

METHOD OF SUPPORTING MANUFACTURE OF A MAGNETIC DISK AND METHOD OF MANUFACTURING A MAGNETIC DISK

Technical Field

This invention relates to a method of supporting manufacture of 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 with adhering particles, convex defects containing the particles are formed on the surface of a magnetic disk 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.

For preventing such adhesion of particles, the manufactured glass substrates are, for example, placed in a container and double packaged with a first packaging bag and a second packaging bag, and thereafter, delivered to a magnetic disk manufacturing plant equipped with the clean room (see, e.g. Japanese Unexamined Patent Application Publication (JP-A) No. H11-157591 (Patent Document 1)). In this event, since the glass substrates 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 described 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:

However, only by devising the packaging method during transportation as in Patent Document 1 or Patent Document 2, there is a possibility that the glass substrates are contaminated when unpackaging the package and transferring the glass substrates into a clean room. There are instances where the packaged glass substrates are transported by a ship, an airplane, a train, or the like and thus are disposed in a space with much dust or exposed to the open air, and therefore, particles or foreign matter adheres to the packaging bag during delivery. There is a possibility that the glass substrates protected from the contamination during transportation are contaminated with such particles just before transfer into the clean room.

In a magnetic disk manufacturing process, cleaning is first carried out as a glass substrate receiving operation. Therefore, it has been considered that there is no big problem even if the particles are adhering to the unpackaged glass substrates. However, even if the cleaning is carried out in the receiving operation, it is not possible to remove all the particles and, thus, if the particles adhering from the beginning are large in amount, the amount of particles that remain on the substrate surfaces also increases. Further, there is also a possibility that the particles adhering to the substrate surfaces damage the substrate surfaces in the cleaning. Moreover, even small convex or concave defects (cracks) or the like that have not conventionally been a problem are becoming unacceptable in terms of a further increase in recording density toward the future. Accordingly, it is not possible to form smooth magnetic layers on the glass substrates in a film forming process and thus the yield rate of magnetic disks as final products decreases.

In view of the above problems, it is an object of this invention to provide a magnetic disk manufacture supporting method and a magnetic disk manufacturing method that can improve the yield of magnetic disks by preventing dust or foreign matter from adhering to glass substrates just before

transfer into a clean room and thus by forming magnetic layers on the glass substrates not contaminated with particles.

As a result of diligently studying a particle or foreign matter removing method in an unpackaging process, the inventors of this application have found that, by improving an unpackaging method just before transferring double-packaged glass substrates into a clean room and the environment of a room where the unpackaging is carried out, it is possible to prevent adhesion of particles or foreign matter to the glass substrates just before a film forming process to thereby form smooth magnetic layers on the glass substrates in the film forming process and thus to improve the yield rate of magnetic disks as final products, and have come to complete this invention.

In order to solve the above problems, a typical structure of a magnetic disk manufacture supporting method according to this invention is, in a magnetic disk manufacture supporting method for supporting manufacture of a magnetic disk that is manufactured from a magnetic-disk glass substrate double packaged with a first and a second packaging bag, characterized by comprising a first unpackaging step of unpackaging the first packaging bag in a first room, a second unpackaging step of unpackaging the second packaging bag in a second room, and a transfer-in step of transferring the magnetic-disk glass substrate into a clean room, wherein an air flow is directed from the second room toward the first room in the first unpackaging step and the second unpackaging step.

With this structure, most of particles or foreign matter adhering to the outside first packaging bag during transportation can be removed when unpackaging the first packaging bag in the first room and thus the amount of particles or foreign matter brought into the second room is reduced. Therefore, as compared with the case where the first packaging bag and the second packaging bag are unpackaged in the same room, it is possible to reduce the

amount of foreign matter or particles finally brought into the clean room. Further, by directing the air flow from the second room toward the first room, it is possible to prevent the particles or foreign matter scattered in the first room from entering the second room and to prevent adhesion of the dust or foreign matter to the inside second packaging bag still packaging the glass substrate. By unpackaging the second packaging bag, protected against adhesion of the dust in this manner, in the second room just before the clean room, the number of particles that adhere to the glass substrate is significantly reduced. Therefore, it becomes possible to improve the yield of magnetic disks.

Another structure of a magnetic disk manufacture supporting method according to this invention is, in a magnetic disk manufacture supporting method for supporting manufacture of a magnetic disk that is manufactured from a magnetic-disk glass substrate double packaged with a first and a second packaging bag, characterized by comprising a first unpackaging step of unpackaging the first packaging bag in a first room, a second unpackaging step of unpackaging the second packaging bag in a second room, and a transfer-in step of transferring the magnetic-disk glass substrate into a clean room, wherein a pressure in the second room is higher than a pressure in the first room.

With this structure, it is possible to generate an air flow directed from the second room toward the first room. Therefore, as described above, it becomes possible to prevent particles or foreign matter scattered in the first room in the first unpackaging step from entering the second room.

It is preferable that the air flow be generated by a fan. Using the fan, it is possible to forcibly generate the air flow directed from the second room toward the first room.

It is preferable that the pressure in the second room be set higher than the pressure in the first room by pressurization using an air compressor

(compressor).

By setting the pressure in the second room to be higher than the pressure in the first room using the air compressor, it is possible to generate the air flow directed from the second room toward the first room. It is preferable that the pressure in the first room be set lower than the pressure in the second room by pressure reduction using a pressure reducer.

By setting the pressure in the first room to be lower than the pressure in the second room using the pressure reducer, it is possible to generate the air flow directed from the second room toward the first room as described above.

In order to solve the above problems, a magnetic disk manufacturing method according to this invention is characterized by performing a film forming step of forming at least a magnetic layer over a surface of the glass substrate unpackaged by the magnetic disk manufacture supporting method described above.

The constituent components and the explanation thereof based on the technical idea of the magnetic disk manufacture supporting method described above are also applicable to the magnetic disk manufacturing method.

According to this invention, it is possible to provide a magnetic disk manufacture supporting method and a magnetic disk manufacturing method that can improve the yield of magnetic disks by preventing dust or foreign matter from adhering to glass substrates just before transfer into a clean room and thus by forming magnetic layers on the glass substrates not contaminated with particles.

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. 4 is a diagram for explaining rooms in which unpackaging processes are carried out; and

Fig. 5 is a diagram showing the results about the number of particles in an Example and Comparative Examples.

Mode for Carrying Out the Invention

Hereinbelow, a preferred embodiment of this invention will be described in detail with reference to the accompanying drawings. Sizes, materials, specific numerical values, and so on shown in the embodiment are only for illustrative purposes for facilitating understanding of the invention and are not intended to limit this invention unless otherwise specified. In this specification and the drawings, components having substantially the same functions and structures are assigned the same symbols to thereby omit duplicate explanation and, further, illustration of components not directly related to this invention is omitted.

First, referring to Fig. 1, a glass substrate for a magnetic disk according to the 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 a magnetic disk as a final product decreases.

Referring to Figs. 2A and 2B, a description will be given of a placed state of glass substrates in cases. Fig. 2A is an enlarged view of a generally rectangular parallelepiped glass substrate case made of plastic, serving as a container for storing glass substrates. A case 200 can accommodate 25 glass substrates and the glass substrates 100 are stored in the case 200. A plurality of cases 200 with the glass substrates 100 placed therein can be stacked as shown in Fig. 2B.

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 (four in this embodiment) cases 200 with the glass substrates 100 placed therein are, in the state of being stacked as shown in Fig.

2B, sealingly packaged with a second packaging bag 220 in the form of an aluminum laminate film while performing degassing, thereby forming a package 222 shown in Fig. 3A.

Thereafter, the package 222 is sealingly packaged with a first packaging bag 210 in the form of a plastic film in the state where degassing is performed or not performed, thereby forming a double package 212 shown in Fig. 3B. This plastic film may be, for example, polyethylene. Although the plurality of cases 200 are packaged in the state of being stacked in this embodiment, packaging may be carried out per case 200.

Next, a description will be given of a magnetic disk manufacture supporting method according to this embodiment.

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.

Fig. 4 is a diagram for explaining rooms in which the unpacking processes are carried out. The film forming process is carried out along a production line provided in a clean room 330. A room adjacent to the clean room 330 is a second room 320 for unpacking the second packaging bag and a room adjacent to the second room 320 on the side opposite to the clean room 330 is a first room 310 for unpacking the first packaging bag.

The double-packaged glass substrates 100, i.e. the double package 212, are transferred into the first room 310. Then, the outside first packaging bag 210 is unpackaged in the first unpacking process, thereby forming the package 222 packaged only with the second packaging bag 220. This package 222 is transferred into the second room 320 where the second packaging bag 220 is unpackaged in the second unpacking process. Thereafter, the glass substrates 100 are, in the state of being removed of the

packaging bags and placed in the cases 200, transferred into the clean room 330 in a later-described transfer-in process.

With this configuration, even if particles or foreign matter adhering to the first packaging bag 210 is scattered in the first room 310, since the second packaging bag 220 is unpackaged in the second room 320, it is possible to prevent adhesion of the particles or foreign matter to the glass substrates 100 when unpackaging the second packaging bag 220. Further, since the second room 320 is provided between the first room 310 and the clean room 330, it is possible to prevent invasion of the particles or foreign matter into the clean room 330.

Further, in Fig. 4, a fan 340 is provided in the first room 310 so that an air flow is generated by discharging the air in the first room 310 to the outside to thereby cause the air to flow from the second room 320 into the first room 310. In this manner, by generating the air flow directed from the second room 320 toward the first room 310, even if the particles or foreign matter adhering to the first packaging bag 210 is scattered in the first room 310, it is possible to reduce invasion of the particles or foreign matter from the first room 310 into the second room 320.

The fan 340 is provided in the first room 310 in this embodiment, but may be provided in the second room 320 or in each of the first room 310 and the second room 320. Further, as another means for generating the air flow described above, there is cited a method of providing a difference between the pressure in the first room 310 and the pressure in the second room 320. In this event, the pressure in the second room 320 is set higher than the pressure in the first room 310. As a method of providing such a pressure difference, there is cited a method of increasing the pressure in the second room 320 using an air compressor or a method of reducing the pressure in the first room 310 using a pressure reducer.

As described above, according to the magnetic disk manufacture supporting method of this embodiment, it is possible to prevent adhesion of particles or foreign matter to the glass substrates in the unpackaging processes and further to prevent invasion of particles or foreign matter into the clean room. Therefore, by forming smooth magnetic layers on the glass substrates in the film forming process, it becomes possible to improve the yield of magnetic disks.

(Example)

Hereinbelow, a description will be given of an Example about a magnetic disk manufacture supporting method and a magnetic disk manufacturing method to which this invention is applied. Magnetic-disk glass substrates 100 and magnetic disks are 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), or may be manufactured as 2.5-inch disks or 3.5-inch disks.

(1) Shaping Process and First Lapping Process

In this Example, 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 and the four cases 200 were stacked, put into a second packaging bag 220 in the form of an aluminum laminate film, and sealingly packaged while reducing the pressure in the second packaging bag 220, thereby forming a package 222. Then, the package 222 was put into a first packaging bag 210 in the form of a plastic film and sealingly packaged while reducing the pressure in the first packaging bag 210, thereby forming a double package 212. In this manner, by sealingly double packaging the glass substrates 100, the permeation of water vapor or gas into the packaging bags is effectively prevented so that it is possible to prevent the water vapor or gas from contacting the glass substrates 100 and thus to maintain the quality of the glass substrates 100 in an excellent state during delivery.

The double package 212 in which the glass substrates 100 were placed in the cases 200 and sealingly double packaged with the first packaging bag 210 and the second packaging bag 220 was 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. Hereinbelow, a description will be given of details of a magnetic disk manufacture supporting process and a magnetic disk manufacturing process carried out in the magnetic disk manufacturing plant.

(9) First Unpackaging Process

Of the double packaging bags of the double package 212, the first packaging bag 210 serving as the outside packaging bag was unpackaged in the first room 310, thereby forming the package 222. The first room 310 is

adjacent to the second room 320 and the air flow is directed from the second room 320.

(10) Second Unpackaging Process

The second packaging bag 220 of the package 222 was unpackaged in the second room 320. The second room 320 is adjacent to the first room 310 and to the clean room 330 in which the production line is provided, wherein the air flow is generated so as to be directed toward the first room 310.

(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 330 where the production line is provided.

[Evaluation]

A description will be given of effectiveness of this Example for glass substrates unpackaged by this manufacture supporting process. The effectiveness is verified in terms of the number of particles. Particles of 100 glass substrates were counted using a surface defect detection apparatus and the average value thereof are indicated as "Number of Particles" in Fig. 5 referred to later.

Fig. 5 is a diagram showing the results of counting the number of particles in an Example and Comparative Examples. Herein, the Example represents a case where an air flow was forcibly directed from the second room toward the first room using a fan, the first unpackaging process was carried out in the first room, and the second unpackaging process was carried out in the second room, Comparative Example 1 represents a case where the first unpackaging process and the second unpackaging process were carried out in the same room, Comparative Example 2 represents a case where no air flow was generated between the first room and the second room, the first unpackaging process was carried out in the first room, and the second

unpackaging process was carried out in the second room, and Comparative Example 3 represents a case where an air flow was forcibly directed in the opposite direction, i.e. from the first room toward the second room, using a fan, the first unpackaging process was carried out in the first room, and the second unpackaging process was carried out in the second room.

As shown in Fig. 5, as compared with the numbers of particles in Comparative Example 1, Comparative Example 2, and Comparative Example 3, the number of particles in the Example is extremely small. As a cause of this, it is considered that, in Comparative Example 1, since the first unpackaging process and the second unpackaging process are carried out in the same room, particles or foreign matter adhering to an outside first packaging bag during transfer is scattered in the room in the first unpackaging process and, thus, when an inside second packaging bag is unpackaged in the second unpackaging process, the particles or foreign matter adheres to the glass substrates. Further, it is also considered that if the room where the first unpackaging process and the second unpackaging process are carried out is adjacent to the clean room, the particles or foreign matter scattered in the room and adhering to the second packaging bag is brought into the clean room.

As a cause of the number of particles being large in Comparative Example 2, it is considered that since there is no air flow between the first room and the second room, particles or foreign matter scattered in the first room in the first unpackaging process is easily brought into the second room and, therefore, it is not possible to sufficiently reduce the amount of particles or foreign matter in the second room and thus the particles or foreign matter adheres to the glass substrates in the second unpackaging process. However, the number of particles is smaller than that in Comparative Example 1. Accordingly, it is seen that, under the common condition of no air flow, the result clearly becomes better by unpackaging the respective bags of the double

package in the separate rooms than by doing it in the same room.

The number of particles is largest in Comparative Example 3. As a cause of this, since the air flow is directed from the first room toward the second room, particles or foreign matter scattered in the first room when a first packaging bag is unpackaged is carried on the air flow so as to flow into the second room. Therefore, it is considered that since most of the particles or foreign matter scattered in the first room is brought into the second room, when a second packaging bag is unpackaged in the second unpackaging process, a large amount of particles or foreign matter adheres to the glass substrates. Further, since the air flow is directed from the first room toward the second room, it is also considered that the particles or foreign matter carried on the air flow reaches the clean room adjacent to the second room on the side opposite to the first room and thus the amount of particles or foreign matter in the clean room increases.

From the above results, it is seen that, by directing the air flow from the second room toward the first room, it is possible to prevent adhesion of particles or foreign matter on the glass substrates after transfer into the clean room where the production line is provided, i.e. just before the film forming process. This makes it possible to form smooth magnetic layers on the glass substrates in the film forming process and thus to improve the yield of magnetic disks.

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

On each of both surfaces of each of the glass substrates 100 obtained through the manufacturing process and the manufacture supporting process 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.

This invention is applicable to a magnetic disk manufacture supporting method and a magnetic disk manufacturing method.

CLAIMS

1. A magnetic disk manufacture supporting method for supporting manufacture of a magnetic disk that is manufactured from a magnetic-disk glass substrate double packaged with a first and a second packaging bag, the magnetic disk manufacture supporting method characterized by comprising:

a first unpackaging step of unpackaging the first packaging bag in a first room,

a second unpackaging step of unpackaging the second packaging bag in a second room, and

a transfer-in step of transferring the magnetic-disk glass substrate into a clean room,

wherein an air flow is directed from the second room toward the first room in the first unpackaging step and the second unpackaging step.

2. A magnetic disk manufacture supporting method for supporting manufacture of a magnetic disk that is manufactured from a magnetic-disk glass substrate double packaged with a first and a second packaging bag, the magnetic disk manufacture supporting method characterized by comprising:

a first unpackaging step of unpackaging the first packaging bag in a first room,

a second unpackaging step of unpackaging the second packaging bag in a second room, and

a transfer-in step of transferring the magnetic-disk glass substrate into a clean room,

wherein a pressure in the second room is higher than a pressure in the first room.

3. A magnetic disk manufacture supporting method according to claim 2, characterized in that the pressure in the first room is reduced by using a pressure reducer so as to be set lower than the pressure in the second room.

4. A magnetic disk manufacturing method characterized by performing a film forming step of forming at least a magnetic layer on the magnetic-disk glass substrate unpackaged by the method according to any one of claims 1 to 3.