INFORMATION RECORD AND A METHOD OF REVERSIBLY RECORDING AND ERASING INFORMATION THEREON

This invention relates to an information record which is reversible in the sense of having an information track therein which can be erased while maintaining the re-recording capability of the medium.

Spong, in U. S. Patent 4,097,895 which issued June 27, 1978 and is incorporated herein by reference, has disclosed an ablative optical recording medium for use in an optical recording system. The optical recording medium comprises a reflective layer which is coated with an absorptive layer, where the thickness of the absorptive layer is chosen so that the reflectivity of the recording medium is reduced. A focused modulated light beam directed at the recording medium vaporizes or ablates the absorptive layer leaving an opening in this layer and exposing the reflective layer. During readout the difference in reflectivity between unperturbed portions of the recording medium and those portions in which an opening or deformation exists is detected optically and converted into an electrical signal representative of the recorded information.

Our UK application No. 1590296 , incorporated herein by reference, discloses an invention by Bell providing an ablative trilayer optical recording meduim having a transparent spacer layer. interposed between the reflective and the absorptive layers of the Spong optical recording medium. The thickness of the absorptive layer is so related to the thickness of the spacer layer and to the optical constants (the index of refraction and the extinction coefficient) of the reflective, spacer and absorptive layers, as to reduce the optical reflectivity of the recording medium. Energy absorbed from a focused modulated light beam ablates, or melts the absorptive layer, producing an opening in this layer, thus exposing the underlying reflective layer through the spacer layer. Alternatively, the absorptive layer may deform without the formation of an opening, also leading to an irreversible change in the reflectivity. This medium permits the use of a broader class of materials in a low reflectivity medium than that provided by the recording medium disclosed by Spong.

Bell et al, in U.S. Patent No. 4222071 issued September 9, 1980 and incorporated herein by reference, have disclosed an improved trilayer optical recording medium having an absorptive layer of a low melting temperature material such as tellurium which provides high quality, high signal-to-noise recording capability with the formation of openings in the absorptive layer.

Bell et al, in U. S. Patent No. 4,101,907 issued July 18, 1978 and incorporated herein by reference, have disclosed an overcoat structure for the Spong and Bell optical recording media which comprises a thin barrier layer overlying the absorptive layer and a thick overcoat layer which overlies the barrier layer. The barrier layer is thermally insulating and chemically unreactive, reducing the effect both of heat generated in the absorptive layer on the overcoat layer and the effect of solvents present during the deposition of the overcoat on the absorptive layer. The thick overcoat layer keeps dust which settles on the structure far removed from the focal plane of the recording lens so that the influence of the dust on the recording and readout signal is reduced.

Blom, in Applied Physics Letters 35, 81 (1979), has disclosed the combination of the Bell tellurium trilayer disc with a thin barrier layer overlying the absorptive layer and has calculated the thermal efficiency of this structure for the formation of openings in the absorptive layer.

In all of the above recording media record information is recorded in an irreversible manner by forming pits or openings or otherwise irreversibly altering the absorptive layer.

We have found that an information track can be reversibly recorded and erased over a useful range of incident light powers in a recording medium having a capping layer overlying the absorptive layer. The information track comprises a series of exposed regions in the absorptive layer whose optical properties have been reversibly changed from those of unexposed regions of the absorptive layer. This change in the optical properties produces a change in the reflectivity of the information recording medium which is detected. The capping layer inhibits irreversible recording in the absorptive

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layer upon exposure of the information record to a recording or erasing light beam.

The invention also comprises a method of recording, erasing and rerecording information in an information recording medium.

In the accompanying drawings:

FIGURE 1 is a schematic illustration of a cross-sectional view of a first embodiment of a reversible information recording medium.

FIGURE 2 is a schematic illustration of a cross-sectional view of a second embodiment of a reversible information recording medium.

FIG. 3 is a schematic illustration of a cross-sectional view of a third embodiment of a reversible information recording medium.

FIG. 4 is a schematic illustration of a cross-sectional view of an information record of the invention having information reversibly recorded therein.

FIG. 5 is a schematic illustration of a recording, readout and erasing apparatus for use with the information record of the invention.

Referring to Fig. 1 the reversible information record 1 may be a monolayer structure which comprises a substrate 12, an absorptive layer 22 overlying the substrate 12, and a capping layer 24 overlying the absorptive layer. The absorptive layer 22 is absorptive of light at the recording, readout and erasing light beam wavelengths. The capping layer 24 is substantially transparent at the wavelengths of the recording, readout and erasing light beams. The substrate and capping layers are composed of materials effective for inhibiting the formation of an irreversible change in the absorptive layer upon exposure to the recording or erasing light beam.

Referring to Fig. 2, the reversible information record 2 may be a bilayer structure which comprises a substrate 12, a reflective layer 18, overlying the substrate 12, which reflects a substantial portion of the light incident thereon at the wavelength of recording and readout light beams; an absorptive layer 22, overlying the reflective layer, of a material which is absorptive of light at the wavelength of the recording, readout and an erasing light

beam; and a capping layer 24 overlying the absorptive layer, of a material which is substantially transparent at the wavelengths of the recording, readout and erasing light beams. The reflective and capping layers are effective for inhibiting the formation of an irreversible change in the absorptive layer upon exposure to a recording or erasing light beam.

Referring to FIG. 3 a reversible information recording medium 3 comprises a substrate 12 having a major surface 14; a non-conformal subbing layer 16 overlies the major surface 14 of the substrate 12; a reflective layer 18 overlies the subbing layer 16; a spacer layer 20, overlies the reflective layer 18; an absorptive layer 22 overlies the spacer layer 20; a capping layer 24 overlies the absorptive layer 22; and a thick overcoat 26 overlies the capping layer 24 and is substantially transparent at the recording, readout and erasing wavelengths. The spacer and capping layers are effective for inhibiting the formation of an irreversible change in the absorptive layer upon exposure to a recording or erasing light beam.

An information track, after recording, comprises a series of regions in the absorptive layer which have been reversibly switched to a state having different optical properties than the unrecorded layer whereby the reflectivity of the information recording medium at the readout wavelength is changed in those regions. The information is encoded as variations in either or both the length and spacing of the regions so switched.

Referring to FIG. 4, the identification of the component layers of an information record 4 is the same as that for the information recording medium 3 shown in FIG. 3. Information is recorded in the form of a track in the absorptive layer 22 which comprises a series of unperturbed regions 42 and a series of perturbed regions 44 whose optical properties at the reading wavelength have been changed by exposure to the recording light beam. Accompanying this change in the local optical properties of the absorptive layer is a change in the local reflectivity of the information record. The variations in the reflectivity of the information record are detected optically and converted into an electrical signal representative of the recorded information.

The substrate 12 may be formed of glass or a plastic material which is effective for inhibiting the formation of an

irreversible change in the absorptive layer such as polyvinylchloride or (poly)methylmethacrylate, typically in the form of a disc. Alternatively, the substrate 12 may be formed of a material, such as aluminum, which reflects light at the recording wavelength thus combining the functions of the substrate 12 and the light reflective layer 18. A substrate need only be thick enough to support the remainder of the structure.

Since any roughness of the surface 14 of the substrate 12 on the scale of the focused light beam diameter will produce noise in the signal channel during readout, a subbing layer 16 in the form of a non-conformal coating of a plastic material, such an epoxy or acrylic resin, may be deposited on the surface 14 prior to formation of the light reflective layer 18 thereon. The subbing layer will have a microscopically smooth surface which reduces this noise source.

The reflective layer 18 preferably reflects a substantial fraction of the incident light at the recording and readout wavelengths and is typically formed of a metal such as aluminum or gold which has high reflectivity at these wavelengths. Preferably the reflective layer 18 reflects at least 50 percent of the incident light. The reflective layer 18, which is typically about 30 to 60 nanometers thick, may be deposited on the surface 14 of the substrate or on the surface of the subbing layer 16 using vacuum evaporation techniques. Alternatively, a single or multilayer dielectric reflector may be used.

The spacer layer 20 is formed of a material such as silicon dioxide, silicon monoxide, titanium dioxide or aluminum oxide which are optically non-scattering and whose properties are such as to inhibit irreversible recording in the absorptive layer upon exposure to a recording or erasing light beam. The materials may be deposited on the reflective layer 18 using electron beam evaporation techniques. Alternatively, organic materials which can form a smooth coating substantially free of defects and which have the requisite inhibiting properties may also be used. These materials may be deposited on the reflective layer using evaporation, spin coating or glow discharge deposition techniques.

The absorptive layer 22 is formed of a material which is capable of being reversibly switched from its original state to a second state having different optical properties at the readout

wavelength. By reversible in this case is meant the capability of being returned to about its original state, having about the original optical properties, by exposure to an erasing light beam or by exposure to heat. It is not necessary that the optical properties at the recording or erasing wavelengths change, but only that the absorptive layer in the second state absorb light at the erasing wavelength. The change in the optical properties may include a change in the index of refraction, the extinction coefficient, a combination of these two or a change in the higher order optical constants, for example, the magneto-optic or electro-optic coefficients which may arise from a domain reversal. The change in the optical properties will lead to a detectable change in the amount of light reflected from the information record.

Classes of materials which can undergo reversible changes in their optical properties upon exposure to a recording or erasing light beam include photochromic materials, such as doped CaF_2 and $CaTiO_3$ and organic compounds; magneto-optic materials such as MnBi and PtCo; and materials which undergo a lattice phase transition where the degree of crystallinity of the material changes. Examples of this last type of material include tellurium, selenium, tellurium or selenium-based chalcogenide alloys, arsenic trisulfide, and arsenic triselenide. These materials may be deposited by appropriate techniques such as vacuum evaporation.

After exposure to the atmosphere some of these materials will oxidize leaving an absorbing layer which is thinner than the layer originally deposited. This effect may be compensated for by depositing a layer which is thicker than that desired, with the subsequent oxidation reducing the effective thickness to the desired value.

In the monolayer structure the thickness of the absorptive layer is chosen to provide a balance between absorption and reflection of the recording and readout light beam. Typically the thickness of the absorptive layer is between about 10 and about 100 nanometers.

In the bilayer structure the thickness of the absorptive layer is chosen so as to reduce the reflectivity of the recording medium at the wavelengths of the recording and readout light beams and preferably to minimize the reflectivity at these wavelengths. Typically this thickness is between about 5 and about 100 nanometers. For example, for a structure having an aluminum reflective layer and

an absorptive layer having about 90% selenium, the thickness of the absorptive layer is about 20 nanometers when the reflectivity is minimized at a wavelength of 488 nanometers.

In the trilayer structure the thickness of the absorptive layer is so related to the thickness of the spacer and capping layers and the optical constants of the reflective, spacer, absorptive, capping and overcoat layers, that the reflectivity of the unexposed recording medium at the recording wavelength is reduced. Preferably, the recording and readout wavelengths are the same and the reflectivity is reduced to a minimum corresponding to the anti-reflection condition. Then a change in the optical properties of the absorptive layer at the reading wavelength will result in an increase in the reflectivity of the recording medium.

The optimal values of the thicknesses of the spacer and absorptive layers can be calculated using, for example, the matrix method as discussed in "Optical Properties of Thin Solid Films" by O. S. Heavens, Dover Publications, Inc., New York, 1965, p. 69.

Alternatively, useful values of the thicknesses of the spacer and absorptive layers can be obtained by depositing the spacer layer as above and then depositing the absorptive layer while monitoring the reflectivity of the recording medium at the recording wavelength. The spacer layer is at least 10 nanometers thick, may be up to about 500 nanometers thick and is typically from about 10 to 150 nanometers thick. Typical values for the thickness of the absorptive layer are from about 1 nanometer to about 60 nanometers.

The capping layer 24 may be formed of a material which is chemically unreactive with respect to the absorptive layer 22 and the overcoat layer 26 and whose properties are such as to inhibit irreversible recording in the absorptive layer upon exposure to a recording or erasing light beam. We believe that mechanical rigidity of the capping and the material underlying the absorptive layer layers is the most important characteristic for inhibiting the formation of an opening or other deformation of the absorptive layer. Preferred materials for this layer include silicon dioxide, silicon monoxide, titanium dioxide and aluminum oxide which may be deposited using electron beam deposition techniques. Other materials such as organic materials which have the requisite properties may also be useful in this application. The thickness of the capping layer is chosen

primarily so that it will inhibit the formation of an irreversible recording in the absorptive layer. Typically, the thickness of this layer is between about 100 and 1000 nanometers.

An overcoat layer 26, preferably between about 0.05 and about 1 millimeter thick, may be applied to the capping layer to eliminate or reduce signal defects caused by surface dust which precipitates from the environment onto the recording medium. Dust particles which lie on the upper surface of the overcoat layer are far removed from the focal plane of the optical system so that their effect on the recording and readout of information on the disc is considerably reduced. A useful material for this application is a silicone, acrylic or epoxy resin. Alternatively the capping layer thickness may be such that the capping layer can also function as the thick overcoat.

An information track may be formed in the information recording medium thereby forming an information record by exposing the recording medium described herein to a modulated recording light beam of sufficient intensity and time duration to change the optical properties of the absorptive layer. This change in the optical properties of the exposed regions in turn produces a change in local reflectivity of the recording medium at the readout wavelength. To record information at video rates, the recording process must be initiated within a time period of about 10 to 30 nanoseconds. The erasure process, the return of the recording medium to about its original state, can take longer. For example, the time for the crystalline-to-amorphous phase transition to be initiated in tellurium and related materials is limited by the rate at which the material is heated to about its melting point, and has been demonstrated to occur with nanosecond range exposure times. The time for the reverse amorphous-to-crystalline transition to occur is relatively slower, since it is limited by the crystal nucleation and growth rate of the crystalline phase. The rate of crystallization can be increased by heating the material to a temperature above its glass transition temperature where the time for recrystallization to occur is typically on the order of microseconds to milliseconds.

Information may be recorded in the information record by reducing the degree of crystallinity of the absorptive layer by exposure to the recording light beam. It is not necessary that the exposed region become completely amorphous since only partial

amorphization is enough to provide a sufficient change in the optical constants of the absorptive layer. It should be clear that the reverse process, of recording information by increasing the degree of crystallinity, is possible since only a change in the degree of crystallinity is necessary. The erasure would then consist in decreasing the degree of crystallinity or re-amorphizing the absorptive layer. This approach may be applicable where low data rates are used or where the growth rate of the crystallization upon heating is comparable with the recording rate.

The utility of the barrier layer of US Patent 4101907 was thought to lie in protecting a thick overcoat layer from thermal damage which results from the melting of a high melting temperature material such as titanium or rhodium. With a low melting temperature absorptive material, such as tellurium or other chalcogenide material, the barrier layer was not required since the heat generated in the melting process does little or no damage to the overcoat layer. The surprising result in the combination of a capping layer with an information recording medium using a tellurium, selenium or a chalcogenide alloy is that, in the resulting structure, information can be recorded and erased over a substantial range of recording light beam powers without irreversibly recording information such as by the formation of openings or other permanent deformations in the absorptive layer.

The role of the capping layer in the present recording process is primarily to inhibit the formation of an opening or other permanent deformation in the absorptive layer during the time period when the absorptive layer is melted. The inhibiting function of the capping layer is limited in that with increasing recording power, a point is eventually reached where an opening or other deformation is formed which renders the process irreversible.

FIG. 5 shows a schematic illustration of an optical recording, reading and erasing system for use with the information record of the invention. The apparatus comprises a recording light source 62 which may be a laser or a light emitting diode; coupled to the recording light source is an input signal source 64 for modulating the recording light source. The modulated light beam emitted by the recording light source 62 is collected and shaped to match the objective lens 68 using the recording optics 66. The modulated beam then enters suitable beam steering means 70; and then enters

the objective lens 68 where it is focused on the recording medium or information record 74. Relative motion of the recording medium 74 and the objective lens 68 may be imparted by means of a turntable drive 76 and radial translation means (not shown). A focus servo 78 detects the spacing between the objective lens 68 and the recording medium 74 and adjusts the spacing so as to maintain the focus of the light beam on the recording medium. As the recording medium 74 moves through the modulated recording beam a series of alternating exposed and unexposed regions is formed in the recording medium where the exposed regions have different optical properties.

An information track contained in the recording medium 74 may be read out by using a readout light source and optics (not shown) which can be either separate from or the same as the recording light source and optics or erasing light source and optics. The readout light source produces a continuous wave light beam which is focused onto the recording medium 74, is modulated by the varying reflectivity of the information track, is collected by the objective lens and propagates through the beam steering means into the playback optics 80 where it is shaped for detection by the photodetector 82 and conversion to an electrical signal at the output signal terminal 84.

Light from the playback optics 80 is also coupled into the tracking servo 86 which generates an error signal proportional to the difference between the position of the light beam on the information recording medium 74 and an information track recorded therein. This error signal is coupled to the beam steering means 70 to make the radial correction of the position of the reading light beam to maintain the focused light beam on the information track.

The light beam emitted by an erasing light source 88 is collected and shaped by erasing optics 90 and then coupled via suitable beam steering means 70 into the optical path. The beam passes into the objective lens 68 where it is focused on the information track, contained in the recording medium 74, which is to be erased. The information track is exposed to an erasing light beam of sufficient power and duration to return the absorptive layer in the exposed regions to about its original state. The erasure may be done in a single exposure, slowing the turntable drive 76 if necessary, or by repeated exposures of the track.

It is to be noted that the recording, readout and erasing light sources can be the same source with the intensity and modulation characteristics of the light source changed for the particular use.

A method of reversibly recording an information track comprises the steps of:

(a) recording an information track by exposing the information recording medium disclosed herein to a modulated recording light beam such that regions of the absorptive layer are reversibly switched to a second state having different optical properties whereby the reflectivity of the information recording medium in the regions so switched is changed, thereby forming an information track in the information recording medium;

(b) erasing the information track by exposing the switched regions to a light beam such that those regions so switched are reversibly switched to a state having about the original optical properties; and

(c) exposing the information recording medium in the regions so erased to a modulated light beam such that regions of the absorptive layer are reversibly switched to a second state having different optical properties thereby forming a new information track in the information recording medium.

For those materials for which the erasure process is thermal in nature, the entire information record can be erased by flood exposure of the absorptive layer to an erasing light beam or by removal of the record from the apparatus and heating with an external source such as an oven. If the erasure process involves recrystallization of regions of the recording medium then the absorptive layer may be heated to a temperature between its glass transition temperature and its melting temperature to speed the erasure process.

EXAMPLE 1

A trilayer information recording medium fabricated according to the principles of the invention included a polyvinylchloride substrate coated with an acrylic resin subbing layer (Future TM acrylic finish manufactured by S.C. Johnson, Inc., Racine, Wisc.) between 10 and 25 micrometers thick, an aluminum reflective layer about 80 nanometers thick, a silicon dioxide spacer layer 62 nanometers thick, a tellurium absorptive layer 5.5 nanometers thick and a silicon dioxide capping layer 167 nanometers thick. The

reflectivity of this medium at the recording, readout and erasing wavelength of 488 nanometers was about 10 percent.

This medium was tested in an optical system having a focussed light beam spot size of about 0.4 by 0.6 micrometers. The recording light beam power incident on the medium was about 7 milliwatts. For erasure an incident light beam power of about 3 milliwatts for about 30 seconds was used. At these power levels 52 cycles of recording, readout and erasure were made with little or no degradation in the quality of the video information recorded with a signal-to-noise ratio (peak-to-peak signal to rms noise in a 4.5 MHz bandwidth) of 45 dB.

EXAMPLE 2

A bilayer information recording medium fabricated according to the principles of the invention included a polyvinylchloride substrate coated with the same acrylic resin subbing layer as in Example 1, an aluminum reflective layer about 80 nanometers thick, a Se_{90} Te_5 As_5 absorptive layer about 20 nanometers thick and a ultra-violet light cured epoxy (Polyrad UV59 manufactured by Polymer Industries, Stamford, Conn.) capping layer between about 80 and 120 micrometers thick. The reflectivity of this medium was several percent at 488 nanometers.

Using the optical system described above five record, read, erase and re-record cycles were made with an incident recording power of about 16 milliwatts, a readout power of about 0.3 milliwatt and an erase power of about 2 milliwatts. The signal-to-noise ratio, as defined in Example 1, was about 40 dB for each recording.

CLAIMS:

1. A reversible information record comprising:

a substrate;

an absorptive layer, overlying the substrate, of a material which is absorptive of light at the wavelengths of a recording, readout and an erasing light beam, which may be reversibly switched to a state having different optical properties and which has an information track therein; and

a capping layer overlying the absorptive layer of a material which is substantially transparent at the wavelengths of the recording, readout and erasing light beams;

wherein the material of the capping layer is effective for inhibiting the formation of an irreversible recording in the absorptive layer upon exposure of the information record to a recording or erasing light beam; and

wherein the information track comprises a series of regions in the absorptive layer which have been reversibly switched to a state having different optical properties whereby the reflectivity of the information record is changed in these regions, with variations in either or both the length of these regions along the track and the spacing between successive regions being representative of the recorded information.

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2. A reversible information record comprising:

a substrate;

an absorptive layer, overlying the substrate, of a material which is absorptive of light at the wavelengths of a recording, readout and an erasing light beam, which may be reversibly switched to a state having a different degree of crystallinity whereby the reflectivity of the information record is changed in those regions so switched, and which has an information track therein;

a capping layer, overlying the absorptive layer, of a material which is substantially transparent at the wavelength of the recording, readout and erasing light beams;

wherein the capping layer is effective for inhibiting the formation of an irreversible recording in the absorptive layer upon exposure of the information record to a recording or erasing light beam; and

wherein the information track in the absorptive layer comprises a series of regions in the absorptive layer having a different degree of crystallinity than the remainder of the layer whereby the reflectivity of the information record is changed in these regions, with variations in either or both the length of these regions along the track and the spacing between successive regions being representative of the recorded information.

3. An information record according to claims 1 or 2 further comprising a reflective layer interposed between the absorptive layer and the substrate and wherein the thickness of the absorptive layer is so related to the optical constants of the reflective, absorptive and capping layers that the reflectivity of an unexposed portion of the information record is reduced

as compared with what its reflectivity would be for other relative thicknesses of the absorptive layer.

4. An information record according to claim 3 further comprising, between the absorptive layer and the reflective layers, a spacer layer which is substantially transparent at the wavelengths of the recording and readout light beams.

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5. An information record according to claim 4 wherein the thickness of the absorptive layer is so related to the thickness of the spacer and capping layers and the optical constants of the reflective, spacer, absorptive and capping layers that the reflectivity of the information record is detectably different in regions in the absorptive layer which have been switched in state and not so switched.

6. An information record according to claim 3 wherein the reflective layer is a material selected from the group consisting of aluminum and gold.

7. An information record according to claim 4 wherein the thicknesses of the spacer, absorptive and capping layers are such that the reflectivity of the unexposed portions of the information record is minimized.

8. An information record according to claim 4 wherein the spacer layer is between about 10 nanometers and about 500 nanometers thick and the absorptive layer is between about 1 nanometer and about 60 nanometers thick.

9. An information record according to claim 8 wherein the spacer layer is comprised of a material selected from the group consisting of silicon dioxide, silicon monoxide, aluminum oxide and titanium dioxide.

10. An information record according to claim 1 or 2 wherein the absorptive layer is comprised of a material selected from the group consisting of tellurium, tellurium based alloys, selenium, selenium based alloys, arsenic trisulfide and arsenic triselenide.

11. An information record according to claim 1 or 2 wherein the thickness of the capping layer is between about 100 nanometers to about 1000 nanometers.

12. An information record according to claim 11 wherein the capping layer is comprised of a material selected from the group consisting of silicon dioxide, silicon monoxide, aluminum oxide and titanium dioxide.

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13. An information record according to claim 2 wherein the degree of crystallinity of those regions of the absorptive layer exposed to the recording light beam is less than that of unexposed regions of the absorptive layer.

14. An information record according to claim 1 or 2 further comprising an overcoat layer overlying the capping layer.

15. An information record according to claim 14 wherein the thickness of the overcoat layer is between about 0.05 and about 1.0 millimeters.

16. A method of reversibly recording an information track in an information recording medium, comprising a substrate, an absorptive layer, overlying the substrate, of a material which is absorptive of light at the wavelength of a recording, readout and an erasing light beam, and which may be reversibly switched to a second state having different optical properties, and a capping layer, overlying the absorptive layer, which is substantially transparent at the wavelength of a recording, readout and erasing light beams and which is effective for inhibiting the formation of an irreversible change in the absorptive layer upon exposure of the recording medium to the recording and erasing light beam, which method comprises the steps of:

(a) recording an information track by exposing the information recording medium to a modulated recording light beam so that regions of the absorptive layer are reversibly switched to a second state having different optical properties whereby the reflectivity of the optical recording medium in the regions so switched is changed, thereby forming an information track in the optical recording medium;

(b) erasing the information track by exposing the switched regions to a light beam so that those regions in the second state are reversibly switched to a state having about the original optical properties; and

(c) exposing the information recording medium in the regions so erased to a modulated light beam so that regions of the absorptive layer are reversibly switched to a second state having different optical properties thereby forming a new information track in the information recording medium, the exposure in each step being effected through the capping layer.

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17. The method according to claim 16 wherein the step of exposing the information recording medium causes a change in the degree of crystallinity of the absorptive layer in the regions so exposed.

18. The method according to claim 17 wherein the step of erasing the information track causes a change in the degree of crystallinity of the absorptive layer in the region erased to about its unexposed state.

19. A method of reversibly erasing information recorded in an information record, comprising a substrate, an absorptive layer, overlying the substrate, of a material which is absorptive of light at the wavelengths of the recording, readout and an erasing light beams, which may be reversibly switched to a state having a different degree of crystallinity whereby the reflectivity of the information record is changed in those regions so switched, and which has an information track therein, a capping layer, overlying the absorptive layer, of a material which is substantially transparent at the wavelength of the recording, readout and erasing light beams and which is effective for inhibiting the formation of an irreversible recording in the absorptive layer upon exposure of the information record to a recording or erasing light beam, which method comprises the step of heating the absorptive layer to a temperature range wherein those regions of the absorptive layer containing the information track are returned to about their original degree of crystallinity.

20. A method according to claim 19 wherein the temperature range is between the glass transition temperature and the melting temperature of the absorptive layer.

21. The method according to claims 16 or 19 wherein the information recording medium further comprises a reflective layer, which reflects light at the wavelength of the recording and readout light beams, interposed between the substrate and the absorptive layer.

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22. The method according to claim 21 wherein the information recording medium further comprises a spacer layer, which is substantially transparent at the wavelength of the recording and readout light beams, interposed between the reflective and absorptive layers.

23. A reversible information record substantially as hereinbefore described with reference to the accompanying drawing.

24. A method of reversibly recording an information track in an information recording medium substantially as hereinbefore described.

25. A method of reversibly erasing information recorded in an information record substantially as hereinbefore described.

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