

OPTICAL DISK AND METHOD OF RECORDING DATA IN THE SAME

Technical Field

The present invention relates to a high-density optical disk and a
5 method of recording data in the high-density optical disk, and more
particularly, to an optical disk in which data is continuously recorded and
then linking is defined at a portion where an overwriting area starts, and
a method of recording data in the optical disk.

10 Background Art

Generally, optical disks are widely employed as information
recording media by optical pickup apparatuses for recording or
reproducing information in a noncontact way and are classified into
compact disks (CDs) and digital versatile disks (DVDs) according to
15 information-recording capacity. Representative recordable, erasable,
and reproducible optical disks are 650 MB compact disc recordables
(CD-Rs), CD-rewritables (RWs), and 4.7 GB DVD-RWs. Furthermore,
23 GB high definition (HD)-DVDs are under development

In the case of CD-RWs, a basic recording unit in which a
20 predetermined capacity of data can be recorded is referred to as a
packet, and the structure of the packet is shown in FIG. 1. In the packet,
a plurality of run-in blocks 103 are defined in front of a user data block
105 in which user data is recorded, and a plurality of run-out blocks 110
are defined behind the user data block 105. In addition, a link block 100
25 is defined in front of the basic recording unit to allow continuous
recording. When the user data block 105 partially includes a defective
area in which data cannot be recorded, recording must be terminated in
front of this defective area. However, an optical recording/reproducing
method or disk structure with respect to such defective area is not
30 defined. Accordingly, processing on defective areas can be different
depending upon manufacturers of disks or recording and reproducing

apparatuses, thereby causes disks to be incompatible with recording and reproducing apparatuses. This problem may commonly occur in CD family recording media, DVD family recording media, and HD-DVD family recording media. Therefore, standardization of optical disks is required.

5 This applicant have disclosed a method of processing a defective area by applying a linking scheme having predetermined rules to a position right behind the defective area on a DVD-RW and a recording medium in Korean Patent Publication No. 2000-75374.

 However, for HD-DVDs having a capacity of 23 GB or greater
10 which will be produced in the future, a method of processing a defective area and a disk structure related thereto have not never been defined. Moreover, a recording method at positions where overwriting starts and ends when overwriting occurs in a partial area in a data recording area has not been defined. Accordingly, as described above, compatibility
15 problems occur, resulting in unreliable recording and reproducing. Therefore, new definitions of and standards for a recording and reproducing method and a disk structure for a case where overwriting is performed or defective areas are formed during overwriting in HD-DVDs are desired.

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Disclosure of the Invention

 To solve the above-described problems, it is a first object of the present invention to provide an optical disk in which linking occurs at a position where overwriting starts and in which recording end data for
25 terminating the recording is recorded at a position where overwriting ends, and a method of recording data in the optical disk, thereby securing compatibility between disks and disk drives and improving recording and reproducing performance on high-density optical disks. It is a second object of the present invention to provide an optical disk in
30 which when a defective area is produced during overwriting, recoding end data for terminating the recording is recorded in front of the defective

area and linking occurs behind the defective area, and a method of recording data in the optical disk, thereby realizing smooth, continuous recording and reproducing.

To achieve the first object of the present invention, there is
5 provided a method of recording data on a recordable and/or reproducible optical disk when data is overwritten. The method includes the step of performing linking in front of a physical cluster from which overwriting starts.

The method further includes the step of recording a guard3 for
10 terminating the recording in a portion following a physical cluster in which overwriting ends.

The linking is performed between adjacent run-out and run-in in front of the physical cluster from which overwriting starts, and a run-in and a run-out are formed respectively in front of and behind every
15 physical clusters to allow the data to be accurately recorded.

The run-in and the run-out comprise a guard1 and a guard2, respectively, for protecting user data.

The guard3 for terminating the recording is recorded in a run-in next to a run-out following the physical cluster in which overwriting ends,
20 and a run-in and a run-out are formed respectively in front of and behind every physical clusters to allow the data to be accurately recorded.

To achieve the second object of the present invention, there is provided a method of recording data on a recordable and/or reproducible optical disk when the data is overwritten. The method includes the
25 steps of performing linking in front of a physical cluster from which overwriting starts when the overwriting is performed after data has been recorded in the optical disk in units of physical clusters; and when a defective area on which recording cannot be performed is included in an area on which overwriting is performed, recording a guard3 for
30 terminating the recording in a portion in front of the defective area.

The method further includes the step of performing linking behind the defective area.

To achieve the first object of the present invention, there is also provided an optical disk which data can be recorded in and reproduced from. The optical disk includes a plurality of physical clusters in which data is recorded; and a plurality of run-ins and run-outs provided in front of and behind the physical clusters to allow data to be accurately recorded. When overwriting is performed in units of physical clusters, linking is performed between a run-in and an adjacent run-out in front of a physical cluster from which the overwriting starts.

To achieve the second object of the present invention, there is also provided an optical disk which data can be recorded in and reproduced from. The optical disk includes a plurality of physical clusters in which data is recorded; a plurality of run-ins and run-outs provided in front of and behind the physical clusters to allow data to be accurately recorded; and a defective area in which a defect occurs before data is recorded or while data is being recorded. When overwriting is performed on a partial area including the defective area and at least one physical cluster, linking is performed between a run-in and an adjacent run-out in front of the partial area on which the overwriting is performed.

Brief Description of the Drawings

FIG. 1 is a diagram of a structure of a basic recording unit applied to a conventional compact disc rewritable (CD-RW);

FIG. 2A is a diagram of a recording structure in which data is recorded in a single physical cluster;

FIG. 2B is a diagram of a recording structure in which data is continuously recorded in a plurality of physical clusters;

FIG. 3A is a diagram of a recording structure in which a portion where data is overwritten on an optical disk according to a first embodiment of the present invention is marked;

FIG. 3B is a diagram for explaining an optical disk and a method of recording data therein according to the first embodiment of the present invention;

FIG. 4A is a diagram of a recording structure in which a portion where data is overwritten on an optical disk according to a second embodiment of the present invention is marked; and

FIG. 4B is a diagram for explaining an optical disk and a method of recording data therein according to the second embodiment of the present invention.

Best mode for carrying out the Invention

The present invention will now be described in more detail with reference to the accompanying drawing.

FIG. 2A shows a case where data is recorded at a single physical cluster 5 in a recordable and/or reproducible high-density optical disk. FIG. 2B shows a case where data is continuously recorded at a plurality of physical clusters 15 in a recordable and/or reproducible high-density optical disk. Each of the physical clusters 5 and 15 includes 32 frames each having a capacity of 2 KB, a sync frame, data for controlling DC offsets, and an error correction code (ECC) for correcting errors. Here, the ECC may have a size of 64 KB.

Run-ins 3 and 13 are defined in front of the respective physical clusters 5 and 15, and run-outs 8 and 18 are defined behind the respective physical clusters 5 and 15. These run-ins 3 and 13 and the run-outs 8 and 18 are provided for accurately recording data in or reproducing data from the physical clusters 5 and 15.

Each of the run-ins 13 can include a guard 13a having a predetermined pattern for overcoming overwriting due to a change in a

data recording start point and a pre-amble 13b for signal processing such as locking or synchronizing. Each of the run-outs 18 can include a post-amble 18a for signal processing and a guard2 18b having a predetermined pattern for overcoming overwriting due to a change in a data recording start point. Consequently, the guard1 13a and the guard2 18b act as buffers for protecting user data.

Guards3 10 and 20 for, as an example, ensuring the buffer area of laser power instability when high power writing ends are provided at positions where recording ends. Data recording or reproducing with respect to a basic recording unit in which data of a predetermined capacity is recorded is completed with the guards3 10 and 20. In the above description, a physical cluster has been employed as a minimum recording unit in which user data is recorded, but additionally, a sector, an ECC block, or a frame can be employed in a minimum recording unit.

FIG. 3A shows a case where overwriting is performed on a physical cluster 15A in which data has been continuously recorded. A run-in is provided in front of each of the physical clusters, and a run-out is provided behind each of the physical clusters. A guard3 20 is provided at a position where recording ends. For example, when overwriting is performed in an area A in FIG. 3A, a run-in, a physical cluster, and a run-out in the overwriting area are denoted by reference characters 13A, 15A, and 18A, respectively. Here, in a method of recording data in an optical disk according to a first embodiment of the present invention, as shown in FIG. 3B, linking occurs between a run-in 13A and a run-out 18' in front of an overwriting area A.

Linking allows recording to be performed smoothly when overwriting erroneously starts from a portion of the run-out 18' or a run-in 13A of FIG. 3A where overwriting should not be performed in the case where overwriting is performed on a part of a disk. In other words, linking is performed by performing error correction in front of the physical cluster

15A in which overwriting is performed in order to compensate for a case in which overwriting does not start at an exact recording start point. A bidirectional arrow between the run-in 13A and the run-out 18' in front of the overwriting area A in FIG. 3B indicates linking.

5 More specifically, linking can be performed by recording a guard2 18b' in the run-out 18'. It is preferable that the guard2 18b' in the run-out 18' and the guard3 20 have the same structure, that is, the same pattern and length. For example, if the guard3 20 has a length of at least 300 channelbits and a continuous pattern including 3T and 5T, it is preferable to configure the guard2 18b' to have a length of at least 300
10 channelbits and a continuous pattern including 3T and 5T. Here, 3T and 5T indicate length units of marks recorded in a disk. Configuring the guard2 18b' in the same structure as the guard3 20 is advantageous in that a linking scheme suggested for the guard3 20 can be applied to
15 the guard2 18b' as it is.

 Overwriting is smoothly performed by performing linking between the run-in 13A and the run-out 18' in front of the overwriting area A. Next, recoding or reproducing is performed on the physical cluster 15A following the run-in 13A, and a guard3 19 for terminating the recording is
20 recorded in the run-in 13' following the run-out 18A where overwriting ends.

 Here, the physical cluster 15A, for example, includes 496 recording frames 15A-1, 15A-2, ...15A-496 illustrated behind the run-in 13A in FIG. 3B. Reference numeral 15-496 denotes a 496-th recording
25 frame of the physical cluster 15 in front of the run-out 18'.

 In the first embodiment, a case where overwriting is performed on a single physical cluster has been described, but the same manner is applied to a case where overwriting is continuously performed on a plurality of physical clusters. In other words, when overwriting is
30 performed on a plurality of physical clusters, linking is performed

between a run-out and a run-in in front of an overwriting area, and a guard3 is recorded in a run-in behind an overwriting area.

The following description concerns an optical disk and a recording method according to a second embodiment of the present invention.

5 FIG. 4A shows a case where a defective area 26 on which recording and reproducing cannot be performed is detected while data is continuously recorded in or reproduced from a plurality of physical clusters 25B in a recordable and/or reproducible high-density optical disk. Here, the address of the defective area 26 is recorded in a defect list field. The
10 defective area 26 can be detected during recording, reproducing, or disk verification. Run-ins 23 and 23B are provided in front of the physical clusters 25 and 25B, respectively, and run-outs 28' and 28B are provided behind the physical clusters 25 and 25B.

A recording method according to the second embodiment of the
15 present invention is applied when data is overwritten in a recording area in which data has been recorded in an optical disk including the defective area 26. In FIG. 4A, an overwriting area is denoted by a reference character B. Run-ins, physical clusters, and run-outs within the overwriting area B are denoted by reference characters including B.

20 Linking is performed between a run-in 23B and a run-out 28' in front of the overwriting area B in FIG. 4B. Linking is indicated by bidirectional arrows in FIG. 4B. Linking has been described above with reference to FIG. 3B, and thus a detailed description thereof will be omitted.

25 Next, since recording cannot be performed on the defective area 26, recording end data for terminating the recording is recorded in a run-in 23B' right in front of the defective area 26. A guard3 24, i.e., recording end data, may be configured in the same manner as the guard3 20 shown in FIG. 2B. For example, the guard3 20 can be
30 configured to have a length of at least 300 channelbits and a continuous

pattern including 3T and 5T, and it is preferable to configure the recording end data to have the same length and pattern as the guard3 20.

Next, when overwriting is started again behind the defective area
5 26, linking is performed between a run-out 28B' and a run-in 23B'' following the defective area 26, as indicated by a bidirectional arrow therebetween. Linking is performed in the same manner as described above. A guard3 29, as an example, ensuring the buffer area of laser power instability when high power writing ends is recorded in a run-in 23'
10 following a last run-out 28B'' of the overwriting area B.

Referring to FIGS. 3B and 4B, an optical disk according to the present invention is designed to allow linking to occur between the run-outs 18' and 28' and the run-ins 13A and 23B in front of the overwriting areas A and B when overwriting is performed. In the optical
15 disk, recording end data, for example, a guard3 24, for terminating the recording is recorded in front of the defective area 26.

In addition, the optical disk of the present invention is designed to allow linking to occur between the run-out 28B' and the run-in 23B'' following the defective area 26. In the optical disk, guards3 19 and 29
20 are recorded behind the last run-outs 18A and 28B'', respectively, of the overwriting areas A and B.

When data is recorded in or reproduced from an optical disk according to the present invention, a light source having a celadon green wavelength and an objective lens having a numerical aperture (NA) of at
25 least 0.7 are used. In addition, an optical disk according to the present invention is characterized by having a track pitch of no greater than 0.35 μm , a minimum recording mark having a length of no greater than 0.2 μm , an ECC recording unit of at least 32 KB, and a recording capacity of at least 20 GB.

30 In an optical disk and a method of recording data in the optical

disk according to the present invention, when overwriting is performed on a portion of the optical disk in which data has been recorded, or when overwriting is performed on a portion including a defective area, linking is performed in front of the portion on which the overwriting is performed or
5 behind the defective area, thereby realizing reliable data recording and reproducing. In addition, a guard3 is recorded in a portion in front of the defective area and in a portion behind an overwriting area to stop the recording. The present invention proposes standards for overwriting and processing defective areas with respect to high-density optical disks
10 in which data is continuously recorded or reproduced, thereby securing compatibility between disks and disk drives and improving recording and reproducing performance on high-density optical disks.

The drawing and specification of the invention are provided for illustration only and are not used to limit the scope of the invention set
15 forth in appended claims.

Industrial Applicability

As described above, the present invention can realize stable and reliable data recording and reproducing by performing linking when
20 overwriting is performed after data has been continuously recorded in a high-density optical disk or when overwriting is performed on a high-density optical disk including a defective area, and recording a guard3, i.e., recording end data, at an appropriate position.

What is claimed is:

1. A method of recording data on a recordable and/or reproducible optical disk when the data is overwritten, the method comprising the step of performing linking in front of a physical cluster
5 from which overwriting starts.

2. The method of claim 1, further comprising the step of recording a guard3 for terminating the recording in a portion following a physical cluster in which overwriting ends.
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3. The method of claim 1 or 2, wherein the linking is performed between adjacent run-out and run-in in front of the physical cluster from which overwriting starts, and a run-in and a run-out are formed respectively in front of and behind every physical clusters to allow
15 the data to be accurately recorded.

4. The method of claim 3, wherein the run-in and the run-out comprise a guard1 and a guard2, respectively, for protecting user data.

5. The method of claim 2 or 4, wherein the guard3 for terminating the recording is recorded in a run-in next to a run-out following the physical cluster in which overwriting ends, and a run-in and a run-out are formed respectively in front of and behind every physical clusters to allow the data to be accurately recorded.
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6. The method of claim 5, wherein the gurad2 and the guard3 have the same length and pattern.
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7. The method of claim 6, wherein the guard3 has a length of at least 300 channelbits and a continuous pattern including at least 3T and 5T.
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8. The method of claim 1 or 2, wherein a light source having a celadon green wavelength is used when the data is recorded in or reproduced from the optical disk.

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9. The method of claim 1 or 2, wherein an objective lens having a numerical aperture of at least 0.7 is used when the data is recorded in or reproduced from the optical disk.

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10. The method of claim 1 or 2, wherein the optical disk has a track pitch of no greater than $0.35\ \mu\text{m}$, a minimum recording mark having a length of no greater than $0.2\ \mu\text{m}$, and an error correction code (ECC) recording unit of at least 32 KB.

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11. The method of claim 5, wherein the optical disk has a track pitch of no greater than $0.35\ \mu\text{m}$, a minimum recording mark having a length of no greater than $0.2\ \mu\text{m}$, and an error correction code (ECC) recording unit of at least 32 KB.

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12. A method of recording data on a recordable and/or reproducible optical disk when the data is overwritten, the method comprising the steps of:

performing linking in front of a physical cluster from which overwriting starts when the overwriting is performed after data has been recorded in the optical disk in units of physical clusters; and

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when a defective area on which recording cannot be performed is included in an area on which overwriting is performed, recording a guard3 for terminating the recording in a portion in front of the defective area.

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13. The method of claim 12, further comprising the step of performing linking behind the defective area.

14. The method of claim 12 or 13, wherein a run-in and a
5 run-out are formed respectively in front of and behind every physical clusters to allow the data to be accurately recorded.

15. The method of claim 14, wherein the linking is performed between adjacent run-in and run-out following the defective area.

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16. The method of claim 14, wherein the linking is performed between a run-in and an adjacent run-out in front of the partial area on which overwriting is performed.

17. The method of claim 15 or 16, wherein the run-in and the
15 run-out comprise a guard1 and a guard2, respectively, for protecting user data.

18. The method of claim 17, wherein the gurad2 and the
20 guard3 have the same length and pattern.

19. The method of claim 12 or 18, wherein the guard3 has a length of at least 300 channelbits and a continuous pattern including at least 3T and 5T.

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20. The method of claim 12 or 13, further comprising the step of recording a guard3 for terminating the recording in a portion following a physical cluster in which overwriting ends.

21. The method of claim 19, wherein the guard3 for terminating
30 the recording is recorded in a run-in next to a run-out following the

physical cluster in which overwriting ends, and a run-in and a run-out are formed respectively in front of and behind every physical clusters to allow the data to be accurately recorded.

5 22. The method of claim 12 or 13, wherein a light source having a celadon green wavelength is used when the data is recorded in or reproduced from the optical disk.

10 23. The method of claim 12 or 13, wherein an objective lens having a numerical aperture of at least 0.7 is used when the data is recorded in or reproduced from the optical disk.

15 24. The method of claim 12 or 13, wherein the optical disk has a track pitch of no greater than 0.35 μm , a minimum recording mark having a length of no greater than 0.2 μm , and an error correction code (ECC) recording unit of at least 32 KB.

20 25. An optical disk which data can be recorded in and reproduced from, the optical disk comprising:
a plurality of physical clusters in which data is recorded; and
a plurality of run-ins and run-outs provided in front of and behind the physical clusters to allow data to be accurately recorded,
wherein when overwriting is performed in units of physical clusters, linking is performed between a run-in and an adjacent run-out in front of
25 a physical cluster from which the overwriting starts.

30 26. The optical disk of claim 25, wherein a guard³ for terminating the recording is recorded in a run-in following a physical cluster in which the overwriting ends when the overwriting is performed in units of physical clusters.

27. The optical disk of claim 25 or 26, wherein each of the run-ins comprises a guard1, and each of the run-outs comprises guard2, to protect user data.

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28. The optical disk of claim 26, wherein the guard2 and the guard3 have the same length and pattern.

29. The optical disk of claim 28, wherein the guard3 has a
10 length of at least 300 channelbits and a continuous pattern including at least 3T and 5T.

30. The optical disk of claim 25 or 26, wherein a light source having a celadon green wavelength is used when the data is recorded in
15 or reproduced from the optical disk.

31. The optical disk of claim 25 or 26, wherein an objective lens having a numerical aperture of at least 0.7 is used when the data is recorded in or reproduced from the optical disk.

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32. The optical disk of claim 25 or 26, wherein the optical disk has a track pitch of no greater than 0.35 μm , a minimum recording mark having a length of no greater than 0.2 μm , and an error correction code (ECC) recording unit of at least 32 KB.

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33. An optical disk which data can be recorded in and reproduced from, the optical disk comprising:

a plurality of physical clusters in which data is recorded;

a plurality of run-ins and run-outs provided in front of and behind

30 the physical clusters to allow data to be accurately recorded; and

a defective area in which a defect occurs before data is recorded or while data is being recorded,

wherein when overwriting is performed on a partial area including the defective area and at least one physical cluster, linking is performed
5 between a run-in and an adjacent run-out in front of the partial area on which the overwriting is performed.

34. The optical disk of claim 33, wherein a guard³ for terminating the recording is recorded in a position in front of the defective
10 area.

35. The optical disk of claim 33 or 34, wherein a guard³ for terminating the recording is recorded in a run-in following the partial area on which overwriting is performed.
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36. The optical disk of claim 33, wherein linking is performed between adjacent run-out and run-in following the defective area.

37. The optical disk of claim 35, wherein linking is performed
20 between adjacent run-out and run-in following the defective area.

38. The optical disk of claim 36 or 37, wherein each of the run-ins comprises a guard¹, and each of the run-outs comprises guard², to protect user data.
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39. The optical disk of claim 38, wherein the guard² and the guard³ have the same length and pattern.

40. The optical disk of claim 39, wherein the guard³ has a
30 length of at least 300 channelbits and a continuous pattern including at least 3T and 5T.

41. The optical disk of claim 33, wherein a light source having a celadon green wavelength is used when the data is recorded in or reproduced from the optical disk.

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42. The optical disk of claim 35, wherein a light source having a celadon green wavelength is used when the data is recorded in or reproduced from the optical disk.

10 43. The optical disk of claim 33, wherein an objective lens having a numerical aperture of at least 0.7 is used when the data is recorded in or reproduced from the optical disk.

15 44. The optical disk of claim 35, wherein an objective lens having a numerical aperture of at least 0.7 is used when the data is recorded in or reproduced from the optical disk.

20 45. The optical disk of claim 33, wherein the optical disk has a track pitch of no greater than 0.35 μm , a minimum recording mark having a length of no greater than 0.2 μm , and an error correction code (ECC) recording unit of at least 32 KB.

25 46. The optical disk of claim 35, wherein the optical disk has a track pitch of no greater than 0.35 μm , a minimum recording mark having a length of no greater than 0.2 μm , and an error correction code (ECC) recording unit of at least 32 KB.