METHOD OF ASSIGNING A SPARE AREA OF AN OPTICAL RECORDING MEDIUM

VERFAHREN ZUM ZUORDNEN VON FREIEN ZONEN VON EINEM OPTISCHEN AUFZEICHNUNGSMEDIUM

PROCEDE D’AFFECTATION DE ZONES LIBRES D’UN SUPPORT D’ENREGISTREMENT OPTIQUE

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Description

Technical field

[0001] The present invention relates to a rewritable optical recording medium and a method of assigning the spare area in the rewritable optical recording medium.

Background Art

[0002] A rewritable optical recording medium generally includes a Rewritable Compact Disc (CD-RW) and a Rewritable Digital Versatile Disc (DVD-RW, DVD-RAM and DVD+RW). The rewritable optical disc performs repeated operations of recording and/or playback of the information on the disc. However, by the repeated operation, a mixture ratio of the mixture forming a recording layer for recording the information on the optical disc is changed from an initial mixture ratio thereof. Thus, the inherent characteristic of the optical disc is not maintained, thereby generating errors during the recording and/or playback of information. This is commonly known as degradation.

[0003] The area where degradation occurs is designated as a defect area which appears upon the implementation of formatting, recording and/or playback commands of the optical disc. The defect area of rewritable optical discs may also be generated due to scratches on the surface, particles such as dust, and errors during manufacturing. Therefore, to prevent data from being recorded on or played back from defect areas of the optical disc, an effective management system for the defect area is necessary.

[0004] FIG. 1 shows a defect management area (DMA) in a lead-in area and a lead-out area of the optical disc to manage a defect area. Particularly, the data area is divided into a plurality of zones for the defect area management, where each zone is further divided into a user area and a spare area. The user area is where data is actually written and the spare area is used when a defect occurs in the user area.

[0005] There are four DMAs in one disc, e.g. DVD-RAM, two of which exist in the lead-in area and two exist in the lead-out area. Because managing defective areas is important, the same contents are repeatedly recorded in all four DMAs to protect the data. Each DMA comprises two blocks of 32 sectors, where one block comprises 16 sectors. The first block of the DMA, called a DDS/PDL block, includes a disc definition structure (DDS) and a primary defect list (PDL). The second block of the DMA, called an SDL block, includes a secondary defect list (SDL). The PDL corresponds to a primary defect data storage and the SDL corresponds to a secondary defect data storage.

[0006] The PDL generally stores entries of defective sectors caused during the manufacture of the disc or identified when formatting a disc, namely initializing and re-initializing a disc. Each entry is composed of an entry type and a sector number corresponding to a defective sector. The SDL lists defective areas in block units, thereby storing entries of defective blocks occurring after formatting or defective blocks which could not be stored in the PDL during the formatting. Each SDL entry has an area for storing a sector number of the first sector of a block having defective sectors, an area for storing a sector number of the first sector of a block replacing the defective block, and reserved areas. Accordingly, defective areas, i.e. defective sectors or defective blocks, within the data area are replaced with normal or non-defective sectors or blocks by a slipping replacement algorithm and a linear replacement algorithm.

[0007] The slipping replacement algorithm is utilized when a defective area is recorded in the PDL. As shown in FIG. 2(a), if defective sectors m and n, corresponding to sectors in the user area, are recorded in the PDL, such defective sectors are skipped to the next available sector. By replacing the defective sectors by subsequent sectors, data is written to a normal sector. As a result, the user area into which data is written slips and occupies the spare area in the amount equivalent to the skipped defective sectors. For example, if two defect sectors are registered in the PDL, data would occupy two sectors of the spare area.

[0008] The linear replacement algorithm is utilized when a defective block is recorded in the SDL or when a defective block is found during playback. As shown in FIG. 2(b), if defective blocks m and n, corresponding to blocks in either the user or spare area, are recorded on the SDL, such defective blocks are replaced by normal blocks in the spare area and the data to be recorded in the defective block are recorded in an assigned spare area.

[0009] As defective areas are compensated utilizing the spare area, methods of assigning the spare area plays an important role in the defective area management. Typically, the spare area may be allocated in each zone or group of the data area or may be allocated in a designated portion of the data area. One method is to allocate the spare area at the inner rings of a disc, i.e. at the top of the data area, as shown in FIGS. 3(a) and (b). In such case, the spare area is called a Primary Spare Area. Namely, the data area excluding the primary spare area becomes the user area.

[0010] The primary spare area, assigned in an initial formatting process, is not given a logical sector number (LSN). Thus, the primary spare area is assigned when a manufacturer produces the optical disc or when a user initially formats an empty disc. A variety of sizes can be allocated for the primary spare area, depending upon an initial data recording capacity, i.e. the initial user area. For example, in order to provide 4.7GB (Giga byte) initial data recording capacity (i.e. initial user area) in a disc with a size of 120mm, 26MB (Mega Byte) may be allocated for the primary spare area and maintain compatibility with DVD-ROM.

[0011] For purposes of explanation, a disc with an in-
Disclosure of invention

Accordingly, an object of the present invention is to solve at least the problems and disadvantages of the related art.

An object of the present invention is to provide an optical recording medium which assigns a primary spare area of the same size to mediums having different initial user area sizes.

Another object of the present invention is to provide an optical recording medium, in which a spare area is assigned during formatting in both the inner and outer rings of the optical recording medium depending upon a mode.

A further object of the present invention is to provide a method of assigning a spare area of an optical recording medium, in which both the primary spare area and secondary spare area are assigned or only the primary spare area is assigned during formatting, depending upon a mode.

A still further object of the present invention is to provide a method of assigning a spare area of an optical recording medium in which conversions between modes is available.

Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objects and advantages of the invention may be realized and attained as particularly pointed out in the appended claims.

To achieve the objects and in accordance with the purposes of the invention, an optical recording medium according to the present invention has a data area divided into a user area and a spare area, in which initial primary spare areas of different optical recording media, having a same data area but different initial user sizes, have the same size.

Also, a method of assigning a spare area of an optical recording medium according to the present invention assigns, during formatting, a primary spare area in at least two modes, depending upon the desired user area size. One assigns the primary spare area in the inner ring of the recording medium and the other assigns both a primary spare area and a supplementary spare area in the inner and outer rings of the recording medium respectively.

In the above method of assigning a spare area of an optical recording medium, the primary spare area is assigned to have the same size regardless of the mode. Also, conversion between the two modes is allowed.

Brief Description of Drawings

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Brief Description of Drawings

Fig. 1 shows a structure of an optical disc in the related art;

Fig. 2(a) shows a slipping replacement algorithm in the related art;

Fig. 2(b) shows a linear replacement algorithm in the related art;

Figs 3(a) and (b) show examples in which a spare area is assigned at the top of the data area;

Fig. 4(a) shows an example of assignment of the spare area in a first mode according to the present invention;

Fig. 4(b) shows an example in which primary spare areas of two modes are assigned to have the same size according to the present invention;

Fig. 5 is a flow chart showing a method of assigning the spare area of the optical recording medium according to the present invention; and

Fig. 6 shows a conversion process between the modes in the optical recording medium according to the present invention.

Mode for Carrying Out the Invention

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

Generally, the present invention allows an assignment of primary spare area of the same size in discs
of the same size and track pitch but different initial user area sizes, thereby improving the compatibility among different discs. For purposes of explanation, a disc with a size of 120mm (hereinafter “the disc”) will be used to explain the present invention.

[0026] The disc may have an initial user area of 4.7GB and a primary spare area of 26MB, as discussed above. In such case, a primary spare area of 26MB would still be allocated to the 120mm disc with less than 4.7GB of an initial user area. The disc will be considered to be in a first mode when the initial user area is less than 4.7GB and in a second mode when the initial user area is equal 4.7GB.

[0027] In the first mode, since a primary spare area of the same size is allocated while less initial user area than the first mode is assigned, a portion of the data area remains. This remaining portion will be referred as a secondary spare area. Particularly, the secondary spare area is equal to the total data area minus the sum of the user area and the primary spare area. For example, if the initial user area of the disc is 4.58GB, the total spare area would be 145MB as shown in FIG. 4(a) and if 26MB is allocated as the primary spare area, the size of the secondary spare area would be 119MB. The secondary spare area may be assigned as a supplementary spare area at the outer rings of a disc or near the bottom of the data area, as shown in FIG. 4(b).

[0028] The secondary spare area is assigned as the supplementary spare area simultaneously when the primary spare area is assigned. Namely, the primary and supplementary spare areas of the first mode may be assigned when the disc manufacturer fabricates the disc or when a user formats the disc. Similarly, the primary spare area of a disc in the second mode is assigned in the same way. However, the supplementary spare area of a disc in the second mode is assigned when necessary as data is recorded or playbacked from a disc.

[0029] Also, the primary spare area of a disc in either the first mode or the second mode is not given a LSN, as discussed above. However, in the second mode, the LSN is not given to the supplementary spare area as well as the primary spare area. Particularly, the LSN is given to the user area of both the first and second modes.

[0030] Furthermore, for convenience of the user of a disc, either the manufacturer or the user can select between the first mode or the second mode, when a disc is formatted. Referring to FIG. 5, when formatting is selected (step 501), the manufacturer or user may select a mode (step 502). If the first mode is selected, both a primary and a supplementary spare areas would be assigned at the top and bottom of a disc, respectively (step 503). If the second mode is selected, only a primary spare area would be assigned at the top of the data area (504).

[0031] Thus, if the first mode is selected when formatting a disc, all three areas, i.e. a primary spare area, a supplementary spare area and a user area, would be assigned. For example, a primary spare area of 26MB, a user area of 4.58GB and a supplementary spare area of 119MB may be assigned to the disc. On the other hand, if the second mode is selected when formatting a disc, a primary spare area a user area would be assigned while a supplementary spare area may be assigned as necessary when recording or playing back data from a disc. For example, a primary spare area of 26MB and a user area of 4.7GB would be assigned to the disc.

[0032] Moreover, the present invention allows a conversion between the first and second mode for further convenience of a user. This is possible because both modes have a primary spare area of the same size.

[0033] If a disc being used needs to be converted from the first mode to the second mode, the assignment of the supplementary spare area can be simply canceled through formatting as shown in FIG. 6. For this conversion, the defect blocks registered in the SDL or only the defect sectors in the defect blocks registered in the SDL would be registered in the PDL. Also, a number of sectors within the primary spare area equivalent to the defect sectors newly registered in the PDL would slip into or become a part of the user area to maintain the initial user area. Once converted, the supplementary spare area may be assigned again as necessary when the primary spare area becomes full.

[0034] If a disc being used needs to be converted from the second mode to the first mode, a reverse process of a conversion from the first mode to the second mode is performed. Particularly, a primary spare area and a supplementary spare area are simultaneously accordingly assigned through formatting. Referring back to FIG. 4(a) and (b), if the disc in the second mode has an initial user area of 4.58GB, 26MB would be assigned at the top of the data area as the primary spare area and 119MB would simultaneously be assigned as the supplementary spare area near the bottom of the data area. Also, similar to the conversion from the first to the second mode, defective blocks registered in the SDL or only the defect sectors in the defect blocks registered in the SDL would be registered in the PDL, and a number of sectors within the primary spare area equivalent to the defect sectors newly registered in the PDL would slip into or become a part of the user area.

[0035] As described above, in the method of assigning the spare area of the optical recording medium according to the present invention, the primary spare areas of discs in the first and the second modes are assigned to have the same initial size, improving compatibility between the two modes. Moreover, while the supplementary spare area of the first mode is assigned simultaneously with the primary spare area and the supplementary spare area of the second mode is assigned if required, a selection between the modes can be made through mode conversion when the disc is formatted. Finally, although a disc with a size of 120mm has been used for purposes of illustration, the present invention
can be applied to any discs with the same disc size but different initial user area sizes.

[0036] The foregoing embodiments are merely exemplary and are not to be construed as limiting the present invention. The present teachings can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.

Claims

1. Method of formatting an optical recording medium having a data area, the method comprising the steps of:

   selecting one of a first format and a second format,
   wherein
   the optical recording medium of the first format has assigned a primary spare area and a secondary spare area to be utilized for defect management purposes, and a user area;
   the optical recording medium of the second format has assigned a primary spare area to be utilized for defect management purposes, and a user area;
   if the first format is selected in the selecting step, assigning a primary spare area, a secondary spare area and a user area;
   if the second format is selected in the selecting step, assigning only a primary spare area and a user area;

   wherein the primary spare areas of the first format and the second format have the same size.

2. The method of claim 1, wherein the user area in the first format is smaller than the user area in second format.

3. The method of claim 1, wherein the primary spare area in the first format and the second format is assigned at the top of the data area of the optical recording medium.

4. The method of claim 1, wherein the supplementary spare area in the first format is assigned near the bottom of the data area of the optical recording medium.

5. The method of one of claims 3 to 4, wherein the supplementary spare area in the first format is not given a logical sector number (LSN).

6. The method of claim 1, further comprising:

   registering one of either defect blocks registered in a secondary defect list (SDL) of a defect management information or only defect sectors in defect blocks registered in the SDL of a defect management information if the spare area is assigned by one of first format and second format.

7. The method of claim 6, further comprising:

   performing a slipping replacement such that a number of sectors within the primary spare area equivalent to the defect sectors newly registered in the PDL become a part of the user area.

Patentansprüche

1. Verfahren zum Formatieren eines optischen Aufzeichnungsmediums mit einem Datenbereich, wobei das Verfahren die Schritte enthält:

   Auswählen eines ersten Formats oder eines zweiten Formats, wobei
das optische Aufzeichnungsmedium des ersten Formats einen primären Reservebereich und einen sekundären Reservebereich, aus Gründen der Verwendung zur Fehlerverwaltung, und einen Nutzerbereich zugeordnet hat;
das optische Aufzeichnungsmedium des zweiten Formats einen primären Reservebereich, aus Gründen der Verwendung zur Fehlerverwaltung, und einen Nutzerbereich zugeordnet hat;
ein primärer Reservebereich, ein sekundärer Reservebereich und ein Nutzerbereich zugeordnet werden, wenn im Auswahlsschritt das erste Format ausgewählt wird;
nur ein primärer Reservebereich und ein Nutzerbereich zugeordnet werden, wenn im Auswahlsschritt das zweite Format ausgewählt wird;
wobei die primären Reservebereiche des ersten Formats und des zweiten Formats dieselbe Größe haben.

2. Verfahren nach Anspruch 1, bei welchem der Nutzerbereich im ersten Format kleiner als der Nutzerbereich im zweiten Format ist.

3. Verfahren nach Anspruch 1, bei welchem der pri-
märe Reservebereich im ersten Format und zwei-
ten Format am Oberbereich des Datenbereichs des
optischen Aufzeichnungsmediums zugeordnet
wird.

4. Verfahren nach Anspruch 1, bei welchem der zu-
sätzliche Reservebereich im ersten Format nahe
dem Unterbereich des Datenbereichs des opti-
schen Aufzeichnungsmediums zugeordnet wird.

5. Verfahren nach einem der Ansprüche 3 bis 4, bei
welchem dem zusätzlichen Reservebereich im er-
sten Format keine logische Sektornummer (LSN)
gegeben wird.

6. Verfahren nach Anspruch 1, welches ferner enthalt:
Registrieren entweder von defekten Blöcken,
welche in einer sekundären Fehlerliste (SDL)
einer Fehlerverwaltungs-Information registriert
sind, oder nur von fehlerhaften Sektoren in feh-
erhaften Blöcken, welche in der SDL einer
Fehlerverwaltungs-Information registriert sind,
in einer primären Fehlerliste (PDL) der Fehler-
verwaltungs-Information, wenn der Reserve-
bereich dem ersten Format oder dem zweiten
Format zugeordnet ist.

7. Verfahren nach Anspruch 6, welches ferner enthalt:
Durchführen nachgebenden Austausches, und
zwar derart, dass eine Anzahl an Sektoren in-
erhalb des primären Reservebereichs, wel-
che gleich den neu in der PDL registrierten feh-
erhaften Sektoren sind, ein Teil des Nutzerbe-
reichs werden.

Revendications

1. Procédé de formatage d’un support d’enregistre-
ment optique ayant une zone de données, le pro-
cédé comprenant les étapes consistant à :

- sélectionner un format parmi un premier format
et un second format, dans lequel
  le support d’enregistrement optique du
premier format a affecté une zone de réserve
primaire et une zone de réserve secondaire qui
doivent être utilisées à des fins de gestion de
defaut et une zone utilisateur ;
  le support d’enregistrement optique du
second format a affecté une zone de réserve
primaire qui doit être utilisée à des fins de ges-
tion de défaut et une zone utilisateur ;

- si le premier format est sélectionné dans l’étape
de sélection, affecter une zone de réserve pri-
maire, une zone de réserve secondaire et une
zone utilisateur ;

- si le second format est sélectionné dans l’étape
de sélection, affecter seulement une zone de
réserve primaire et une zone utilisateur ;

- dans lequel les zones de réserve primaire du
premier format et du second format ont la même
taille.

2. Procédé selon la revendication 1, dans lequel la zo-
me utilisateur dans le premier format est plus petite
que la zone utilisateur dans le second format.

3. Procédé selon la revendication 1, dans lequel la zo-
ne de réserve primaire dans le premier format et
dans le second format est affectée au sommet de
la zone de données du support d’enregistrement
optique.

4. Procédé selon la revendication 1, dans lequel la zo-
ne de réserve supplémentaire dans le premier for-
mat est affectée près du fond de la zone de données
du support d’enregistrement optique.

5. Procédé selon l’une quelconque des revendications
3 à 4, dans lequel la zone de réserve supplémen-
taire dans le premier format ne reçoit pas un numé-
ro de secteur logique (LSN).

6. Procédé selon la revendication 1, comprenant, en
outre, les étapes consistant à :
enregistrer un de chacun des blocs défectueux
enregistrés dans une liste des défauts secon-
daire (SDL) des informations de gestion de
defaut ou seulement les secteurs défectueux
dans les blocs défectueux enregistrés dans le
SDL des informations de gestion de défaut dans une liste de défaux primaires (PDL) des
informations de gestion de défaut si la zone ré-
servée est affectée à l’un du premier format et
du second format.

7. Procédé selon la revendication 6, comprenant, en
outre, les étapes consistant à :
effectuer un remplacement glissant de sorte
qu’un certain nombre de secteurs à l’intérieur
de la zone de réserve primaire équivalents aux
secteurs défectueux nouvellement enregistrés
dans le PDL deviennent une partie de la zone
utilisateur.
FIG. 1

<table>
<thead>
<tr>
<th>lead-in area</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DMA1</td>
<td>reserved</td>
</tr>
<tr>
<td></td>
<td>DMA2</td>
<td>reserved</td>
</tr>
<tr>
<td>user area of zone 0</td>
<td>spare area</td>
<td></td>
</tr>
<tr>
<td>user area of zone 1</td>
<td>spare area</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>user area of zone N-1</td>
<td>spare area</td>
<td></td>
</tr>
<tr>
<td>user area of zone N</td>
<td>spare area</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lead out area</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DMA3</td>
<td>reserved</td>
</tr>
<tr>
<td></td>
<td>DMA4</td>
<td>reserved</td>
</tr>
</tbody>
</table>
FIG. 2

(a)

(b)

m data blocks     n data blocks

user area or spare area

sector number

LSN

spare area

sector number

LSN

(m+n)

spare blocks
FIG. 5

Start

Formatting 501

Mode selection?

- Mode-1
  Assign both primary and supplementary spare areas 503

- Mode-2
  Assign only primary spare area 504