rate phase-change media for the digital video recording system, B. Tieke, M. Dekker, N. Pfeffer, R. van Woudenberg, G. Zhou, Philips Research Labs. (Netherlands); I. P. Ubbens, Philips Optical Disc Technology Ctr. (Netherlands) ..... [3864-64]

We demonstrate phase-change recording with 33 Mb/s user data-rate at a numerical aperture of 0.85 and red wavelength. First results at 413 nm are reported.

9:45 am
WA6 ▪ Crystallization process in thin films of GeSbTe, C. Peng, M. Mansuripur, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-65]

We have investigated the effects of thermal and photo-induced phenomena on the crystallization of an amorphous $Ge_2Sb_{2.3}Te_5$ thin film sample. Our experimental results shed some light on the relative significance of the two mechanisms involved.

10:00 to 10:30 am ..... Coffee Break

WB ▪ Testing and Evaluation

Presiders: **Tow C. Chong,** National Univ. of Singapore; **James Z. Kwiecien,** Imation Corp. (USA)

10:30 am (Invited)
WB1 ▪ Analysis of thermomagnetic recording by using magnetic field microscopy
H. Nemoto, H. Saga, Y. Honda, Hitachi, Ltd. (Japan) ..... [3864-66]

Magneto-resistive detection signals from a newly developed flux-detectable RE-TM recording medium are compared to magnetic states observed by magnetic states observed by magnetic-force microscopy.

11:00 am
WB2 ▪ Crystallization and amorphization studies on a Ge2Sb2Te5 thin film sample using a two-laser static tester, P. K. Khulbe, X. Xun, M. Mansuripur, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-67]

A novel, two-laser static tester has been constructed for the study of phase-change and magnetooptical recording media. We present results of measurements pertaining to the dynamics of crystallization and amorphization in thin films of GeSbTe alloy.

11:15 am

WB3 ▪ Imaging of phase-change optical disk by the reflection-mode scattering-type scanning near-field optical microscope, M. Yamaguchi, Y. Sasaki, H. Sasaki, T. Konada, Y. Horikawa, Olympus Optical Co., Ltd. (Japan); A. Ebina, T. Umezawa, T. Horiguchi, Teijin Ltd. (Japan) ..... [3864-68]

Phase-change recording marks on the groove were successfully observed with a reflection-mode scattering-type scanning near-field optical microscope.

11:30 am

WB4 ▪ Instrument to measure tilt of the objective lens of a near-field recording head, P. H. Malyak, M. A. Wilder, D. L. Kent, J. Watson, J. S. Berg, Firefly Technologies, Inc. (USA) ..... [3864-69]

We describe a traveling-microscope-based instrument that measures tilt of the objective lens of a nearfield recording head with 100 μRad resolution.

11:45 am

WB5 ▪ In-situ identification of material property values for phase-change optical recording, T. Hurst, Hewlett-Packard Labs.; P. K. Khulbe, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-70]

Reflectance measurements from a new two-laser static optical tester are transformed into improved material property value estimates for simulating the performance of phase-change optical recording disks.

Noon

WB6 ▪ Variation in optical disc birefringence measurements, K. B. Rochford, S. T. Kreger, J. W. West, National Institute of Standards and Technology (USA) ..... [3864-71]

We report a large variation in disc retardance measurements using commercial instruments. We discuss sources of variation and specific errors in one class of polarimetric instruments.

12:15 to 1:30 pm ..... Lunch Break

WC ▪ Blue Lasers

Presiders: **Shigeo Kubota,** Sony Corp. (Japan); Henk van Houten, Philips Research Labs. (Netherlands)

1:30 pm (Invited)

WC1 ▪ Optical disk recording using a GaN blue laser diode, I. Ichimura, F. Maeda, K. Osato, K. Yamamoto, Y. Kasami, Sony Corp. (Japan) ..... [3864-72]

The combination of a GaN laser diode and a small wide-band actuator with a lightweight two-element lens has achieved 20 GB of capacity.

2:00 pm

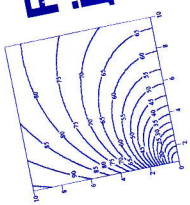
WC2 ▪ 27.4 GByte read-only dual-layer disc for blue laser, T. Higuchi, S. Miyanabe, M. Okano, Pioneer Electronic Corp. (Japan) ..... [3864-73]

The authors prototyped a 27.4 Gbyte read only dual layer disc system. It shows the sufficient tilt margin over ±0.58 degrees.

2:15 pm

WC3 ▪ Magneto-optical disk for blue lasers, Y. Sabi, K. Kawase, K. Yamaguchi, N. Ando, Y. Maeda, T. Harada, M. Kanno, Sony Corp. (Japan) ..... [3864-74]

A conventional MO achieved above 6 Gbit/inch^2 with a 407 nm laser and NA 0.60 lens, by introducing a newly designed structure suitable for blue.



rotation angle and intensity. Rotation angle oscillations with air gap are described.

2:30 pm

WC4 ▪ New method of the readout signal generation to reduce the adjacent track crosstalk, C. S. Chung, T. K. Kim, S. T. Jung, C. W. Lee, S. S. Joo, I. S. Park, Samsung Electronics Co., Ltd. (Korea) ..... [3864-75]

We can reduce the adjacent track crosstalk for high density optical memories by new signal detection, dividing the exit pupil of objective lens in radial direction.

2:45 pm

WC5 ▪ Miniaturized SHG blue laser without coupling lenses, Y. Kitaoka, T. Yokoyama, K. Mizuuchi, K. Yamamoto, Matsushita Electric Industrial Co., Ltd. (Japan) ..... [3864-76]

Miniaturized SHG blue laser (5 X 12 X 1.5mm^3) without coupling lenses using a QPM-SHG waveguide device is demonstrated to generate blue light of 2mW.

3:00 to 3:30 pm ..... Coffee Break

WD ▪ Poster Session II

Presiders: **Gordon R. Knight,** TeraStor Corp. (USA); **Ryuichi Katayama,** NEC Corp. (Japan)

3:30-3:35 pm: Invited Poster presentation

3:35-4:30 pm: Two-minute presentations of poster topics

4:30-6:00 pm: Poster viewing

(Invited)

WD1 ▪ Dual-level optical discs, J. M. Bruneau, MPO Disque Compact (France); A. Fargeix, B. Bechevet, CEA-LETI (France); F. X. Pirot, MPO Disque Compact (France); B. Valon, CEA-LETI (France) ..... [3864-77]

Dual level optical recording is an attractive solution to increase the capacity of optical discs. We report our last results for the development of a pre-recorded/rewritable and double rewritable configuration.

WD2 ▪ PRML (partial response maximum likelihood) simulator with nonlinearity compensated channel model, H. Kim, S. Ahn, S. Jeong, K. Park, J. Kim, LG Electronics Inc. (Korea) ..... [3864-78]

A PRML simulation results with the nonlinearity compensated channel model are presented. And the effects of linear model and nonlinear model are discussed.

WD3 ▪ Examination of tungsten-oxide-based thin films for optical memory, R. J. Bussjager, J. M. Osman, Air Force Research Lab.; J. Chaiken, Syracuse Univ.; M. A. Getbehead, D. S. Hinkel, T. McEwen, Air Force Research Lab. (USA) .. [3864-79]

Tungsten oxide material is being evaluated for use as an optical media. We describe the test bed utilized and report the performance differences of thin films of WO_3 and W_2O_5 using aluminum and glass disc substrates.

WD4 ▪ Electro-optic scanner for an optical head fine actuator, J. Zhai, Y. Huang, S. Schroeck, W. C. Messner, T. E. Schlesinger, D. D. Stancil, Carnegie Mellon Univ. (USA) ..... [3864-80]

An electro-optic scanner has been used as a fine actuator to perform high-speed track following and fine seek across nine tracks on an optical disk.

WD5 ▪ Optical field study in solid immersion lens, F. Guo, T. E. Schlesinger, D. D. Stancil, Carnegie Mellon Univ. (USA) ..... [3864-81]

A new optical field analysis is used for SILs to estimate spot size, rotation angle and intensity. Rotation angle oscillations with air gap are described.

Place Stamp Here

SPIE—Society of Photo-Optical Instrumentation Engineers
P.O. Box 10
Bellingham, WA 98227-0010 USA

WD6 ▪ Physical properties of volume holographic recording utilizing photoinitiated polymerization for nonvolatile digital data storage, L. Paraschis, Y. Sugiyama, L. Hesselink, Stanford Univ. (USA) ..... [3864-82]

We evaluate the physical properties that allow for efficient volume holographic recording utilizing photoinitiated (cationic-ring-opening) polymerization. We primarily identify monomer diffusive transport that contributes to grating development even after exposure at high intensities, yielding high recording sensitivity.

WD7 ▪ Design of near-field probe for optical recording using a 3-dimensional finite-difference time-domain method, K. Hirota, Toray Industries Inc. (Japan);T. D. Milster, Y. Zhang, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-83]

Tapered dielectric near field-probes are designed for optical recording by means of a 3-Dimensional Finite Difference Time Domain (FDTD) method.

WD8 ▪ Subsampled digital retiming for optical disk, G. Feyh, J. M. Graba, Cirrus Logic, Inc. (USA) ..... [3864-84]

High speed optical data is synchronized faithfully with an all-digital retiming loop whose clock speed is almost half the maximum channel rate.

WD9 ▪ Comparison of timing recovery schemes for optical storage systems, Y. Yuan, B. Vijaya Kumar, Carnegie Mellon Univ. (USA) ..... [3864-85]

Three timing recovery schemes are applied to a simulated optical recording channel and their performances are compared.

WD10 ▪ Multitrack storage of I0,000 holograms in a disk-type photorefractive crystal, S. Tao, Q. Yuan, Z. Jiang, G. Liu, M. Xu, Beijing Polytechnic Univ. (China) ..... [3864-86]

Multi-track storage of 10,000 holograms in a sector of photorefractive disk using spatioangular multiplexing is demonstrated. The analysis and performances of this memory are given.

WD11 ▪ Recrystallization velocity of phase-change material, C. Trappe, Technical Univ. Aachen (Germany); B. Bechevet, B. Hyot, LETI CEA (France); S. Facsko, H. Kurz, Technical Univ. Aachen (Germany) ..... [3864-87]

Nitride interfaces have a strong influence on the recrystallization behavior of stacked optical phase change recording material. This is demonstrated by real time reflectivity measurements.

WD12 ▪ Multilevel reflection modulation recording for phase-change optical disks, L. P. Shi, T. C. Chong, P. K. Tan, X. Miao, J. J. Ho, Y. Wu, National Univ. of Singapore ..... [3864-88]

Multi-level reflection was obtained on rewritable phase change optical disks by using static tester using different level of power amplitudes. The combination of size effect and partial crystallization effect is proposed as main reason to cause the multi-level reflection.

WD13 ▪ Experimental model of sled system in optical disk drive, J. Han, National Univ. of Singapore; K. M. Hock, W. Li, Sony Precision Engineering Ctr. (Singapore); T. C. Chong, National Univ. of Singapore; K. Shintani, K. Tong, Sony Precision Engineering Ctr. (Singapore); C. Huang, R. Rayaraj, National Univ. of Singapore ..... [3864-89]

A model of sled system is derived from experiments to improve sled servo and track jump in optical disk drive. The model simulation well matches experimental data.

WD14 ▪ Three-dimensional FDTD analysis of optical disk storage system, J. Liu, B. Xu, T. C. Chong, National Univ. of Singapore ..... [3864-90]

This summary addresses how to analyze the optical disk storage system by three-dimensional finite difference time-domain (FDTD) method.

WD15 ▪ New additional layer to realize initialization-free function for DVD-RAM disk, X. Miao, T. C. Chong, L. P. Shi, P. K. Tan, F. Li, National Univ. of Singapore ..... [3864-91]

The Sb_2Te_3 additional layer to realize the initialization-free function for the GeSbTe DVD-RAM disks is reported. Shorter time is required for complete erasure.

WD16 ▪ Comparison of two coding schemes for generating DC-free RLL sequences, W. Y. Wilson, National Univ. of Singapore; K. A. Immink, Institute of Experimental Mathematics (Germany); B. Xu, T. C. Chong, National Univ. of Singapore ..... [3864-92]

We report on the performance assessment of two methods for generating dc-free runlength limited sequences that can be applied in optical recording.

WD17 ▪ Theoretical analysis of recording light distribution in phase-change near-field recording using SIL, J. Liu, T. C. Chong, B. Xu, National Univ. of Singapore ..... [3864-93]

We investigate the recording light distribution within the recording layer of phase-change near-field recording, and also analyze its relationship with the disk structure.

WD18 ▪ Aspherical supersphere solid immersion lens for near-field optical recording, M. Liu, B. Xu, T. C. Chong, G. Yuan, C. Y. Bah, National Univ. of Singapore ..... [3864-94]

Aspherical supersphere Solid Immersion Lens (ASSIL) with large assembly tolerance were designed. The tolerance could be increased about 35% more than that of SSIL if the critical aberration was defined as 0.015λ.

WD19 ▪ Finite element analysis of structural resonance of actuator in optical pickup head, J. P. Yang, G. Yuan, Z. J. Liu, B. Xu, M. Liu,Y. C. Lu, Y. H. Wang, T. C. Chong, National Univ. of Singapore ..... [3864-95]

This paper studies structural resonance of actuator in optical pickup head using finite element analysis. Numerical results are compared with those obtained experimentally.

WD20 ▪ Three-dimensional thermal modeling and analysis of near-field rewritable phase-change optical disks, J. J. Ho, J. C. Lee, T. C.Chong, L. P. Shi, Z. J. Liu, National Univ. of Singapore ..... [3864-96]

Three-dimensional thermal modeling and analyses based on an improved thermal model are performed on grooved near-field rewritable phase-change optical disk for the first time. Temperature profiles and heat flow characteristics were obtained and analyzed.

WD21 ▪ Superlattice-like phase-change optical recording disks, T. C. Chong, L. P. Shi, X. Miao, P. K. Tan, R. Zhao, Z. P. Cai, National Univ. of Singapore ..... [3864-97]

Superlattice-like phase-change optical disks, where the recording layer consists of alternating thin layers with two different phase change materials, have been fabricated and investigated. The signal change in writing, reading and erasing was observed at the pulse width of 7ns.

WD22 ▪ Computer-aided design and analysis of rewritable phase-change optical disk, R. Zhao, K. G. Lim, J. Liu, J. J. Ho, T. C. Chong, Z.J. Liu, B. Xu, L. P. Shi, National Univ. of Singapore ..... [3864-98]

An integrated phase-change optical disk design software capable of simulating and analyzing various thermal and optical effects needed for optical disk design was developed. Using this software, the optical and thermal effects of blue laser irradiation were simulated and analyzed.

WD23 ▪ Neural-network-aided pixel alignment in digital holographic storage, C. Phua, J. Liu, J. Li, X. Xu, Y. Wu, T. C. Chong, National Univ. of Singapore ..... [3864-99]

Back-propagation neural network technique is proposed for adaptive pixel alignment in digital holographic storage, so as to enhance the reliability of digital data retrieval.

WD24 ▪ Multichannel response estimation for digital holographic data storage, J. Li, Y. Wu, T. C. Chong, X. Xu, C. Phua, J. Liu, National Univ. of Singapore ..... [3864-100]

We investigate an adaptive method to estimate the multi-channel PSF using LMS (least mean square) algorithm for digital holographic data storage system.

WD25 ▪ Mechanism of super-resolution optical near-field structure, D. Tsai, F. H. Ho, C. W. Yang, National Chung Cheng Univ. (Taiwan); M. Gu, P. Ke, Victoria Univ. of Technology (Australia) ..... [3864-101]

Surface plasmon enhanced near-field photo-thermal energy transfer effects are used to explain the working mechanism of the super resolution optical near-field structure.

6:00 to 7:30 pm ..... Dinner Break

Wed. 7:30 to 9:30 pm

WE ▪ Panel Discussion on Technology Fusion of Optical Recording and Magnetic Recording

Presiders: **Paul J. Wehrenberg,** Apple Computer, Inc.; **Masahiko Kaneko,** Sony Corp. (Japan)

Thursday 15 July

ThA ▪ General Media

Presiders: **Terril Hurst,** Hewlett-Packard Labs.; **Jun Saito,** Nikon Corp. (Japan)

8:30 am (Invited)

ThA1 ▪ Recent advances in optical media manufacturing technology, B. J. Bartholomeusz, Multi Media Masters & Machinery (USA) ..... [3864-102]

In this talk we will explore recent advances and evolving technological requirements as they pertain to CD and DVD recordable and rewritable manufacturing technology.

9:00 am (Invited)

ThA2 ▪ Ten-year overview and future prospects of write-once organic recordable media, E. Hamada, Taiyo Yuden Co., Ltd. (Japan) ..... [3864-103]

CD-R was introduced 10 years ago and now it is widely spread. It has great advantages of compatibility with CD and good performances for various speed recordings. The performances are achieved from the thermal property of organic dye materials. The potential for higher density and higher speed recording will be discussed.

9:15 am

ThA3 ▪ Cover-layer technology for the high-NA digital video recording system, M. M. Decre, Philips Research Labs. (Netherlands); P. H. Vromans, Philips Optical Disc Technology Ctr. (Netherlands); J. M. den Toonder, A. L. Braun, H. A. Wierenga, Philips Research Labs. (Netherlands); I. P. Ubbens, Philips Optical Disc Technology Ctr. (Netherlands) ..... [3864-104]

We present two techniques, spin-coating of a resin and bonding of a sheet, to realize a thin cover layer within ±3% thickness uniformity tolerances.

9:30 am

ThA4 ▪ Computation of the effective depth of grooves in an optical disk using vector diffraction theory, W. Yeh, L. Li, M. Mansuripur, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-105]

We present results of vector diffraction simulations pertaining to the effective depth of the groove for different track pitches and different numerical apertures of the objective lens.

9:45 am

ThA5 ▪ Approach for high-speed recording of 4.7 GB DVD-R, T. Fujii, T. Tajima, R. Negishi, I. Okitsu, Y. Tomizawa, K. Ebara, T. Nakajima, E. Hamada, Taiyo Yuden Co., Ltd. (Japan) ..... [3864-106]

High speed (2X, 4X) recording was examined with thermal analysis and disc design for DVD-R 4.7GB. Potentiality of 4X recording was proved.

10:00 to 10:30 am ..... Coffee Break

ThB ▪ Coding and Channels

Presiders: **Josh N. Hogan,** Hewlett-Packard Labs. (USA); **Yoshinori Honguh,** Toshiba Corp. (Japan)

10:30 am (Invited)

ThB1 ▪ Signal processing for 15/27 GB read-only disk system, F. Yokogawa, S. Miyanabe, M. Ogasawara, H. Kuribayashi, Y. Tomita, K. Yamamoto, Pioneer Electronic Corp. (Japan) ..... [3864-107]

In order to realize 15/27GB read-only disk system using blue laser, new signal processing is required. We have realized 15/27GB system by using 2 dimensional adaptive equalizer. The 2 dimensional equalizer was composed of the crosstalk cancel system, the asymmetry compensation type tangential adaptive equalizer, and the limit equalizer.

11:00 am

ThB2 ▪ Error modeling and performance analysis of error-correcting codes for the digital video recording system, K. Yamamoto, M. Hattori, T. Narahara, Sony Corp. (Japan) ..... [3864-108]

Error modeling techniques using hidden Markov models and numerical performance analysis methods of error-correcting codes are proposed. DVD code and Picket code are compared.

11:15 am

ThB3 ▪ Concatenated codes and iterative (turbo) decoding for PRML optical recording channels, L. L. McPheters, S. McLaughlin, Georgia Institute of Technology (USA) . [3864-109]

Turbo codes are applied to partial response optical recording channels. Gains of up to 5.5 dB at a bit error rate of 10^{-5} over a baseline PRML systems can be achieved.

11:30 am

ThB4 ▪ Linear modeling and nonlinearity compensation of the high-density disc channel, S. Ahn, H. Kim, S. Jeong, K. Park, J. Kim, LG Electronics Inc. (Korea) ..... [3864-110]

A practical model to clearly show the identification of channel in high density disc is suggested. Nonlinear effect compensation is useful for the practical approach.

11:45 am

ThB5 ▪ Optically equalized PRML channels for high-density optical data storage, C. Wright, S. D. Jepson, P. W. Nutter, Univ. of Manchester (UK) ..... [3864-111]

The use of shading bands to equalize optically the optical data storage readout channel to partial response targets of the PR(a,b,b,a) type is described.

Noon to 1:30 pm ..... Lunch Break

ThC ▪ Near-Field

Presiders: **Dong-Ho Shin,** Samsung Electronics Co., Ltd. (Korea); **Gordon S. Kino,** Stanford Univ. (USA)

1:30 pm (Invited)

ThC1 ▪ Optical near-field aperture storage technology (ONFAST) for high-density high-performance data storage applications, A. Partovi, Lucent Technologies/Bell Labs. (USA) ..... [3864-112]

Optical near-field aperture storage technique (ONFAST) uses a very small-aperture laser (VSAL) flying in close proximity to phase change media to achieve high areal density and data rate. ONFAST has the potential for achieving densities of over 500 Gb/in^2.

2:00 pm

ThC2 ▪ Near-field phase-change optical recording over 1.2 numerical aperture, K. Kishima, I. Ichimura, K. Yamamoto, K. Osato, Y. Kuroda, K. Saito, Sony Corp. (Japan) ..... [3864-113]

A new solid-immersion-lens and active gap control have achieved optical contact and doubled linear recording density of 4.7GB-DVD-RAM.

2:15 pm

ThC3 ▪ Evanescent coupling in magneto-optical and phase-change disk systems based on the solid immersion lens (SIL), W. Yeh, M. Mansuripur, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-114]

Results of numerical computations pertaining to evanescent wave coupling for near-field magneto-optical and phase-change disks based on the concept of solid immersion lens are presented.

2:30 pm

ThC4 ▪ Near-field phase-change optical recording using a GaP hemispherical lens, K. Hirota, Toray Industries Inc. (Japan); T. D. Milster, Optical Sciences Ctr./Univ. of Arizona; K. Shimura, Toshiba Corp. (Japan); Y. Zhang, J. S. Jo, Optical Sciences Ctr./ Univ. of Arizona (USA) ..... [3864-115]

A solid immersion lens and a modified liquid immersion lens (MLIL) were studied. The phase change marks, whose diameter was 200 nm, were recorded by MLIL.

2:45 pm

ThC5 ▪ Proposal of a near-field optical head using a new solid immersion mirror, K. Ueyanagi, T. Tomono, Fuji Xerox Co., Ltd. (Japan) ..... [3864-116]

A new near-field optical head using a hemi-parabolic solid immersion mirror is proposed, which height and weight are less than 1mm and 1gr, respectively.

3:00 pm

ThC6 ▪ Signal characteristics from a catadioptric system for near-field application, C. W. Lee, S. T. Jung, J. E. Seo, Y. Kim, D. Shin, Samsung Electronics Co., Ltd. (Korea) ..... [3864-117]

We investigate write and read signals from a catadioptric optical system for near field optical memory with a MO disk. CNR has been estimated to be around 35dB at 1MHz.

3:15 to 3:45 pm ..... Coffee Break

ThD ▪ Super-Resolution

Presiders: **Roger A. Hajjar,** TeraStor Corp. (USA); **Hiroshi Ooki,** Nikon Corp. (Japan)

3:45 pm (Invited)

ThD1 ▪ New technique for readout of super-density data storage beyond the diffraction limit, J. Tominaga, National Institute for Advanced Interdisciplinary Research (Japan) ..... [3864-118]

An approach for high speed optical near-field recording and detection is shortly reviewed, and the basic near-field scattering by super-resolution near-field structure (Super-RENS) is discussed.

4:15 pm

ThD2 ▪ Aperture formation and mechanism of super-RENS, J. Tominaga, N. Atoda, National Institute for Advanced Interdisciplinary Research (Japan) ..... [3864-119]

The formation and mechanism of nanometer sized apertures of superresolution near-field structure (Super-RENS) was thermally, mechanically and optically investigated. An aperture of an antimony film forced in a high compressive stress showed the resolution of less than 100 nm, whereas the film forced in a tensile stress did not. An aperture formation mechanism is proposed by balance between the aperture formation energy and the surface energy including the internal stresses.

4:30 pm

ThD3 ▪ Pupil plane filtering for improved signal detection in an optical data storage system incorporating a solid immersion lens, K. Shimura, Toshiba Corp. (Japan) and Optical Sciences Ctr./Univ. of Arizona (USA); T. D. Milster, Optical Sciences Ctr./Univ. of Arizona (USA); K. Hirota, Toray Industries Inc. (Japan) and Optical Sciences Ctr./Univ. of Arizona (USA); J. S. Jo, Optical Sciences Ctr./Univ. of Arizona (USA) ..... [3864-120]

We show an optical filtering techniques that improves signal contrast and the tolerance for change in gap height when a certain phase-change recording stack is used.

4:45 pm

ThD4 ▪ Focusing the solid immersion lens, G. S. Kino, Stanford Univ. (USA); R. A. Hajjar, TeraStor Corp. (USA) ..... [3864-121]

The optimum focus position of an SIL depends on the thickness of the air gap and the different layers used in an optical storage system.

5:00 pm

ThD5 ▪ Grating-assisted super-resolution for scanning optical systems, H. Ooki, K. Otaki, H. Osawa, J. Saito, Nikon Corp. (Japan) ..... [3864-122]

Theoretical consideration on a novel super-resolution technique using very fine gratings placed on the optical disc is presented.. The concept came from W. Lukosz's historical work in 1963.

Closing Remarks ▪ Thurs. 5:15 pm

Key to Authors & Presiders

K

L

M

N

O

P

R

S

T

U

V

W

X

Y

Z

Postdeadline Papers

The purpose of postdeadline papers is to give participants the opportunity to hear new and significant material in rapidly advancing areas. Only those papers judged to be truly excellent and compelling in their timeliness will be accepted.

The Technical Program Committee for ISOM/ODS will accept a limited number of postdeadline papers for presentation. Papers reporting extraordinary results must reach SPIE no later than **21 June 1999**. No papers may be brought to the meeting.

All authors of postdeadline papers must submit
* cover letter indicating the significance of the contribution
* three-page summary
* postdeadline paper form

Papers will be reviewed by the program committee. Authors will be notified of acceptance and mode of presentation (oral or poster) about one week before the conference.

Accepted postdeadline papers will be presented Monday 12 July. Copies of the accepted postdeadline papers will be distributed at the meeting.

Poster Sessions

A key feature of the technical program will be poster sessions. These will give authors the opportunity to present their work in greater detail and should facilitate discussions with interested attendees. New to ISOM/ODS, and to highlight the importance of posters, "invited posters" will keynote the sessions.

Immediately prior to the poster session there will be a five-minute verbal summary of the invited poster and two-minute introductions to each contributed poster.

Each poster presenter is provided a space 4' by 8' (1.22 m x 2.44 m) in which to display a summary of the paper. Authors must remain in the vicinity of the poster board for the duration of the session to answer the questions of attendees. In order to ensure a high quality presentation, all poster materials must be in printed form (handwritten text will not be accepted). The abstract and summary of both oral and poster papers are published in the Technical Digest.

Audiovisual Equipment

The meeting room will contain the following audiovisual equipment:

- Podium microphone
- Lavaliere microphone
- Two overhead projectors
- Projection pointer
- Two 2-in. x 2-in. (35mm) slide projectors
- Screen

Additional equipment will be made available only by special arrangement and may involve a rental fee. Contact the Meetings Department at SPIE if you have a request for nonstandard equipment by 1 June 1999; Phone: 360 676-3290; Fax: 360 647-1445; E-mail: jamesb@spie.org.

Publication of Conference Papers

In addition to the Technical Digest available at the conference, conference papers will be published as a special issue of the Japanese Journal of Applied Physics (JJAP). All authors accepted for the joint meeting of ISOM/ODS '99 are strongly encouraged to submit their contributions for publication in this journal. Authors' kits and copyright forms for submission to the journal will be sent to each contact author in May 1999. The due date for submissions to the JJAP is 10 August 1999. Submitted papers will be refereed based on the JJAP standard. This special issue of JJAP, to be published in February 2000, will be made available to all attendees of the joint ISOM/ODS '99 at a discounted price. Order forms will be distributed at the conference.

Tabletop Exhibits

An informal exhibit of small tabletop displays featuring pertinent equipment, materials, and literature will be held in conjunction with the joint ISOM/ODS 1999. Ample time will be allowed for all attendees to visit the exhibits and speak with representatives from the industry. For information about exhibiting, please contact the Exhibit Department at SPIE. Phone: 360 676-3290; Fax: 360 647-1445; E-mail: exhibits@spie.org.

Reception

A reception celebrating the unique culinary offerings of Hawaii will be held for all conference participants on Tuesday evening 13 July. Please wear your conference badge.

Messages

Messages for participants at the meeting should be directed to the SPIE Registration Desk. The address, telephone number, and fax number for the Sheraton Kauai Resort follows:

Sheraton Kauai Resort
2440 Hoonani Road
Poipu Beach, Koloa, HI 96756
Phone: 808 742-1661; Fax 808 742-9777

Messages will be taken during registration hours and posted on a message board.

Speaker and Presider Check-in

All speakers and presiders are requested to check in at the Registration Desk. Authors are encouraged to preload and preview their slides at least 30 minutes before their session begins. Slides may be retrieved at the same location after the session.

Presiders are requested to check in at the Registration Desk for a quick review of equipment and procedures.

Registration

Preregistration is strongly encouraged for quick pick-up of registration materials and for your own convenience! The registration fee for the joint ISOM/ODS 1999 meeting includes admission to technical sessions, the conference reception, refreshment breaks throughout the conference, and one copy of the Technical Digest.

	Before 2 July1999	After 2 July 1999
IEEE-LEOS, OSA, SPIE, JSAP		
Member	$405	$455
Nonmember	$465	$515
Fulltime student/emeritus*	$190	$215
Accompanying person**	$50	$50

**Full-time students are entitled to the same privileges as a regular registrant. They must provide student identification at the time of registration. Emeritus members may also register at the discounted rate.*
***Includes only conference reception and refreshment breaks.*

To take advantage of the early registration rate for the conference, return the enclosed form with your payment by **2 July 1999** to ISOM/ODS, SPIE 1000 20th Street, PO Box 10, Bellingham, WA 98225. Payment must accompany form.

Refund Policy for Preregistration

There is a $35 service charge for processing refunds. A letter requesting the refund should state the preregistrant's name and to whom the check should be made payable. Requests for preregistration refunds must be received no later than 7 working days prior to the first day of the meeting to be honored. No refunds will be issued after 2 July 1999.

Registration Hours

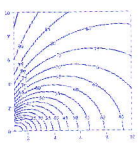
Registration will be located in the Poipu Ballroom Foyer Sunday through Thursday during the following hours:

Sunday 11 July	7:00 am to 6:00 pm
Monday 12 July	7:00 am to 7:00 pm
Tuesday 13 July	7:00 am to 5:00 pm
Wednesday 14 July	7:00 am to 5:00 pm
Thursday 15 July	8:00 am to 4:00 pm

Technical Digest

A copy of the Technical Digest is provided with the registration fee indicated above.

Additional digests may be ordered in advance at a cost of $40 per volume. Please complete the appropriate section on the Registration Form.



Housing Accommodations

A block of sleeping rooms has been reserved for the convenience of the meeting attendees at the Sheraton Kauai Resort. The convention rates available for the dates of 9-19 July are the following for single/double occupancy*. These rates are subject to the current tax rate of 10.16% and one-time porterage fee of $4.50 per person.

Garden Room $135; Lagoon Room $165; Ocean View $205

**Charge for additional person over 18 years of age is $40 + tax; under 18 is free. Maximum number of persons per room is 3 adults or 2 adults and 2 children.*

Reservations will be guaranteed upon receipt of first night room and tax deposit. This deposit must be received by **9 June 1999**. After this date reservations will be accepted at the convention rate only on a space available basis. To ensure your reservation at the low conference rate, please send your Housing Form today! Cancellations of hotel rooms MUST be made 72 hours prior to arrival.

The Sheraton Kauai Resort

Sheraton Kauai Resort, set amidst 20 acres of lush ocean-front gardens, has been the anchor resort property at Poipu for nearly 30 years. Poipu is centrally located with access to all the wonders and activities of Kauai. The full complement of guest services and facilities includes two swimming pools, massage and fitness center, tennis courts, a children's center, a host of beach activities plus equipment rental and instruction, a choice of championship golf courses, and shops both in the hotel and the nearby Poipu Shopping Village, to name a few.

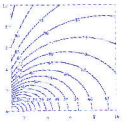
Island of Kauai

Kauai is famous for its diverse and scenic wonders, such as the 3,567 foot deep Waimea Canyon, stretching 14 miles across the western end of the island, the 3,000 foot high mountain cliffs on the north shore, 43 white sand beaches, Hawaii's only navigable rivers, four of the top ten golf courses in the State of Hawaii, the largest coffee plantation, 480 acres of guava orchards, and near perfect year-round weather, with daytime temperatures ranging from the mid-70's to the mid-80's (slightly warmer in the summer).

Housing Form

International Symposium on
Optical Memory and Optical Data Storage 1999
11–15 July 1999 • Sheraton Kauai Resort

Fill out this form and send by 9 June to:
Sheraton Kauai Resort
2440 Hoonani Road
Poipu Beach, Koloa, HI 96756
Phone: 808 742-1661 • Fax: 808 742-9777



Name: _____

# of persons: Adult_____ Child _____

Names of other individuals sharing room:

_____

_____

Address: _____

_____

City:_____ State:_____ Zip: _____

Country (non-U.S.): _____

E-mail: _____

Phone: _____

Fax: _____

Arrival Date: _____ Departure Date: _____

Room Type:	*View type:*	*Rate:**
☐ Single	☐ Garden Room	$135
☐ Double	☐ Lagoon Room	$165
	☐ Ocean Deluxe Room	$205

The following are by request only:

☐ King Bed ☐ Two Double Beds ☐ Smoking

** Rates are based on single or double occupancy at 10.16% tax per night.*

Method of Payment:

☐ Master Card ☐ VISA ☐ Discover
☐ Diner's Club ☐ Check enclosed

Credit Card #: _____

Expiration Date: _____

Signature: _____

Check in time: 3:00 pm. Check out time: 12 Noon.

Reservations need to be made by the cut-off date of **9 June 1999**. After this date, reservations will be accepted at the convention rate only on a space available basis. A deposit of one night's room and tax rate must be sent with your reservation. This deposit will be kept if the reservation is not canceled prior to 72 hours before arrival.