

PACKAGE FOR A GLASS SUBSTRATE FOR A MAGNETIC DISK, METHOD OF PACKAGING A GLASS SUBSTRATE FOR A MAGNETIC DISK AND METHOD OF MANUFACTURING A MAGNETIC DISK

Technical Field

This invention relates to a package for a glass substrate for a magnetic disk, a method of packaging a glass substrate for a magnetic disk, and a method of manufacturing a magnetic disk.

Background Art

In recent years, the information recording technique, particularly the magnetic recording technique, has remarkably advanced following the development of information technology. With the reduction in size and thickness and the increase in recording density of magnetic disks, glass substrates excellent in substrate surface flatness and substrate strength have started to be used as substrates for magnetic recording media such as HDDs (hard disk drives) being one of the magnetic recording media, instead of aluminum substrates that have conventionally been widely used.

Further, following the increase in density of the magnetic recording technique, magnetic heads have also shifted from thin film heads to magnetoresistive heads (MR heads) and giant magnetoresistive heads (GMR heads), wherein the flying height of a magnetic head from a substrate has reduced to about 20nm to 5nm. There are instances where such a magnetic head mounted with a magnetoresistive effect element causes, as its inherent failure, the head crash failure or thermal asperity failure. Since these failures occur due to minute irregularities on the surface of a magnetic disk, the surface

of the magnetic disk is required to have extremely high-level smoothness and flatness.

A glass substrate for such a magnetic disk attaching importance to the smoothness and flatness as described above hates contamination caused by adhesion of particles due to dust or the like to the surface of the glass substrate. This is because if a magnetic layer is formed on a glass substrate contaminated with particles, corrosion occurs to cause the head crash failure or thermal asperity failure. Therefore, the operation of forming magnetic layers on the surfaces of glass substrates is normally carried out in a clean room.

Herein, there arises a problem of particles that adhere to the glass substrates while transporting the manufactured glass substrates to the clean room.

As a prior art handling magnetic disks, not glass substrates, as packaging objects, there is one wherein magnetic disks are transported while being placed in a receiving container and double packaged with a first packaging bag and a second packaging bag (see, e.g. Japanese Unexamined Patent Application Publication (JP-A) No. H11-157591 (Patent Document 1)). According to this package, since the magnetic disks are sealed in the packaging bags, it is possible to prevent invasion of particles or foreign matter into the packaging bags.

Further, there has been proposed a technique of preventing contamination of glass substrates during transportation by the use of a packaging bag made of a material, for example, as that in Japanese Unexamined Patent Application Publication (JP-A) No. 2001-240178 (Patent Document 2). In Patent Document 2, glass substrates are sealingly packaged along with a holder using a packaging member having a water vapor permeability of $5\text{g/m}^2 \cdot \text{day}$ or less, thereby preventing degradation of the main surfaces of the glass substrates during transportation, storage, or the like.

Disclosure of the Invention

Although the packaging techniques for preventing contamination of magnetic disks have been proposed in Patent Document 1 and so on, there has not been discovered means for completely preventing adhesion of particles to glass substrates. In the case where a glass substrate is a packaging object, there is an inherent problem different from the case of a magnetic disk. That is, even if packaged, water vapor or the open air contacts the glass substrate so that ions at the surface of the glass substrate are released to disrupt the ion balance or there is even a possibility that the surface is roughened due to oxidation.

It is therefore an object of this invention to provide a package for a magnetic-disk glass substrate, a magnetic-disk glass substrate packaging method, and a magnetic disk manufacturing method that can more reliably prevent adhesion of dust or foreign matter to the glass substrate during transportation and a change in state of the surface of the glass substrate.

As a result of diligent studies on the above problem, the inventors of this application have found that the most effective method for improving the glass substrate yield rate at this stage is to strengthen packaging means during glass substrate transportation in which the possibility is high that particles adhere to a glass substrate or its surface state changes, and have come to complete this invention.

In order to achieve the above object, a package for a magnetic-disk glass substrate according to a mode of this invention is characterized by comprising a case for placing therein one or more magnetic-disk glass substrates, a first packaging bag that is made of a metal laminate film and seals the case in a degassed state, and a second packaging bag that is made of a plastic film and seals in a degassed state the first packaging bag further from its

outside.

According to the above structure, the outside second packaging bag with dust adhering thereto is first unpackaged before transferring the glass substrate into a clean room. Then, the inside first packaging bag is unpackaged and the glass substrate placed in the case is transferred into the clean room. Since the package is double packaged, when the second packaging bag is unpackaged as described above, it is possible to almost completely remove the dust that adheres during transportation.

Further, since both packaging bags are degassed and sealed, permeation of water vapor or gas is effectively prevented. Since the metal laminate film has a higher shielding property against water vapor or gas than the plastic film, the effect of the above shielding property can be obtained more effectively by using the metal laminate film as the inside first packaging bag. As a metal of the metal laminate, use can be suitably made of, instead of aluminum, a stainless material, chromium, a steel plate subjected to chromic-acid treatment, phosphoric-acid treatment, chromate treatment, or plating with nickel, tin, or zinc, or the like.

It is also considered to use the metal laminate film for both the first packaging bag and the second packaging bag. However, the metal laminate film has a complicated structure as compared with a plastic film such as a polyethylene film and thus there is a possibility that the material cost rises sharply. Therefore, by realizing shielding of water vapor or gas with the first packaging bag made of the metal laminate film and preventing invasion of dust and most of water vapor with the second packaging bag made of the plastic film, it is possible to suppress the material cost to be low while ensuring the packaging performance.

It is preferable that the second packaging bag directly package the first packaging bag and four corners of the first packaging bag each be rounded or

each have an obtuse angle. By this, it is prevented that the outside second packaging bag is torn due to the pointed shape of the four corners of the inside strong first packaging bag.

That is, the metal laminate film has high hardness and the hardness increases at edge portions thereof because the edge portions are heat-sealed (bonded under heat and pressure) to lose flexibility. On the other hand, the plastic film forming the second packaging bag as the outer bag has high flexibility and thus cannot obtain so much strength. In addition, if the second packaging bag is also degassed, it is brought into tight contact with the first packaging bag so that the corners of the first packaging bag repeatedly contact the same portions of the second packaging bag due to vibration or external pressure during transfer, and thus there is a possibility of finally tearing the second packaging bag.

In Patent Document 1, double packaging is carried out with the first and second packaging bags and, for preventing tearing of the bag, a box-shaped case is interposed between the first and second packaging bags. The interposition of such a case requires time and labor for unpackaging and further causes an increase in weight during transportation, which is thus not preferable.

On the other hand, by chamfering (rounding) the four corners of the first packaging bag, even if the second packaging bag directly packages the first packaging bag and both are in tight contact with each other, it is possible to effectively prevent the tearing. Experimentally, the chamfering of the corners of the first packaging bag is satisfactory if, although depending on the strength of the second packaging bag, the radius of curvature is about 1/10 of the width of the heat-sealed portion.

The first packaging bag preferably comprises a polyethylene film, an aluminum film, a drawn nylon film, and a polyethylene terephthalate film.

By laminating these materials, the water vapor permeability and the

oxygen permeability can be reduced as described below.

The water vapor permeability of the first packaging bag is preferably $0.1\text{g/m}^2 \cdot \text{day}$ or less. This is because, by setting the water vapor permeability to such a value, it is prevented that the glass substrate is exposed to moisture and contaminated and that the state of the surface changes.

The oxygen permeability of the first packaging bag is preferably $0.1\text{cc/m}^2 \cdot \text{day}$ or less. This is because, as in the case of using the packaging bag with the low water vapor permeability, if the packaging bag with the low oxygen permeability is used, it is possible to prevent a change in state of the surface of the glass substrate.

In order to achieve the above object, a magnetic-disk glass substrate packaging method according to a mode of this invention is characterized by placing one or more magnetic-disk glass substrates in a case, sealing the case with a first packaging bag, in a degassed state, made of a metal laminate film, and sealing the first packaging bag further from its outside with a second packaging bag, in a degassed state, made of a plastic film.

Further, in order to achieve the above object, a magnetic disk manufacturing method according to a mode of this invention is characterized by performing a film forming step of forming at least a magnetic layer on a magnetic-disk glass substrate packaged using the above package.

The constituent components and the explanation thereof based on the technical idea of the package for the magnetic-disk glass substrate described above are also applicable to the magnetic-disk glass substrate packaging method and the magnetic disk manufacturing method.

According to this invention, it is possible to transfer a glass substrate into a clean room where formation of a magnetic layer is carried out, in the state where adhesion of dust or foreign matter to the glass substrate during transportation is prevented more reliably. Further, there is no occurrence of a

change in state of the surface of the glass substrate due to contact of the glass substrate with moisture or the open air during transportation. As a result, the yield rate of magnetic disks as final products is improved.

Brief Description of the Drawings

Fig. 1 illustrates a glass substrate for a magnetic disk according to an embodiment of this invention, wherein (a) is a perspective view and (b) is a sectional view taken along line X-X in (a);

Fig. 2A is a perspective view for explaining a method of placing glass substrates in a case;

Fig. 2B is a perspective view of a state where a plurality of cases with glass substrates placed therein are stacked and adjacently disposed;

Fig. 3A is a perspective view showing a state where the plurality of cases with the glass substrates placed therein are packaged with a first packaging bag;

Fig. 3B is a perspective view showing a state where the plurality of cases with the glass substrates placed therein are packaged with a second packaging bag in addition to the first packaging bag;

Fig. 4A is a sectional view for explaining one example of the size of the first packaging bag;

Fig. 4B is an enlarged view illustrating only a portion 4b in Fig. 4A;

Fig. 5 is a schematic view for explaining a laminate structure of the first packaging bag;

Fig. 6 is a list showing the properties of the first packaging bag; and

Fig. 7 is a table showing the results of conducting endurance tests in a hot and humid environment for a double package including the first and second packaging bags and a single package as a comparative example.

Mode for Carrying Out the Invention

First, referring to Fig. 1, a glass substrate for a magnetic disk according to an embodiment of this invention will be described.

The magnetic-disk glass substrate 100 has a disk shape with an inner hole formed at the center thereof. Each of main surfaces 110 is a region for recording/reproducing information and thus is substantially smooth for allowing a recording head to fly thereover.

The magnetic-disk glass substrate 100 comprises the main surfaces 110 that will serve as information recording/reproducing regions, an end face 120 perpendicular to the main surfaces 110, and chamfered faces 130 interposed between the main surfaces 110 and the end face 120, respectively. Since it may happen that the boundary between the end face 120 and each chamfered face 130 becomes unclear by a later-described end face polishing process, this embodiment also includes a case where the end face 120 and the chamfered faces 130 on both sides thereof cooperatively form one curved surface.

If particles or foreign matter adheres to the magnetic-disk glass substrate 100, particularly to the main surfaces 110 thereof, before a magnetic-disk film forming process, smooth magnetic layers cannot be formed on the glass substrate in the film forming process and thus the yield rate of magnetic disks as final products decreases.

Referring to Figs. 2A and 2B, a description will be given of a method of storing glass substrates 100.

A case 200 is a generally rectangular parallelepiped container made of plastic and can accommodate 25 glass substrates 100. As shown in Fig. 2A, the glass substrates 100 are placed in the case 200 in the state where they are adjacent to each other in a thickness direction thereof. A plurality of, for example, four, cases 200 with the glass substrates 100 placed therein can be

stacked (or adjacently arranged) as shown in Fig. 2B. The number of glass substrates 100 placed in the case 200 may be one or more and is not particularly limited.

Referring also to Figs. 3A and 3B, a description will be given of a packaged state of the cases with the glass substrates placed therein.

The plurality of cases 200 with the glass substrates 100 placed therein are, in the state of being stacked as shown in Fig. 2B, first packaged with a degassed first packaging bag 210 in the form of a metal laminate film so as to be sealed in a degassed state, thereby obtaining a package 212 as shown in Fig. 3A. Then, as shown in Fig. 3B, the first packaging bag 210 is further packaged with a second packaging bag 220 in the form of a plastic film directly from the outside so as to be sealed in a degassed state, thereby obtaining a double package 222. This plastic film may be, for example, polyethylene. Although the plurality of cases 200 are packaged in the state of being stacked (or adjacently arranged) in this embodiment, packaging may be carried out per case 200.

According to the above configuration, with respect to unpackaging, the outside second packaging bag 220 with dust adhering thereto is first unpackaged before transferring the glass substrates 100 into a clean room. Then, the inside first packaging bag 210 is unpackaged and the glass substrates placed in the cases 200 are transferred into the clean room. Since the package is double packaged, when the second packaging bag 220 is unpackaged as described above, it is possible to almost completely remove the dust that adheres during transportation.

Further, since both packaging bags 210 and 220 are degassed and sealed, permeation of water vapor or gas is effectively prevented. The degassing may be carried out after filling an inert gas such as nitrogen.

Referring to Figs. 4 and 4B, one example of the size of the first

packaging bag will be described.

Herein, the longitudinal and transverse size of the first packaging bag is set to 500mm×400mm and the width of a heat-sealed portion 170 is set to 10mm. These numerical values are only illustrative. As shown in the same figures, four corners of the first packaging bag 210 are each rounded into a curved shape with a radius of curvature of 1mm. Alternatively, the corners each may have an obtuse angle. By this, even when the second packaging bag 220 directly packages the first packaging bag 210 so that both are in tight contact with each other, the outside second packaging bag 220 is prevented from being torn due to the pointed shape of the four corners of the inside strong first packaging bag 210. The reason for setting the radius of curvature to 1mm is that if each corner is rounded with the radius of curvature about 1/10 of the width of the heat-sealed portion 170, it is sufficient to ensure the tearing preventing function.

The packaging bag 210 is heat-sealed at the hatched portion 170 along three sides thereof. After enclosing an object, the bag is degassed and heat-sealed at an opening portion 180, thereby sealing the enclosed object.

Referring to Fig. 5, the laminate structure of the first packaging bag will be described.

In this embodiment, as described above, the first packaging bag 210 is made of the metal laminate film. In this application, if a film comprises a plurality of stacked films and at least one of them is a metal film, the film is called a metal laminate film. Specifically, as shown in Fig. 5, the first packaging bag 210 comprises, from the inside, a polyethylene film 410, an aluminum film (metal film) 420, a drawn nylon film 430, and a polyethylene terephthalate film 440 that are stacked together.

By laminating these materials in the above order, the water vapor permeability and the oxygen permeability can be reduced as described below.

Referring to Fig. 6, the properties of the aluminum laminate film of Fig. 5 will be described.

In Fig. 6, particularly, attention should be paid to the fact that the first packaging bag 210 has a water vapor permeability of $0.1\text{g/m}^2 \cdot \text{day}$ or less and an oxygen permeability of $0.1\text{cc/m}^2 \cdot \text{day}$ or less. By setting the water vapor permeability and the oxygen permeability to such values, it is possible to reliably avoid a change in state of the surface of the glass substrate 100 otherwise caused by a chemical change due to exposure of the glass substrate 100 to moisture.

Besides, the heat seal strength is $24.5\text{N}/15\text{mm}$. This heat seal strength is obtained by double heat sealing. The double heat sealing is a method of performing the first heat sealing along a certain line and further performing the second heat sealing along a line outside the certain line with respect to the portion 170 shown in Fig. 4 while performing degassing.

The glass substrates 100 packaged as described above are shipped from a glass substrate manufacturing plant and transported to a magnetic disk manufacturing plant. After arrival at the magnetic disk manufacturing plant, unpacking processes are carried out.

Of the double packaging bags of the double package 222, the second packaging bag 210 serving as the outside packaging bag is unpackaged in a predetermined room (illustration omitted), thereby obtaining the package 212. This predetermined room is adjacent to another room (illustration omitted) and the air flow is preferably directed from this another room.

The first packaging bag 210 of the package 212 is unpackaged in this other room. This other room is an intermediate room adjacent to the predetermined room and to the clean room in which a production line is provided, wherein the air flow is generated so as to be directed toward the predetermined room.

(Example)

Hereinbelow, a description will be given of an Example about a magnetic-disk glass substrate manufacturing method, a magnetic-disk glass substrate, and a magnetic disk, to which this invention is applied.

Magnetic-disk glass substrates 100 to be packaged are intended to be manufactured as 2.5-inch disks. Alternatively, the glass substrates 100 may be manufactured as magnetic disks having a predetermined shape, such as 0.8-inch disks (inner diameter 6mm, outer diameter 21.7mm, thickness 0.381mm), 1.0-inch disks (inner diameter 7mm, outer diameter 27.4mm, thickness 0.381mm), or 1.8-inch magnetic disks (inner diameter 12mm, outer diameter 48mm, thickness 0.508mm). The glass substrates 100 may alternatively be applied to 3.5-inch disks, but substrates not made of glass, such as aluminum substrates, are not intended as packaging objects.

(1) Shaping Process and First Lapping Process

In this embodiment, as a material of glass substrates 100, there can be cited sodalime glass, aluminosilicate glass, borosilicate glass, crystallized glass, or the like. Among them, the aluminosilicate glass is preferable. Since the aluminosilicate glass can obtain smoothness and high rigidity, the magnetic spacing, particularly the flying height of a magnetic head, can be reduced more stably. Further, the aluminosilicate glass can obtain high rigidity and strength by chemical strengthening.

First, molten aluminosilicate glass was formed into a disk shape by direct pressing using upper, lower, and drum molds, thereby obtaining an amorphous plate-like glass. As the aluminosilicate glass, use was made of a glass for chemical strengthening. Other than the direct pressing, disk-shaped magnetic-disk glass substrates 100 may be obtained by cutting them out, using a grindstone, from a sheet glass formed by a downdraw method or a float method. As the aluminosilicate glass, use was made of a chemical

strengthening glass containing, as main components, SiO_2 : 58 to 75wt%, Al_2O_3 : 5 to 23wt%, Li_2O : 3 to 10wt%, and Na_2O : 4 to 13wt%.

Then, lapping was applied to both main surfaces of the plate-like glass, thereby obtaining a disk-shaped glass base member. The lapping was carried out using a double-side lapping machine employing a planetary gear mechanism with the use of alumina-based free abrasive grains. Specifically, the lapping was carried out by pressing lapping surface plates onto both surfaces of the plate-like glass from the upper and lower sides, supplying a grinding fluid containing the free abrasive grains onto the main surfaces of the plate-like glass, and relatively moving them to each other. By this lapping, there was obtained the glass base member having the flat main surfaces.

(2) Cutting-Out Process (Coring, Forming)

Then, the glass base member was cut using a diamond cutter, thereby cutting out disk-shaped glass substrates from the glass base member. Then, using a cylindrical diamond drill, an inner hole was formed at a central portion of each glass substrate, thereby obtaining annular glass substrates 100 (coring). Then, grinding was applied to inner peripheral end faces and outer peripheral end faces 120 using diamond grindstones, thereby carrying out predetermined chamfering (forming).

(3) Second Lapping Process

Then, second lapping was applied to both main surfaces 110 of each of the obtained glass substrates 100 in the same manner as in the first lapping process. By performing this second lapping process, minute irregularities formed on the main surfaces in the cutting-out process or an end face polishing process as a previous process can be removed in advance, so that it becomes possible to complete a subsequent polishing process of the main surfaces 110 in a short time.

(4) End Face Polishing Process

Then, outer peripheral end face polishing of the glass substrates 100 was carried out. First, the end faces 120 were independently polished prior to chamfered faces 130. A polishing method may be, for example, a method of simultaneously polishing a plurality of the glass substrates 100 using a brush, but the machining allowance becomes large. Therefore, use may be made of, for example, a single-wafer polishing method.

Subsequently, the chamfered faces 130 were mirror-polished. By this, the difference in surface roughness of the chamfered faces 130 of each glass substrate 100 over the entire circumference fell within the range of $0.001\mu\text{m}$ or less. Then, the glass substrates 100 having been subjected to the end face polishing process were washed with water. By this end face polishing process, the end faces 120 of the glass substrates 100 were finished to a mirror surface state that can prevent precipitation of sodium and potassium.

In this Example, it has been described that the chamfered faces 130 were polished after the end faces were polished. However, this order is optional and it may be configured that the chamfered faces 130 are first polished and then the end faces 120 are polished.

Then, with respect to the inner peripheral end faces, it may be configured that a block is formed by stacking a number of the glass substrates and chamfered inner peripheral end portions are simultaneously polished using a brush roll. In this event, as polishing abrasive grains, use was made of a slurry (free abrasive grains) containing cerium oxide abrasive grains.

(5) Main Surface Polishing Process

A first polishing process was first carried out as a main surface polishing process. This first polishing process mainly aims to remove cracks or strains remaining on the main surfaces 110 during the above lapping processes. In this first polishing process, the main surfaces 110 were polished using a double-side polishing machine having a planetary gear mechanism with the use

of a hard resin polisher. Cerium oxide abrasive grains were used as a polishing material.

The glass substrates 100 having been subjected to the first polishing process were immersed in respective cleaning baths of neutral detergent, pure water, and IPA (isopropyl alcohol) in turn so as to be cleaned.

Then, a second polishing process was carried out as a main surface polishing process. This second polishing process aims to finish the main surfaces 110 into mirror surfaces. In this second polishing process, the main surfaces 110 were mirror-polished using a double-side polishing machine having a planetary gear mechanism with the use of a soft resin foam polisher. As a polishing material, use was made of cerium oxide abrasive grains finer than the cerium oxide abrasive grains used in the first polishing process.

The glass substrates 100 having been subjected to the second polishing process were immersed in respective cleaning baths of neutral detergent, pure water, and IPA (isopropyl alcohol) in turn so as to be cleaned. An ultrasonic wave was applied to each cleaning bath.

(6) Chemical Strengthening Process

Then, chemical strengthening was applied to the glass substrates 100 having been subjected to the above lapping processes and polishing processes. The chemical strengthening was carried out by preparing a chemical strengthening solution in the form of a mixture of potassium nitrate (60%) and sodium nitrate (40%), heating this chemical strengthening solution to 400°C and preheating the cleaned glass substrates 100 to 300°C, and immersing the glass substrates 100 in the chemical strengthening solution for about 3 hours. In order to chemically strengthen the entire surfaces of the glass substrates 100, the immersion was carried out in the state where the glass substrates 100 were placed in a holder so as to be held at their end faces 120.

By performing the immersion process in the chemical strengthening

solution as described above, lithium ions and sodium ions in the surface layers of each glass substrate 100 are replaced by sodium ions and potassium ions in the chemical strengthening solution, respectively, so that the glass substrates 100 are strengthened. The thickness of a compressive stress layer formed in each surface layer of each glass substrate 100 was about 100 μ m to 200 μ m.

The glass substrates 100 having been subjected to the chemical strengthening process were immersed in a water bath at 20°C so as to be rapidly cooled, and maintained for about 10 minutes. Then, the rapidly cooled glass substrates 100 were immersed in concentrated sulfuric acid heated to about 40°C, so as to be cleaned. Further, the glass substrates 100 having been subjected to the sulfuric acid cleaning were immersed in respective cleaning baths of pure water and IPA (isopropyl alcohol) in turn so as to be cleaned. An ultrasonic wave was applied to each cleaning bath.

By performing the first lapping process, the cutting-out process, the end face polishing process, the second lapping process, the first and second polishing processes, and the chemical strengthening process as described above, there were obtained the flat, smooth, and high-rigidity magnetic-disk glass substrates 100.

(7) Inspection Process

Smoothness inspection was conducted for the main surfaces 110 of the obtained magnetic-disk glass substrates 100. Using an apparatus such as a surface defect detection apparatus (AOI : Automatic Optical Inspection) or an OSA (Optical Surface Analyzer), the inspection process irradiates light onto the magnetic-disk glass substrate 100, measures one or both of the intensity and displacement of light reflected from the magnetic-disk glass substrate 100 to determine whether or not adhering matter, a concave portion, or a convex portion exists, and evaluates the substrate state.

(8) Packaging Process

25 magnetic-disk glass substrates 100 were placed in each of four cases 200, the four cases 200 were stacked, and a first packaging bag 210 made of an aluminum laminate film was sealed in a degassed state, thereby forming a package 212. Then, a second packaging bag 220 made of a plastic film was sealed in a degassed state further from the outside of the package 212, thereby forming a double package 222.

The double package 222 in which the glass substrates 100 were placed in the cases 200 and double packaged with the first packaging bag 210 and the second packaging bag 220 as described above is shipped from the glass substrate manufacturing plant and transported to the magnetic disk manufacturing plant by a ship, an airplane, a train, or the like.

(9) Unpackaging Process

Of the double package 222, the second packaging bag 220 serving as the outside packaging bag was unpackaged in a predetermined room, thereby forming the package 212. This predetermined room is adjacent to another room and the air flow is directed from this other room (illustration of the predetermined room and the other room is omitted).

The first packaging bag 210 of the package 212 was unpackaged in the other room. This other room is adjacent to the predetermined room and to the clean room in which the production line is provided, wherein the air flow is generated so as to be directed toward the predetermined room.

(11) Transfer-in Process

In order to perform a film forming process of forming magnetic layers on the glass substrates 100, the glass substrates 100 placed in the cases 200 were transferred into the clean room (illustration omitted) where the production line was provided.

[Evaluation]

A description will be given of effectiveness of this embodiment for the

glass substrates unpackaged by the above processes. In Fig. 7, the double package 222 being this embodiment and the single package 212 being a comparative example were left standing in a hot and humid (50°C/60%RH) environment for 5 days and then the number of particles adhering to the glass surfaces was counted using the surface defect detection apparatus (OSA6100) again (measurement was performed for 100 glass substrates for each). As a result, there is observed a clear difference in the count number of particles between this embodiment (double packaging) and the comparative example (single packaging) and there is obtained a result where the former shows high superiority as the packaging quality.

(12) Magnetic Disk Manufacturing Process (Film Forming Process)

This process is characterized by performing a film forming process of forming at least a magnetic layer on each of the magnetic-disk glass substrates packaged using the above package.

On each of both surfaces of each of the glass substrates 100 obtained through the packaging method and the manufacturing processes described above, an adhesive layer of a Cr alloy, a soft magnetic layer of a CoTaZr-group alloy, an underlayer of Ru, a perpendicular magnetic recording layer of a CoCrPt-group alloy, a protective layer of hydrogenated carbon, and a lubricating layer of perfluoropolyether were formed in this order, thereby manufacturing perpendicular magnetic recording disks. This structure is one example of the structure of a perpendicular magnetic disk. Magnetic layers and so on may be formed as an in-plane magnetic disk.

While the preferred embodiment of this invention has been described with reference to the accompanying drawings, it is needless to say that this invention is not limited thereto. It is obvious that a person skilled in the art can think of various changed examples or modified examples within the scope of claims and it is readily understood that those examples also belong to the

technical scope of this invention.

Industrial Applicability

This invention is applicable to a package for a magnetic-disk glass substrate, a magnetic-disk glass substrate packaging method, and a magnetic disk manufacturing method.

CLAIMS

1. A package for a magnetic-disk glass substrate, comprising:
a case for placing therein one or more magnetic-disk glass substrates,
a first packaging bag that is made of a metal laminate film and seals
said case in a degassed state, and
a second packaging bag that is made of a plastic film and seals in a
degassed state said first packaging bag further from its outside.
2. The package according to claim 1, wherein said second packaging
bag directly packages said first packaging bag and four corners of said first
packaging bag are each rounded or each has an obtuse angle.
3. The package according to claim 1 or 2, wherein said first packaging
bag comprises a polyethylene film, an aluminum film, a drawn nylon film, and a
polyethylene terephthalate film.
4. The package according to any one of claims 1 to 3, wherein said
first packaging bag has a water vapor permeability of $0.1\text{g/m}^2 \cdot \text{day}$ or less.
5. The package according to any one of claims 1 to 4, wherein said
first packaging bag has an oxygen permeability of $0.1\text{cc/m}^2 \cdot \text{day}$ or less.
6. The package according to any one of claims 1 to 5, wherein said
first packaging bag has a light-shielding property.
7. A magnetic-disk glass substrate packaging method, comprising:
placing one or more magnetic-disk glass substrates in a case,
degassing a first packaging bag made of a metal laminate film and
sealing said case with said first packaging bag, and
degassing a second packaging bag made of a plastic film and sealing
said first packaging bag further from its outside with said second packaging bag.
8. A magnetic disk manufacturing method, comprising:
preparing a magnetic-disk glass substrate packaged by using the

package according to any one of claims 1 to 6, and

performing a film forming step of forming at least a magnetic layer on said glass substrate.