

18. High - Density Recording on Air - Stabilized Flexible Optical Disk

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Abstract

Using high NA lens is important for highly density recording. But its working distance and defocus margin is small. To overcome the problem, a flexible substrate disk and air stabilizer was used. The stabilizer is placed on a substrate side of a flexible disk, with an optical pickup set on the opposite side of the stabilizer. This system reduces disk axial runout by the stabilizer. Therefore the stabilizer does not cause scratching of the disk surface on the pickup side. If the disk rotates in closing the stabilizer and disk, airflow is generated between the stabilizer and the disk surface. This airflow reduces axial runout of the disk. This new system showed small axial runout, so this system could record signal which density was 0.13?m/bit. This time, we report new stabilizer system. This is more suitable than only one point stabilizer system for reduction characteristic of axial runout.

1. Crystal structure and its thermal behavior of $\text{Ge}_8\text{Sb}_2\text{Te}_{11}$ ($\text{GeTe}:\text{Sb}_2\text{Te}_3 = 8:1$), a suitable material for high-speed and high-density phase-change recording

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Abstract

In Blu-ray discs, on which as much as 50 GB of information can be recorded by blue-violet laser, the thickness of recording film is now only several nanometers to realize higher density and faster recording. For Blu-ray disc, such GeTe-rich pseudobinary compounds as $\text{Ge}_8\text{Sb}_2\text{Te}_{11}$ ($\text{GeTe}:\text{Sb}_2\text{Te}_3 = 8:1$) are adopted to enable sufficient optical changes between the amorphous and crystalline states of the film, which are transparent and opaque to the light, respectively. We investigated in detail the crystal structure and its temperature dependency in $\text{Ge}_8\text{Sb}_2\text{Te}_{11}$ by powder X-ray diffraction using a synchrotron radiation facility and examined the chemical bonding nature by molecular orbital calculation, which revealed followings. Erased (laser-crystallized) area of the film is an aggregate of microcrystallites. In these crystallites, an enormous number of free (conduction) electrons are present, which makes it opaque to light at visible and near-visible wavelengths. The density of free electrons rises with increased GeTe content, emphasizing the difference in optical properties between the amorphous and crystalline phases. This is presumed to enable sufficient optical changes even in very thin films only a few nanometers thick used for Blu-ray discs.

2, Structural investigation of Sb-Te sputtered films

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Abstract

X-ray structure analysis was carried out about Sb-Te sputtered films with different compositions. It turned out that the structure of every specimen is based on the cubic close-packed structure, and a stacking period changes with composition.

3. Crystal Structure and Feasibility for 16x DVD-Rewritable Media of In-Sb Phase-Change Material

Hiroshi Miura¹⁾, Eiko Suzuki¹⁾, Hiroko Tashiro¹⁾, Makoto Harigaya¹⁾, Kazunori Ito¹⁾, Noriyuki Iwata²⁾, Atsuyuki Watada²⁾, Katsuhiko Tani²⁾, Yoshiyuki Nakata³⁾, and Shuichi Emura⁴⁾
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Abstract

Recently, several Sb-based materials, Ga-Sb, Ge-Sb and In-Sb, have been proposed as phase-change layer of high-speed rewritable media. In-Sb forms the cubic crystal structure and has particularly fast crystallization speed compared with the other materials, which form hexagonal crystal structure similar to Sb. However, this material segregates InSb (In:Sb=1:1) at the composition around eutectic. This causes significant degradation of the reflectivity of phase-change media after a thermal aging test. Increasing Sb concentration higher than 80% is effective to suppress the degradation and change the crystal structure of In-Sb from cubic to hexagonal. At In₁₈Sb₈₂, although the main crystal structure remained cubic, the degradation of reflectivity was suppressed less than 2% and the maximum erase velocity was 56 m/s. Jitter around 12% was obtained as the overwriting characteristics at 56m/s (DVD16X) with this composition. It suggests that this material can be applied to 16x DVD rewritable media.

4. Optical property analysis for readout mechanism evaluation of super-RENS disk

Takashi Nakano

(National Institute of Advanced Industrial Science and Technology (AIST))

Abstract

The optical properties of super-resolution signals in the Fourier-plane of focus showed readout-power dependence. The properties could be explained by a shift of a special-temperature region in a laser spot under a ferroelectric catastrophe model.

5. Diffractive electro-magnetic photonics for physical description of optically nonlinear and anisotropic media

MyoungJune Kim, HakCheol XueZhe Li, SangYoul Kim
(Ajou University)

Abstract

Using Huygens -Fresnel principle, Simulator of disk preformat and phase change multiplayer was programmed. Focusing of light is approximated with Fourier transformation. As an important effect of focusing, nonlinear deviation of complex refraction index was widely surveyed. Maxwell-Jones Matrix and Jones-Fresnel Reflection & Transmission Coefficient was derived from complex refractive index function matrix(CRIFM), and analyzed the effect of nonlinear component in optical disk reproducing signal of Optical Storage-Recording Materials.

6. Electric properties of thin GeSbTe and AgInSbTe films by annealing

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Abstract

We have studied electric properties of 20nm and 50nm-thick Ge₂Sb₂Te₅ and AgInSbTe films for nonvolatile memory cell. The thin films were prepared as a film sample and a device sample after annealing at various temperatures from 140 °C to 415 °C. Large dynamic range of changing resistance for film samples is confirmed but the device sample has narrow range, which is not essential. We discuss on the resistance changes of some samples for miniaturizing the phase change memory element.

7. Phase Change RAM-A High performance Nonvolatile Memory Technology for Stand Alone and Embedded Applications

Hideki Horii

(Samsung Electronics Co., Ltd.)

8. Phase-change optical disk came from behind and won!

Isao Satoh

(Matsushita Electric Industrial Co., Ltd.)

Abstract

Phase-change technology has been dominating the rewritable optical discs like CD-RW, DVD, BD and HD DVD. It could be a big surprise when we came back to the end of the 1980s.

Author has engaged in phase-change optical disc technology from 1980. He was an eyewitness and also one of the key figures realized these achievements. In this paper, the history of optical disc media is reviewed and the universal knowledge to gain the supremacy of format wars. It was really interesting, challenging, and energy-consuming experiences.

9. Theoretical and Experimental Study on Evaluation of the Initialization Conditions of Phase-Change Optical Discs: Proposal of Pulse Initialization

Toshimichi Shintani a) , Hiroyuki Minemura a) , Yoshiaki Ogino b) , Noriyuki Ishikawa b) and Eiji Sahota b)

(a) Hitachi, Ltd. b) Hitachi Computer Peripherals Co., Ltd.)

Abstract

The relationship between the initialization conditions and the overwrite characteristics was investigated for phase-change optical discs. The results show that the initialized states can be categorized into insufficient, sufficient and damaged states. Initialization with low velocities lowers the margin of the sufficient state. Pulse initialization with a low velocity resulted in good overwrite characteristics.

10. Observation of Low reflectivity Crystallized State of Phase Change Optical Disc

Shinji Shirasaka ^{a)}, Yoshiharu Tami ^{a)}, Yoshiaki Ogino ^{a)}, Eiji Sahota ^{a)} and Toshimichi Shintani ^{b)}

(^{a)}Hitachi Computer Peripherals Co.,Ltd, ^{b)}Hitachi, Ltd.)

Abstract

Two type of crystallized states with Phase change optical disc exist at the initializing process. The difference between each of state is not only the reflectivity but initial jitter of overwrite. So focus on the erase power of overwrite, observe the specification of low reflectivity crystallized state.

11. Blu-ray Disc Mastering Using deep-UV Laser Beam Recorder

Takashi Ohgo, Tetsuya kondo, Eiji Nakagawa, Takashi Tsurukubo, and Toshiya Saito
(Victor Company of Japan, Ltd.)

Abstract

The authors have developed a novel laser beam mastering system using a deep-UV laser for a high-density optical disc. Technologies of direct focus servo, recording signal compensation and high contrast photoresist material are applied in the laser beam recorder. The evaluation results for the 25-Gbyte-capacity Blu-ray ROM (BD-ROM) disc revealed that uniform recording and reasonable jitter can be realized. Furthermore, the evaluation of the Blu-ray Rewritable (BD-RE) disc indicated the wide process margin and confirmed that the disc was practical for application in the market. Although the optics consists of conventional 266 nm laser with numerical aperture (NA) 0.9 objective lens, it successfully realizes both BD-ROM and BD-RE mastering.

12. TeOx-based film as Heat-mode type Photoresist

Eiichi Ito*, Yuko Kawaguchi, Morio Tomiyama, Shinya Abe and Eiji Ohno,
(Matsushita Electric Industrial Co., Ltd.)

ABSTRACT:

Conventional mastering technologies employ photolithography with photon-mode recording. The size of patterns has been downsized by shortening wave length of exposure source. Leading mastering technologies for Blu-ray Disc ROM, which require forming pits smaller than 150nm, employ electron beam. But it costs much. Recently some technologies of photolithography with heat-mode recording were reported. The technologies enable laser light to form pits for Blu-ray Disc ROM because heat-mode recording enable forming much smaller pits than the beam spot. Heat-mode mastering technologies without electron beam have advantages to build low-cost mastering system. The key to establish it is development of new photoresist. We discovered that TeOx-based material is useful as heat-mode type photoresist. Thermal Isolation Film drastically improved the patterning resolution. TeOx-based photoresist and Thermal Isolation Film enable BD-ROM mastering. The jitter values satisfy Blu-ray Disc system were obtained at the full range of replicated discs. Furthermore we made the mechanism of TeOx-based photoresist clear to present a beneficial guidance for researching new heat-mode type photoresists. Segregation of TeO₂ and TeOx-based material and dissolution of TeO₂ are the mechanism how TeOx works as heat-mode type photoresist. This mechanism is applicable for other heat-mode type recordable materials that are recoded by condensation or crystallization.

13. Dielectric-Thin-Film with High-Deposition-Rate for HD DVD Rewritable Media

Eiji Kariyada, Shuichi Ohkubo, Hideki Tanabe, and Tatsunori Ide

(NEC Corporation)

Abstract

We have developed a method for sputtering low-n dielectric thin films more rapidly than the conventional SiO₂ dielectric thin films. We have found that the deposition rate for the SiNiON film using a SiNi target with argon, oxygen, and nitrogen mixed gas was four times faster than that for the conventional SiO₂ film and was almost the same as that for the ZnS-SiO₂ film. Both films had almost similar refractive indexes. We have also confirmed that the rewritable media with the SiNiON film had excellent R/W characteristics.

14. 216Mbps Speed 50GB Phase Change Write Once Disc

Reiji Tamura

(Hitachi Maxell Ltd.)

Abstract

15. 100Mbps High-Speed Write/Read Characteristics for a 50 GB/layer Optical disk

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K. Adachi ²

(1:Hitachi Ltd., 2: HitachiMaxell Ltd.)

Abstract

High-density write/read technology for 50 GB/layer at a data transfer rate of 100 Mbps was developed. Good bit error rates under 1×10^{-4} were obtained in a condition using a phase-change WO-disk and a 3-beam cross-talk-canceller.

16. High Speed Crystallization Materials for the Rewritable HD DVD

Tsukasa Nakai, Sumio Ashida, Keiichiro Yusu, Noritake Ohmachi, Kazuyo Umezawa,
Naomasa Nakamura
(Toshiba Corporation)

Abstract

We have investigated high speed crystallization materials of the Rewritable HD DVD media. Two key materials were used in order to achieve faster crystallization for the phase-change recording media, a novel pseudo-binary alloy film as the recording layer and improved hafnium oxide-based composite material as the interface layers. The HD DVD format is a next-generation optical recording system having blue-violet lasers with the wavelength of 405 nm, numerical aperture (NA) of 0.65 and light incidence on 0.6-mm-thick substrate having the land and groove format. The feasibility of higher data transfer rate, 2X or more has been successfully demonstrated for the dual-layer type HD DVD-ARW having the user data capacity of more than 30 GB.

17. High Density Near Field Optical Disc Recording using Phase Change Media and Polycarbonate Substrate

Ariyoshi Nakaoki, Masataka Shinoda, Kmihiro Saito, Takao Kondo, Tsutomu Ishimoto,
Takeshi Matsui, Kim Sunmin
(Sony Corporation)

Abstract

A high density recording on optical disc with near field technology has been examined. We had succeeded in achieving a high numerical aperture (NA) of 1.83 by the developed solid immersion lens (SIL) which were made by high refractive index material ($n=2.0$). The gap distance between SIL and disc surface was kept about 20 nm by optical servo system. In order to realize the near field recording, we adopted a molded polycarbonate substrate and a phase change media. The embossed pattern on substrate was created by the drawing system with an electron beam and the track pitch was 160 nm. The top layer of SiN was deposited because of optical optimization and thermal optimization. We observed the clear eye pattern of recorded 17pp pattern which were recorded by blue laser of 405 nm with varying a pit length from 110 nm to 50 nm. We measured the bit error rate by an adaptive 8 taps PRML and obtained a value of 5×10^{-4} at bit length of 55 nm.

19. High-transmittance Write-once Medium with Te-O-Pd Film Suitable for Multilayer Disc on BD Format

Hideki KITAURA, Katsuyuki TAKAHASHI, Haruhiko HABUTA, Noboru YAMADA
(Matsushita Electric Industrial Co., Ltd.)

Abstract

We have developed a high-transmittance write-once medium with Te-O-Pd recording film. The medium shows transmittance of 78% and 2T CNR of 43 dB as high as that of L1 of conventional dual layer medium on BD format.