(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 February 2006 (09.02.2006)

PCT

(10) International Publication Number
WO 2006/014071 A1

(51) International Patent Classification[7]: G11B 7/00, 20/18

(21) International Application Number:
PCT/KR2005/002518

(22) International Filing Date: 2 August 2005 (02.08.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/592,525 2 August 2004 (02.08.2004) US
10-2004-0085289 25 October 2004 (25.10.2004) KR

(71) Applicant *(for all designated States except US)*: **LG ELECTRONICS INC.** [KR/KR]; 20, Yoido-dong, Youngdungpo-gu, Seoul, 150-721 (KR).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **PARK, Yong Cheol** [KR/KR]; 407-306, Jugong APT., Byeoryang-dong, Gwachon-si, Gyeonggi-do, 427-731 (KR).

(74) Agents: **BAHNG, Hae Cheol** et al.; 15th Floor Yosam Building, 648-23, Yeoksam-dong, Kangnam-gu, Seoul, 135-080 (KR).

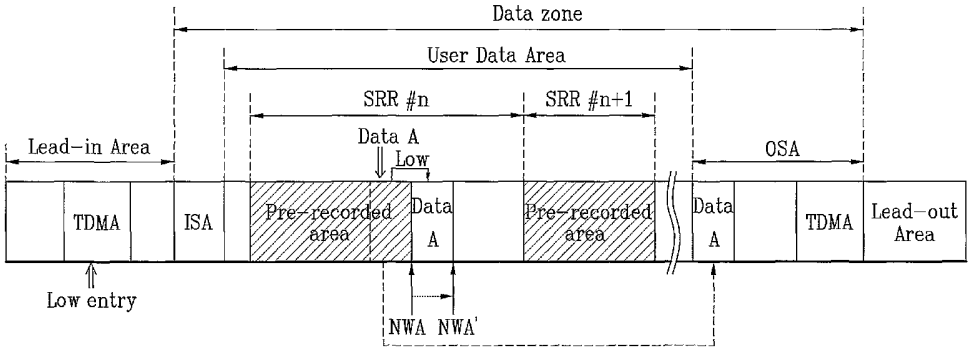
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** METHOD AND APPARATUS FOR RECORDING DATA ON AND REPRODUCING DATA FROM A RECORDING MEDIUM AND THE RECORDING MEDIUM



(57) **Abstract:** In an embodiment of the method of recording data on a recording medium, a management information entry is recorded in a temporary defect management area of the recording medium. The management information entry indicates a portion of a user data area of the recording medium, and the management information entry includes first and second status indicators indicating a status of the management information entry. For example, the first status indicator may indicate whether replacement is being performed with respect to the indicated portion of the user data area, and the second status indicator may indicate a type of replacement.

WO 2006/014071 A1

[DESCRIPTION]

METHOD AND APPARATUS FOR RECORDING DATA ON AND REPRODUCING DATA FROM A RECORDING MEDIUM AND THE RECORDING MEDIUM

Technical Field

The present invention relates to recording media, and methods and apparatuses associated therewith.

Background Art

A new type of high density optical disc, such as a Blu-ray RE-writable disc (BD-RE), that can record and store high definition audio and video data for a long period of time, is being developed. As shown in FIG. 1, the BD-RE has a lead-in area, a data zone, and a lead-out area. An inner spare area (ISA) and an outer spare area (OSA) are respectively allocated at a fore end and a rear end of the data zone. A recording unit of the BD-RE is a cluster. Referring to FIG. 1, whether or not a defect area exists within the data zone can be detected during the recording of the data. When a defect area is detected, replacement recording operations are performed. For example, the data that is intended to be recorded in the defect area is recorded in a spare area (*e.g.*, the inner spare area (ISA)). Then, position information of the detected defect area and the replacement recorded spare area are recorded and stored as management information in a defect list (DFL) of a disc management area (DMA) located within the lead-

in area.

During a read operation of this data, the data recorded in the spare area is read and reproduced, instead of the data of the defect area, by accessing the DFL; thereby preventing a data recording/reproducing error from occurring.

A write-once recordable blu-ray disc (BD-WO) is also under development. Unlike a rewritable disc, data can only be recorded once in the entire area of a write-once optical disc; and data cannot be physically overwritten in the write-once optical disc. Nevertheless, there may occur instances, where it would be desirable to edit or partially modify recorded data. For example, for simplicity of use of the host or the user, virtual overwriting of the data may be desirable.

Disclosure of Invention

In an embodiment of the method of recording data on a recording medium, a management information entry is recorded in a temporary defect management area of the recording medium. The management information entry indicates a portion of a user data area of the recording medium, and the management information entry includes first and second status indicators indicating a status of the management information entry. For example, the first status indicator may indicate whether replacement is being performed with respect to the indicated portion of the user data area.

In one embodiment, if the first status indicator

indicates that replacement is being performed, information entry further indicates a replacement portion of the recording medium that replaces the indicated portion of the user data area.

Also, if the first status indicator indicates that replacement is being performed, the second status indicator may indicate a type of replacement. For example, the types of replacement may include single data unit replacement and continuous data unit replacement.

In an embodiment of the method of recording data on a recording medium, at least a first management entry is recorded in a temporary defect management area of the recording medium. The first management entry identifies a cluster in a user data area of the recording medium, includes a first status indicator indicating that the identified cluster is being replaced, includes a second status indicator indicating whether the replacement is at least one of a single cluster replacement and continuous cluster replacement, and identifies a replacement cluster.

In an embodiment of a method of reproducing a recording medium, a management information entry is recorded in a temporary defect management area of the recording medium. The management information entry indicates a portion of a user data area of the recording medium, and the management information entry includes first and second status indicators

indicating a status of the management informati
is reproduced from the user data area based on the reproduced management information entry.

In an embodiment of a recording medium having a data structure for managing replacement of portions of a user data area of the recording medium, a temporary defect management area of the recording medium includes at least one management information entry. The management information entry indicates a portion of a user data area of the recording medium, and includes first and second status indicators indicating a status of the management information entry.

Another embodiment of the method of recording data in a recording medium, stream records data in consecutive clusters of a user data area of the recording medium such that a defective portion of the user data area is skipped and recording continues in sequence at a next available recordable portion of the user data area.

This embodiment may further include recording a management information entry in a temporary defect management area of the recording medium. Here, the management information entry identifies the skipped recorded portion.

Another embodiment of the method of reproducing a recording medium, reproduces a management information entry indicating a defective portion of a user data area of the recording medium. Stream recorded data is reproduced from the

user data area based on the management informat that the defective portion is skipped and reproduction continues at a next non-defective portion of the user data area.

In a further embodiment of the method of recording data in a recording medium, a command to record data in an order of consecutive data units is received. Then, the data is recorded in the order of consecutive data units on the recording medium such that defective and recorded areas of the recording medium are skipped and recording continues at a next non-defective and recordable area.

This embodiment may further include recording management information in a temporary defect management area of the recording medium. Here, the management information indicates a mapping between the skipped area and the non-defective and recordable area.

In a further embodiment of the method of reproducing a recording medium, management information is reproduced from a temporary defect management area of the recording medium. The management information indicates a first range of clusters of a user data area of the recording medium that has been continuous replacement recorded and indicates a second range of clusters of the recording medium serving as the replacement recorded area. Data is reproduced based on the reproduced management information.

In a further embodiment of the recording m

data structure for managing replacement of portions of a user data area of the recording medium, a temporary defect management area of the recording medium includes management information. The management information indicates a first range of clusters of a user data area of the recording medium that has been continuous replacement recorded and indicates a second range of clusters of the recording medium serving as the replacement recorded area.

Brief Description of Drawings

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiments of the invention and together with the description serve to explain the principle of the invention. In the drawings:

FIG. 1 illustrates a structure of a general re-writable optical disc and a method for managing defects;

FIG. 2 illustrates a logical overwriting method for a write-once optical disc according to an embodiment of the present invention;

FIG. 3 illustrates a method for recording a LOW entry according to an embodiment of the present invention;

FIG. 4 illustrates an example of logical overwriting

being performed on a closed SRR in the write-onc according to an embodiment of the present invention;

FIG. 5 illustrates a method for managing defects in the write-once optical disc according to an embodiment of the present invention;

FIG. 6 illustrates a method for allocating TDMA in the write-once optical disc according to an embodiment of the present invention;

FIGs. 7A to 7C illustrate methods for logical overwriting and for managing defects in the write-once optical disc according to embodiments of the present invention; and

FIG. 8 illustrates a block diagram of an optical recording and reproducing apparatus according to an embodiment of the present invention.

Best Mode for Carrying Out the Invention

Reference will now be made in detail to example embodiments of the present invention, which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

FIG. 2 illustrates a logical overwriting method for a write-once high density optical disc according to an embodiment of the present invention. As shown, the write-once high density optical disc includes a lead-in area, a data zone,

and a lead-out area. The data zone includes area (ISA), an outer spare area (OSA), and a user data area. The lead-in area is used as an area for recording diverse management information for recording/reproducing data on/from the optical disc. The lead-in area may be provided with a temporary disc management area (TDMA), which is an area, generally of fixed size, for recording defect management information and recording management information for the optical disc. A separate additional TDMA within a spare may also be allocated for defects that may frequently occur during the use of the optical disc and for updating the recording management information.

In a write-once optical disc having the above-described structure, data recording may be categorized into two types: a sequential recording mode (SRM) type and a random recording mode (RRM) type. In the SRM type, in order to facilitate recording of data on the optical disc, the user data area in which actual user data is recorded is divided into a plurality of consecutive recording areas for recording data. Each of the divided plurality of consecutive recording areas is referred to as a Sequential Recording Range (SRR). The recording of data in a SRR is performed on a next recordable (or writable) non-recorded cluster. An address of the next recordable non-recorded cluster in an SRR is referred to as a Next Writable Address (NWA). More specifically, in the SRR, a

directly subsequent unrecorded area after a becomes the NWA, and the recording of data begins from the NWA. Therefore, when sequential recording of data is performed starting from the NWA, the NWA may dynamically increase in accordance with the recording of the data.

In the above-described SRM type, a command for writing (or overwriting) data in a recorded area or portion within a SRR (SRR #n) may be given (or made) by a user or a host. In this case, due to the characteristic of the write-once optical disc, physical writing of the data can only be performed once, and so writing (or recording) of data on a recorded area is not possible. In other words, overwriting of data cannot be physically performed. According to embodiments of the present invention, in the SRM type of the recordable high density optical disc, when an overwriting command requesting data to be overwritten on a recorded area is given (or made), the data that is to be written on the recorded portion is instead recorded beginning at a NWA of the same SRR, beginning at a NWA of another SRR, or in a spare area. This is referred to as a Logical Overwrite (LOW).

For example, as shown in FIG. 2, when a writing (or recording) command for data A of a recorded data area within an SRR (SRR #n) is transmitted, the data A that is to be recorded in the pre-recorded data area is either recorded at a next writable area, which is the NWA, of the SRR (SRR #n)

including the recorded data area or, alternati
in a spare area (e.g., the OSA). The area is pre-recorded in the sense that the area was recorded on prior to recording of data A. When the data is recorded in the NWA of the SRR (SRR #n), a next writable area from the SRR (SRR #n) becomes NWA'. After performing the replacement recording of the data, as described above, information on the position of the area in which data was to be overwritten and the replacement recorded area is recorded in the TDMA as a LOW entry. The LOW entry is broadly categorized into two types: a Re-Allocated Defect (RAD) type and a Continuous Re-allocated Defect (CRD) type.

FIG. 3 illustrates a method for recording a LOW entry according to an embodiment of the present invention. Referring to FIG. 3, the LOW entry may be expressed (or described) as a CRD type entry, which is a replacement type for consecutive defective clusters or overwriting clusters. More specifically, when a command for overwriting data A on the pre-recorded area is transmitted, data A is replacement recorded on a replacement area. Thereafter, if data A is intended to be recorded in a plurality of clusters, the LOW entry is registered as the CRD type. In case of the CRD type, the entry recorded in the TDMA is expressed (or recorded) by using two DFL entries.

As shown, each DFL entry includes a "Status 1" field, a "Defective Cluster first PSN" field, a "Status 2" field, and a

"Replacement Cluster first PSN" field. When t field is recorded as '0000', this indicates either a RAD type DFL entry or a CRD type DFL entry, wherein replacement recording is completed normally in the defect area or the overwriting area. When the "Status 1" field is recorded as '0001', this indicates a Non-Reallocatable Defect (NRD) type DFL entry, wherein neither the defect area nor the overwriting area has a designated replacement area for the replacement recording. Namely, the position of the defect is noted in the entry, but since no replacement recording took place, any replacement position information in the entry is meaningless.

Position information of the cluster wherein a defect has occurred or the cluster that has been overwritten (e.g., by the LOW process) is recorded in the "Defective Cluster first PSN" field. The position information is recorded as a first physical sector number (PSN) of the corresponding cluster.

When '0000' is recorded in the "Status 2" field, this indicates that defect replacement or overwriting replacement has occurred in one cluster. When '0001' is recorded in the "Status 2" field, this indicates that the DFL entry provides position information for the start (or beginning) of a plurality of consecutive defective or overwriting clusters. When '0010' is recorded in the "Status 2" field, this indicates that the DFL entry provides position information for the end of the plurality of consecutive defective or

overwriting clusters.

The position information of a replacement recorded area of a defective area or an overwriting area is recorded in the "Replacement Cluster first PSN" field, wherein the information is recorded as a first physical sector number (PSN) of the corresponding cluster.

In view of the above, when '0001' is recorded in the "Status 2" field and "0000" in the "Status 1" field, (i) the "Defective Cluster first PSN" indicates the PSN of a first defective cluster in a series of defective clusters or a series of overwritten clusters and (ii) the "Replacement Cluster first PSN" indicates the PSN of a first cluster in the series of clusters replacing the defective or overwritten clusters. And, when '0010' is recorded in the "Status 2" field and "0000" in the "Status 1" field, (i) the "Defective Cluster first PSN" indicates the PSN of a last defective cluster in a series of defective clusters or a series of overwritten clusters and (ii) the "Replacement Cluster first PSN" indicates the PSN of a last cluster in the series of clusters replacing the defective or overwritten clusters.

Each DFL entry is formed of 8 bytes (64 bits), wherein 4 bits are allocated for each of the "Status" fields and 28 bits are allocated for each of the "Defective Cluster first PSN" field and the "Replacement Cluster first PSN" field. In an example of an overwriting method using an entry format having

the above-described structure, shown in FIG. 3, indicating that replacement recording has been performed is recorded in the "Status 1" field of the first entry (DFL entry 1), and a first physical sector number (PSN) 'a' of the first cluster is recorded in the "Defective Cluster first PSN" field. Additionally, a '0001' bit indicating a start (or beginning) of consecutive defective or overwritten clusters is recorded in the "Status 2" field. And, a first physical sector number (PSN) 'c' of a replacement recorded area of the overwriting area is recorded in the "Replacement Cluster first PSN" field.

Moreover, a '0000' bit indicating that replacement recording has been performed is recorded in the "Status 1" field of the second entry (DFL entry 2), and a first physical sector number (PSN) 'b' of the last cluster, among the overwriting clusters, is recorded in the "Defective Cluster first PSN" field. Additionally, a '0010' bit indicating an end of consecutive defective clusters is recorded in the "Status 2" field. And, a first physical sector number (PSN) 'd' of the last cluster, among the replacement recorded areas of the overwriting area, is recorded in the "Replacement Cluster first PSN" field. Therefore, when a host requires the reproduction of the area a-b, in accordance with a user request, the area c-d is reproduced by referring to the LOW entry information, which is recorded in the TDMA. As described above, in the method for expressing (or describing)

the management information on overwriting entries (DFL entry 1, DFL entry 2), for consecutive defective or overwriting clusters, the two entries are collectively referred to as a CRD entry.

Meanwhile, the replacement type for a defective or overwriting cluster may be expressed as a single DFL entry, and the DFL entry will be referred to as an RAD entry. Furthermore, the replacement type for the defective or overwriting cluster is referred to as a RAD type. In the SRM type recording method, and when the replacement recording for logical overwriting is performed at an NWA of the user data area, the replacement recording may be performed in two different cases, *i.e.*, when the SRR is open and when the SRR is closed. First of all, in the SRM type, an open SRR is an area still having an unrecorded or recordable area and has an NWA corresponding to the beginning of the unrecorded area. A closed SRR is a completely recorded SRR or an SRR where recording is no longer allowed, for example due to a user request, even though recordable area may still remain in the SRR. An NWA does not exist within the closed SRR. Accordingly, when a data overwriting command for a pre-recorded area within an open SRR (SRR #n) is transmitted, the data that is to be recorded in the pre-recorded area is either recorded at an NWA of the present (or current) open SRR or replacement recorded at any one of the NWAs of the open SRRs.

FIG. 4 illustrates an example of logic being performed on a closed SRR in the write-once optical disc according to an embodiment of the present invention. Referring to FIG. 4, when the writing command given (or made) by the host is an overwriting command on a pre-recorded area in a closed SRR, since the closed NWA does not include any NWA as described above, the replacement recording is performed on an open SRR having an NWA. In other words, even when non-recorded area remains in the present closed SRR, the non-recorded area is not used as the replacement area. At this point, when overwriting data on the pre-recorded area of the closed SRR, the replacement recording may also be performed on a spare area. More specifically, in an open SRR and a closed SRR, replacement recording is performed in an NWA of the user data area. However, in the case of the closed SRR, the replacement recording may be specifically performed in a spare area instead of the user data area.

FIG. 5 illustrates a method for managing defects in a write-once optical disc according to an embodiment of the present invention. Referring to FIG. 5, when a defect area exists within the write-once high density optical disc, data that is to be recorded on the defect area is either replacement recorded at an NWA of the user data area or replacement recorded in the spare area. More specifically, by replacement recording the data that is to be recorded in a

defect area, which is a defect area that ma_ during recording (or writing) or reproduction (or reading) of the data, reliability and stability of the data can be ensured.

After performing the above-described replacement recording, the position information of the defect area and the replacement recorded area are recorded in the TDMA as RAD or CRD type defect entries. Thereafter, when the defect area is to be reproduced, reference is made to the defect entry information so as to reproduce the data of the replacement recorded area. The same is true when an overwritten area is to be reproduced.

As described above, logical overwriting or defect management is performed for the write-once high density optical disc according to the present invention. Because such operations may frequently occur during the usage of the disc, sufficient TDMA should be allocated in order to record the position information for logical overwriting and the position information for defect management. Accordingly, a method of allocating additional TDMA within the inner spare area (ISA) as well as the outer spare area (OSA) is used in the present invention, which will be described in detail with reference to FIG. 6.

FIG. 6 illustrates a method for allocating TDMA in the write-once optical disc according to an embodiment of the present invention. Referring to FIG. 6, and also FIGs. 4 and

5, additional TDMA may be allocated in the spa write-once high density optical disc. And, more particularly, the additional TDMA may be allocated in the inner spare area (ISA). The size of the TDMA is allocated to be smaller than the size of the spare area, wherein the size is allocated to be either 0 or 1/4 of the size of the spare area such that the TDMA varies based on the size of the spare area.

FIGs. 7A to 7C illustrate a method for logical overwriting and a method for managing defects in the write-once optical disc according to an embodiment of the present invention. More specifically, FIG. 7A illustrates a method for replacement recording when a defect area is detected. FIG. 7B illustrates a method for replacement recording in accordance with logical overwriting. And, FIG. 7C illustrates a method for replacement recording of data during stream recording.

Referring to FIG. 7A, a defect area may exist in an area wherein data X, Y, and Z are to be recorded in accordance with a command from the host. Each of data X, Y, and Z has the size of one cluster. As described above, when a defect area exists within the area in which data is to be recorded, the data is replacement recorded either on a next recordable (or writable) area or on a spare area. When the data is replacement recorded on a next recordable area, the data is sequentially recorded starting from the next recordable area

(NWA') after skipping the defect area, as shov

After completing the replacement recording, position information of the replacement recording is recorded within the TDMA as a CRD entry. Therefore, when reproducing the data X, Y, and Z, reference is made to the CRD entry information so as to reproduce the replacement recorded data.

FIG. 7B illustrates a method for replacement recording in accordance with a logical overwriting. Referring to FIG. 7B, when data X, Y, and Z are to be recorded on a next recordable area (NWA) in accordance with a command from the host, the next recordable area (NWA) may already be an area wherein replacement recording of a logical overwriting is completed. More specifically, when the NWA has been moved (or relocated) due to the logical overwriting, without notifying the host, the data X, Y, and Z are recorded on a next recordable area (NWA') of the replacement recorded area (NWA). The NWA is moved (or replaced) without notifying the host because the logical overwriting is performed independently within the optical disc drive. Therefore, the NWA may be moved when the optical disc drive fails to notify (or report) the next recordable area to the host. After replacement recording the data X, Y, and Z as described above, the position information of the replacement recording is recorded in the TDMA as a CRD entry. Thereafter, when reproducing the data X, Y, and Z, reference is made to the CRD entry information so as to

reproduce the replacement recorded data.

recording may also be conducted in a spare area.

FIG. 7C illustrates a method for replacement recording of data during stream recording. Referring to FIG. 7C, in the write-once high density optical disc, when a defect is detected while stream recording real-time data such as broadcast programs or movies, wherein time flow is an important factor, the data is recorded on a non-defective area by skipping the detected defect area. The recording of data that is to be recorded in the defect area is treated identically as replacement recording of the data on a non-defective and recordable area. Information on the positions of replacement recorded data A, B, C, and D is recorded as a CRD entry. After recording the CRD entry, as described above, when reproducing data in a later process, reference is made to the CRD entry information so as to reproduce the data A, B, C, and D. And, this method is advantageous in that information on the defect area that is detected in the user data area is not required to be reported separately to host.

FIG. 8 illustrates a block diagram of an optical recording and reproducing apparatus according to the present invention. Referring to FIG. 8, the optical recording and/or reproducing apparatus includes a recording/reproducing device 10 for performing recording/reproduction on the optical disc, and a host, or controller 20 for controlling the

recording/reproducing device 10. (H recording/reproducing device 10 is often referred to as an "optical disc drive", and both terms will be used in the description of the present invention).

Basically, in the above-described optical recording and reproducing apparatus, the host 20 gives a writing or reproduction command to write or reproduce to/from a particular area of the optical disc to the recording/reproducing device 10, and the recording/reproducing device 10 performs the recording/reproduction to/from the particular area on the optical disc in response to the command from the host 20. The recording/reproducing device 10 includes an interface unit 12 for performing communication, such as exchanges of data and commands, with the host 20; a pickup unit 11 for writing/reading data to/from the optical disc directly; a data processor 13 for receiving a signal from the pickup unit 11 and recovering a desired signal value, or modulating a signal to be recorded into a signal that can be written on the optical disc; a servo unit 14 for controlling the pickup unit 11 to read a signal from the optical disc accurately, or write a signal on the optical disc accurately; a memory 15 for temporarily storing diverse information including management information and data; and a microcomputer 16 for controlling various parts of the recording/reproducing device 10.

In the optical recording and/or reproduc process steps of an embodiment of the method for recording data on the recordable (e.g., a write-once) optical disc will now be described. Upon inserting the recordable optical disc into the optical recording and/or reproducing apparatus, management information is read from the optical disc and stored in the memory 15 of the recording/reproducing device 10. Herein, if the user desires to write on a particular area of the optical disc, the host 20, which responds to a writing command indicating this desire, provides information on a desired writing position to the recording/reproducing device 10, along with a set of data that is to be written.

The microcomputer 16 in the recording/reproducing device 10 receives the writing command, and determines (i) whether the area of the optical disc in which the host 20 desires to write the data is a defective area or not and/or (ii) whether the area has already been recorded on based on the management information stored in the memory 15. Then, the microcomputer 16 performs data writing according to the writing command from the host 20 on an area which is neither the defective area nor a recorded area. For example, if the area is in a closed SSR or has a starting address less than the LRA of the SSR to be written, then the area is determined as already recorded.

While performing writing of data as described above, when overwriting or defect management is to be performed in

accordance with the user command, the data recorded (or written) on the overlapping (or overwriting) area or the defect area is replacement recorded in another area within the data zone, such as the user data area or the spare area, as described above with respect to one of the embodiments of the present invention. Then, corresponding management information including RAD and CRD entries that are created during this process are recorded in the TDMA, for example, within the lead-in area. For this, the microcomputer 16 provides the position information of the replacement recorded area and the data to the servo unit 14 and the data-processor 13, so that the recording or replacement recording is completed at a desired position on the optical disc through the pickup unit 11.

Hereinafter, a method for reproducing data, which is recorded as described above, from the optical disc according to the present invention will be described in detail. When the write-once optical disc, wherein the data is recorded, is inserted into the optical recording and/or reproducing apparatus, management information is read from the optical disc and stored in the memory 15 of the recording/reproducing device 10, for use at the time of recording/reproduction data to/from the optical disc.

Herein, if the user desires to read (or reproduce) data from a particular area of the optical disc, the host 20, which

responds to a reading command indicating this de information on a desired reading position to the recording/reproducing device 10. The microcomputer 16 in the recording/reproducing device 10 receives the reading command, and using the management information determines whether the area of the optical disc from which the host 20 desires to read the data from is an area that has been replaced. If so, the microcomputer 16 determines a position of the replacement area from the management information. However, when replacement recording has not been performed, the microcomputer 16 reads (or reproduces) the data of the indicated area and transmits the read information to the host 20. If replacement recording (*e.g.*, RAD/CRD type) has been performed, the microcomputer 16 reads the data from the determined replacement area and transmits the read information to the host 20.

Industrial Applicability

As described above, the method and apparatus for recording and reproducing data on/from a recording medium according to the present invention provides a method for logical overwriting data and a method for managing defects such that the write-once recording medium can be more efficiently managed and reproduced.

While the invention has been disclosed with respect to a

limited number of embodiments, those skilled having the benefit of this disclosure, will appreciate numerous modifications and variations there from. For example, while described with respect to a Blu-ray write-once optical disk in several instances, the present invention is not limited to this standard of write-once optical disk, to write-once recording media or to optical discs as the recording medium. It is intended that all such modifications and variations fall within the spirit and scope of the invention.

[CLAIMS]

1. A method of recording data on a recording medium, comprising:

recording a management information entry in a temporary defect management area of the recording medium, the management information entry indicating a portion of a user data area of the recording medium, and the management information entry including first and second status indicators indicating a status of the management information entry.

2. The method of claim 1, wherein the first status indicator indicates whether replacement is being performed with respect to the indicated portion of the user data area.

3. The method of claim 2, wherein if the first status indicator indicates that replacement is being performed, the management information entry further indicates a replacement portion of the recording medium that replaces the indicated portion of the user data area.

4. The method of claim 3, wherein if the first status indicator indicates that replacement is being performed, the second status indicator indicates a type of replacement.

5. The method of claim 3, wherein the types replacement include single data unit replacement and continuous data unit replacement.

6. The method of claim 5, wherein a data unit is a cluster.

7. The method of claim 6, wherein the management information entry indicates the indicated portion by providing a first physical sector number of the indicated portion and indicates the indicated replacement portion by providing a first physical sector number of the indicated replacement portion.

8. The method of claim 5, wherein if the second status indicator indicates the type of replacement is continuous, then the indicated portion is one of a first data unit in a sequence of data units and a last data unit in the sequence of data units and the indicated replacement portion is a corresponding one of a first replacement data unit in a sequence of replacement data units and a last replacement data unit in the sequence of replacement data units.

9. The method of claim 5, wherein the temporary defect management area has a fixed size.

10. The method of claim 9, wherein the temporary defect management area is located at a lead-in area of the recording medium.

11. The method of claim 5, wherein the temporary defect management area is located in a spare area of the recording medium.

12. The method of claim 11, wherein the temporary defect management area located in the spare area is in addition to another temporary defect management area located in a lead-in area of the recording medium.

13. The method of claim 11, wherein the temporary defect management area has a size that varies based on a size of the spare area.

14. A method of recording data on a recording medium, comprising:

recording at least a first management entry in a temporary defect management area of the recording medium, the first management entry identifying a cluster in a user data area of the recording medium, including a first status indicator indicating that the identified cluster is being

replaced, including a second status indicator in whether the replacement is at least one of a single cluster replacement and continuous cluster replacement, and identifying a replacement cluster.

15. The method of claim 14, wherein if the second status indicator indicates continuous cluster replacement, the identified cluster is one of a first cluster and a last cluster in a sequence of clusters being replaced, and the identified replacement cluster is a corresponding one of a first replacement cluster and a last replacement cluster in a sequence of replacement clusters.

16. The method of claim 14, wherein if the second status indicator indicates continuous cluster replacement and the identified replacement cluster is the first cluster in the sequence of replacement cluster, the method further comprises:

recording a second management entry in a temporary defect management area of the recording medium, the second management entry identifying a last cluster in a user data area of the recording medium, including a first status indicator indicating that the identified last cluster is being replaced, including a second status indicator indicating continuous cluster replacement, and identifying the last replacement cluster.

17. The method of claim14, wherein the first management entry identifies the identified cluster by providing a first physical sector number of the identified cluster and identifies the identified replacement cluster by providing a first physical sector number of the identified replacement cluster.

18. A method of reproducing a recording medium, comprising:

reproducing a management information entry in a temporary defect management area of the recording medium, the management information entry indicating a portion of a user data area of the recording medium, and the management information entry including first and second status indicators indicating a status of the management information entry; and

reproducing data from the user data area based on the reproduced management information entry.

19. A recording medium having a data structure for managing replacement of portions of a user data area of the recording medium, comprising:

a temporary defect management area of the recording medium including at least one management information entry, the management information entry indicating a portion of a

user data area of the recording medium, and the information entry including first and second status indicators indicating a status of the management information entry.

20. A method of recording data in a recording medium, comprising:

stream recording data in consecutive clusters of a user data area of the recording medium such that a defective portion of the user data area is skipped and recording continues in sequence at a next available recordable portion of the user data area.

21. The method of claim 20, wherein the stream recording step stream records real-time data.

22. The method of claim 20, further comprising:

recording a management information entry in a temporary defect management area of the recording medium, the management information entry identifying the skipped recorded portion.

23. The method of claim 20, wherein the stream recording step records the data in clusters such that defective clusters of the user data area are skipped and recording continues in sequence at a next available non-defective cluster.

24. The method of claim 23, further compris

recording a management information entry in a temporary defect management area of the recording medium, the management information entry indicating at least one skipped defective cluster.

25. A method of reproducing a recording medium, comprising:

reproducing a management information entry indicating a defective portion of a user data area of the recording medium; and

reproducing stream recorded data from the user data area based on the management information entry such that the defective portion is skipped and reproduction continues at a next non-defective portion of the user data area.

26. A method of recording data in a recording medium, comprising:

receiving a command to record data in an order of consecutive data units; and

recording the data in the order of consecutive data units on the recording medium such that defective and recorded areas of the recording medium are skipped and recording continues at a next non-defective and recordable area.

27. The method of claim 26, wherein the rec records the data in the user data area.

28. The method of claim 27, wherein the recording step records the data beginning at a next unrecorded and non-defective area of the user data area following a next recordable area indicated in the received command if the indicated next recordable area is one of a recorded area and a defective area.

29. The method of claim 26, wherein the recording step records the data in a spare area of the recording medium.

30. The method of claim 26, wherein a data unit is a cluster.

31. The method of claim 26, further comprising:

recording management information in a temporary defect management area of the recording medium, the management information indicating a mapping between the skipped area and the non-defective and recordable area.

32. The method of claim 31, wherein the recording management information step records a continuous re-allocated defect entry associated with the recording the data step.

33. A method of reproducing a recording medium, comprising:

reproducing a management information from a temporary defect management area of the recording medium, the management information indicating a first range of clusters of a user data area of the recording medium that has been continuous replacement recorded and indicating a second range of clusters of the recording medium serving as the replacement recorded area; and

reproducing data based on the reproduced management information.

34. A recording medium having a data structure for managing replacement of portions of a user data area of the recording medium, comprising:

a temporary defect management area of the recording medium including management information, the management information indicating a first range of clusters of a user data area of the recording medium that has been continuous replacement recorded and indicating a second range of clusters of the recording medium serving as the replacement recorded area.

FIG. 1

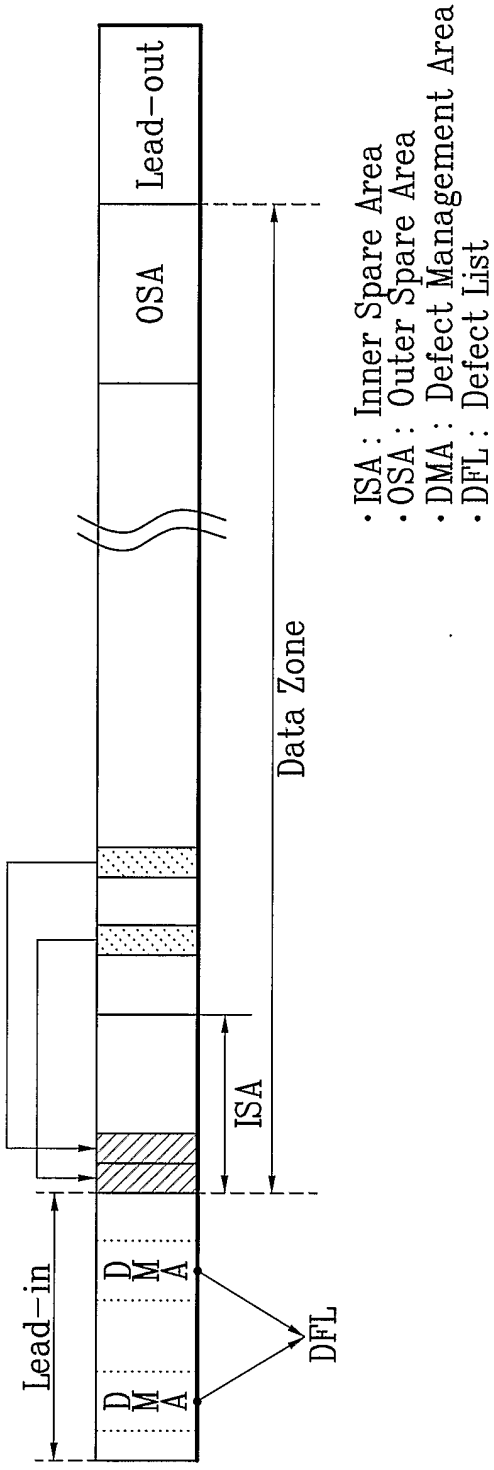

Lead-out
OSA
Data Zone
ISA
Lead-in
DMA
DMA
DFL
• ISA : Inner Spare Area
• OSA : Outer Spare Area
• DMA : Defect Management Area
• DFL : Defect List

FIG. 2

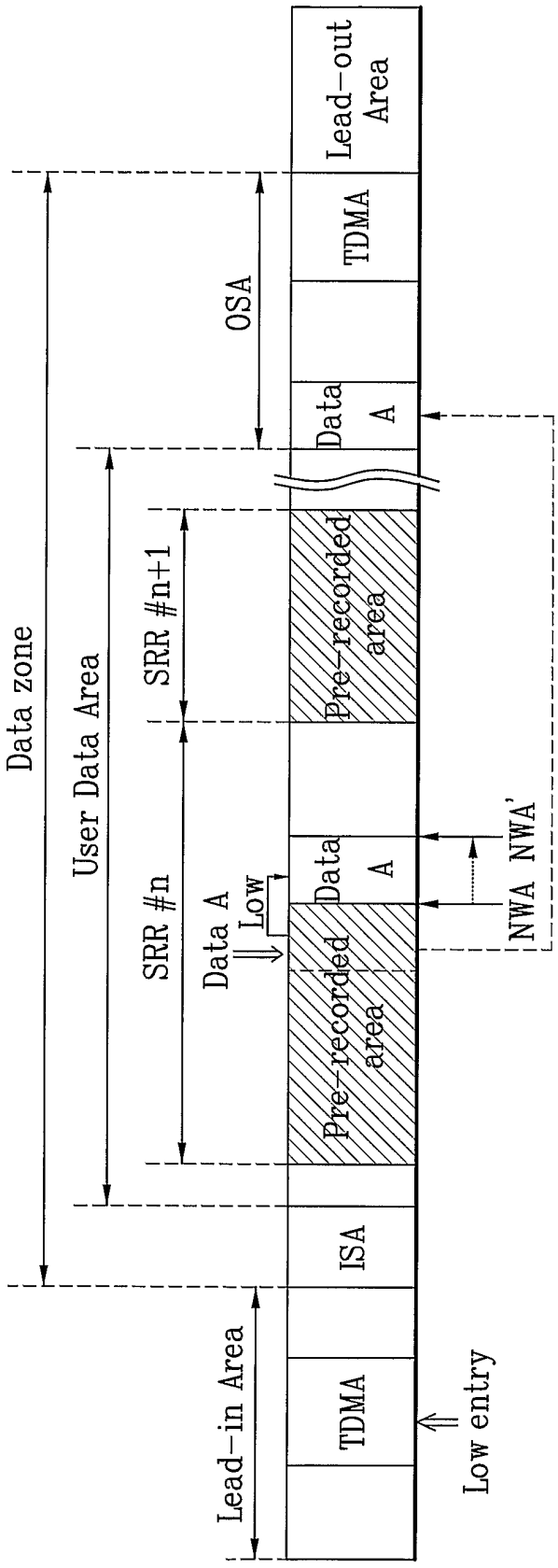
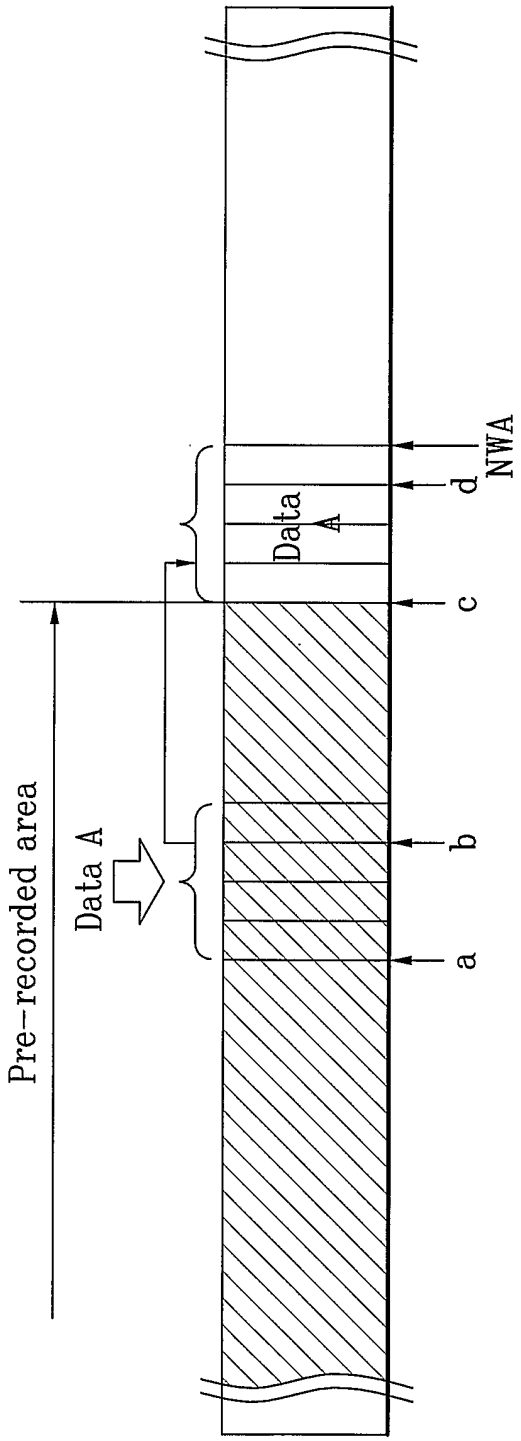

Lead-in Area
TDMA
ISA
Pre-recorded area
Data A
Low
Data A
SRR #n
SRR #n+1
User Data Area
Data zone
OSA
Pre-recorded area
Data A
TDMA
Lead-out Area
NWA
NWA'
Low entry

FIG. 3



Staus 1	Defective Cluster first PSN	Staus 2	Replacement Cluster first PSN

	$b_{63} \cdots b_{60}$	$b_{59} \cdots \cdots b_{32}$	$b_{31} \cdots b_{28}$	$b_{27} \cdots \cdots b_0$
DFL entry 1	0000	a	0001 (start)	c
DFL entry 2	0000	b	0010 (end)	d

CRD entry

FIG. 4

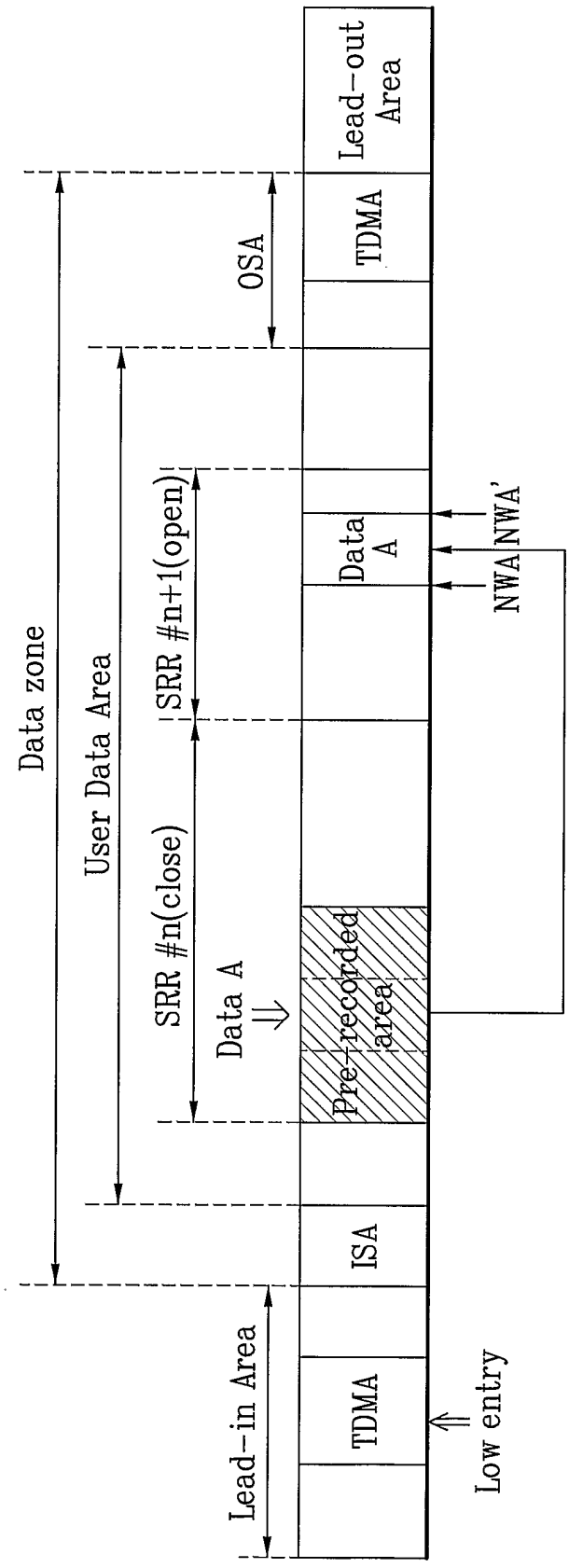

Lead-out Area
TDMA
OSA
Data zone
User Data Area
SRR #n+1(open)
Data A
NWA
NWA'
SRR #n(close)
Data A
Pre-recorded area
ISA
Lead-in Area
TDMA
Low entry

FIG. 5

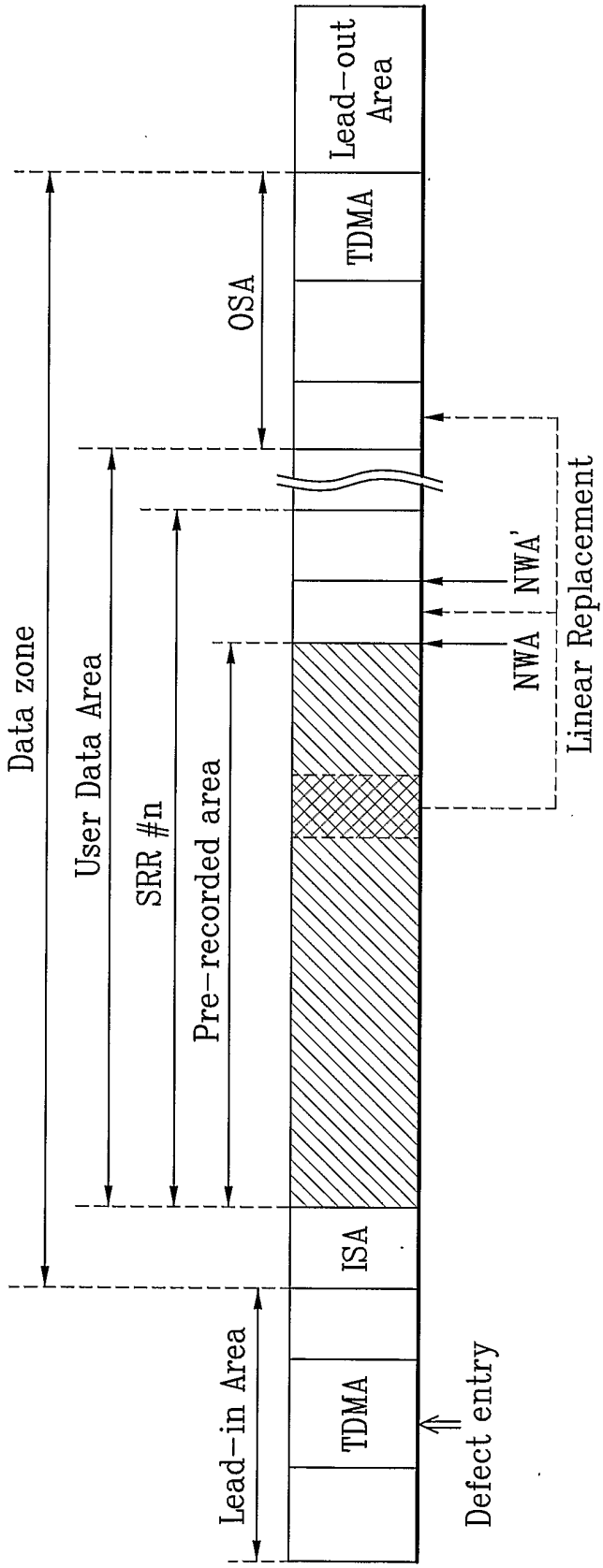

Lead-out Area
TDMA
OSA
Data zone
User Data Area
SRR #n
Pre-recorded area
NWA'
NWA
Linear Replacement
ISA
Lead-in Area
TDMA
Defect entry

FIG. 6

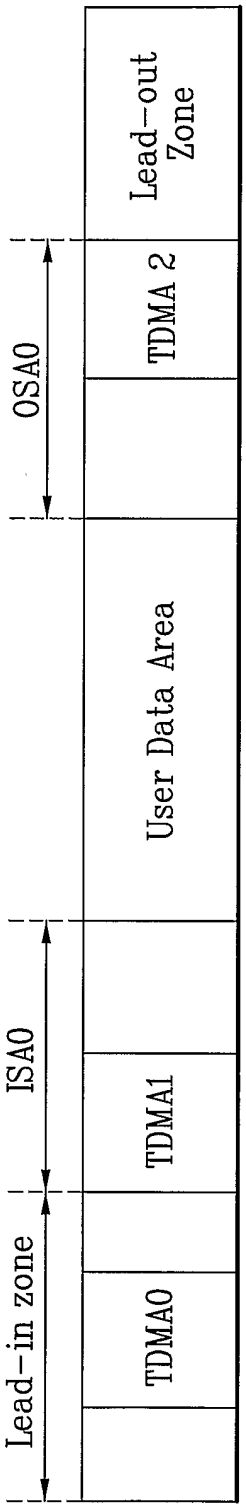

Lead-in zone
TDMA0
ISA0
TDMA1
User Data Area
OSA0
TDMA 2
Lead-out Zone

FIG. 7A

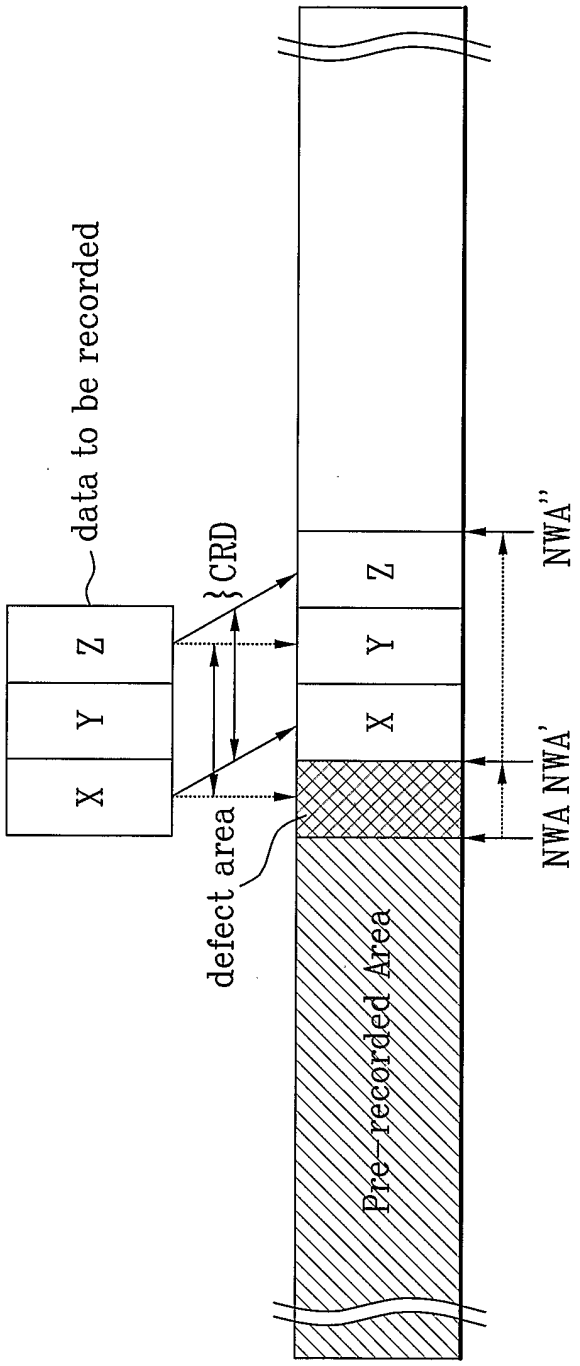

data to be recorded
X
Y
Z
CRD
defect area
X
Y
Z
NWA''
NWA NWA'
Pre-recorded Area

FIG. 7B

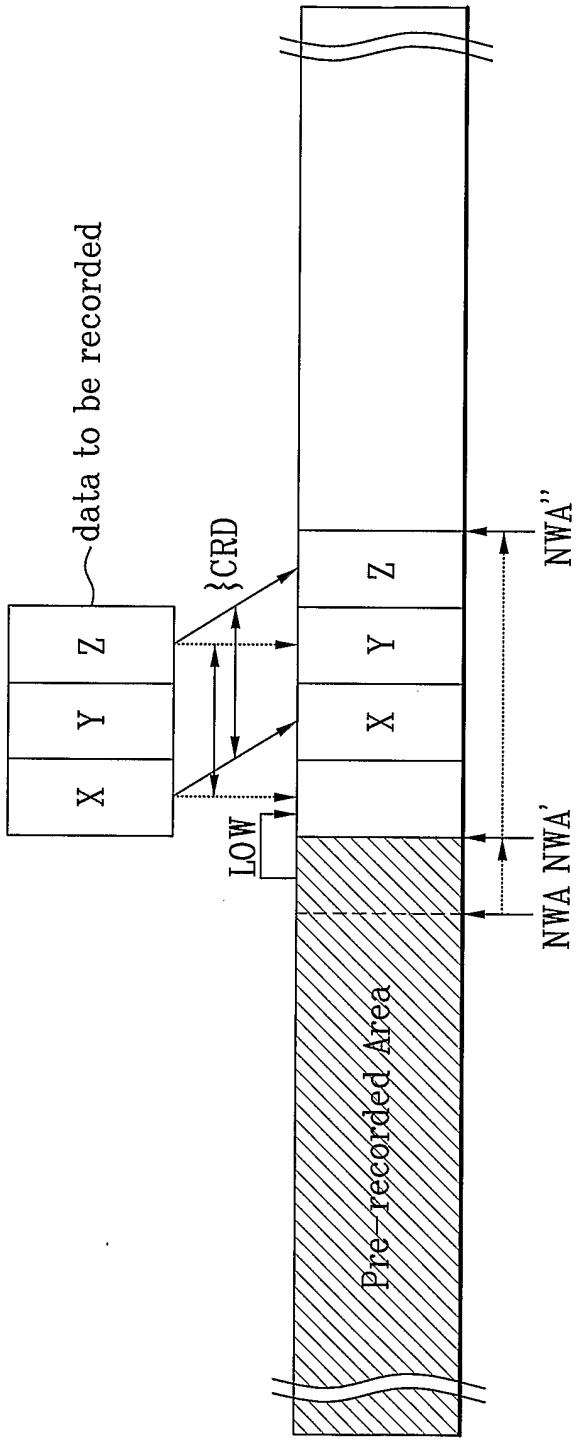

data to be recorded
Z
Y
X
{CRD
LOW
Z
Y
X
NWA''
NWA NWA'
Pre-recorded Area

FIG. 7C

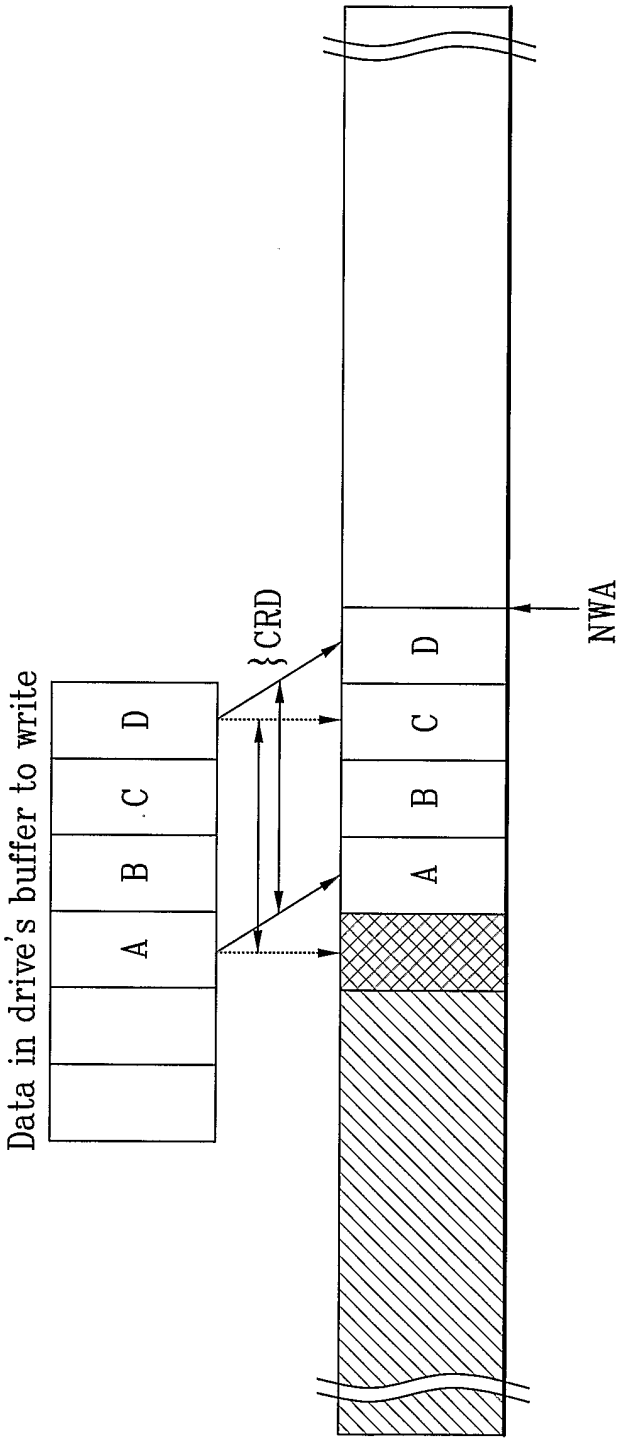
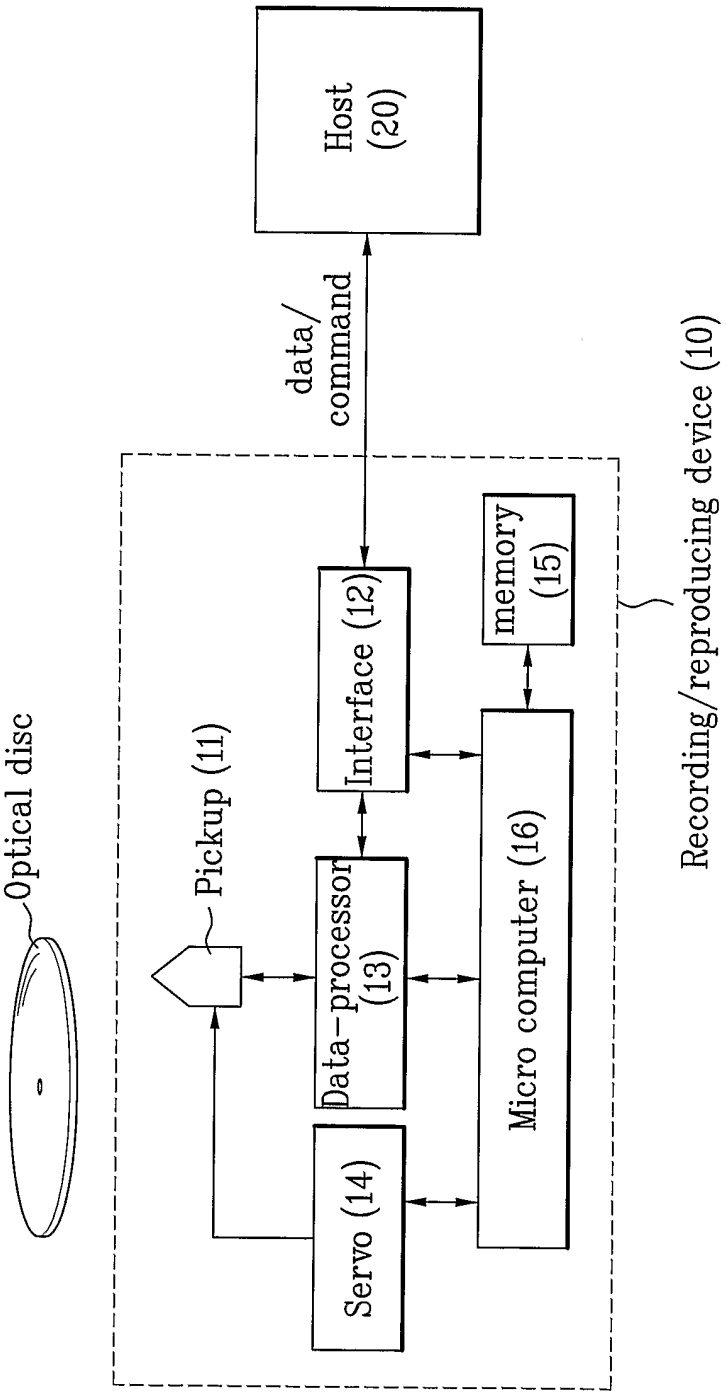


FIG. 8


Host (20)
data/ command
Recording/reproducing device (10)
Optical disc
Pickup (11)
Interface (12)
memory (15)
Data-processor (13)
Micro computer (16)
Servo (14)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 2005/002518

A. CLASSIFICATION OF SUBJECT MATTER
IPC[7]: G11B 7/00, 20/18
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC[7]: G11B 7/00, 20/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
---

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2004/0145980 A1 (Y.C. PARK) 29 July 2004 (29.07.2004) *abstract; [0013] - [0020], [0038],[0040], [0045], [0055], [0056], claims, figures 4, 5A, 5B.*	1,10, 11,12,13 34
A	EP 1 298 659 A1 (SAMSUNG ELECTRONICS CO., LTD) 2 April 2003 (02.04.2003) *abstract, [0001] - [0081], figures 1-9.*	1, 20, 21, 25, 26
A	US 2004/0125717 A1 (JUNG-WAN KO) 1 July 2004 (01.07.2004) *abstract, [0009] - [0022], claims, figures 1-9.*	1, 14, 18, 19

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2005 (12.12.2005)	19 December 2005 (19.12.2005)
Name and mailing address of the ISA/ AT **Austrian Patent Office** Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24 / 535	Authorized officer ERBER H. Telephone No. +43 / 1 / 534 24 / 410

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004/0114474 A1 (Y.C. PARK) 17 June 2004 (17.06.2004) *abstract, [0010] - [0018], claims, figures 1-15.*	1, 14, 18, 19, 33, 34
A	US 2004/0076096 A1 (SUNG-HEE HWANG et al.) 22 April 2004 (22.04.2004) *abstract, claims, figures 1, 2, 3.*	1, 2, 10, 14, 18, 19, 33, 34
	US 2004/0062160 A1 (Y.C. PARK et al.) 1 April 2004 (01.04.2004)	
A	WO 2004/015707 A1 (SAMSUNG ELECTRONICS CO., LTD) 19 February 2004 (19.02.2004) *abstract, claims, figures 1-4.*	1, 14, 20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 2005/002518

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
EP	A	1298659		HK	A1	1039677	2005-05-20
				HK	A1	1039678	2005-04-01
				CN	A	1516177	2004-07-28
				CN	A	1492408	2004-04-28
				DE	T2	69915157T	2004-12-30
				SG	A1	103868	2004-05-26
US	A	20040062160				none	
US	A	20040076096				none	
US	A	20040114474				none	
US	A	20040125717				none	
US	A	20040145980				none	
WO	A1	2004015707	2004-02-19	CN	A	1675709	2005-09-28
				EP	A1	1550123	2005-07-06
				AU	A1	2003241200	2004-02-25