



(51) International Patent Classification:

G11B 5/84 (2006.01) B24B 57/02 (2006.01)
B24B 1/00 (2006.01) C03C 19/00 (2006.01)

(21) International Application Number:

PCT/TH2011/000030

(22) International Filing Date:

25 July 2011 (25.07.2011)

(25) Filing Language:

English

(26) Publication Language:

English

(71) Applicants (for all designated States except US): **HOYA GLASS DISK THAILAND LTD** [TH/TH]; 60/26 Moo 4 Tambol Banklang, Amphur Muang, Lamphun 5100 (TH). **HOYA CORPORATION** [JP/JP]; 7-5, Naka-Ochiai 2-chome, Shinjuku-ku, Tokyo 1618525 (JP).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **SUPADEJ, Phuchong** [TH/TH]; 60/26, Moo 4 Tambol Banklang, Amphur Muang, Lumphum 51000 (TH).

(74) Agent: **VACHANAVUTTIVONG, Darani**; Tilleke & Gibbins International Limited, No. 1011, Supalai Grand Tower, 20th-26th Floors, Rama 3 Road, Chongnonsi Sub-District, Yannawa District, Bangkok 10120 (TH).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: A METHOD OF MANUFACTURING GLASS SUBSTRATES FOR INFORMATION RECORDING MEDIUM

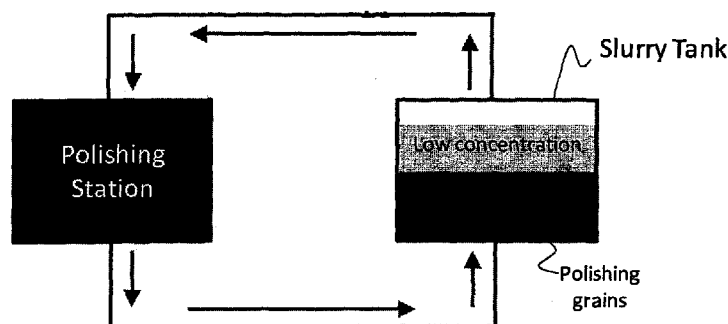


Figure 1

(57) Abstract: The present invention disclosed a method of manufacturing glass substrates for information recording medium comprising steps to suppress flatness variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process using new-formulated or recycled slurry. The present invention also related to a method to suppress flatness variation by removing glass sludge from the polishing slurry circulation.



A method of manufacturing glass substrates for information recording medium

TECHNICAL FIELD OF THE INVENTION

5 The present invention relates to a method of manufacturing glass substrates for information recording medium comprising steps to suppress flatness variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process using new-formulated or recycled slurry.

SUMMARY OF THE INVENTION

10 The present invention has been made in view of the circumstances described below, and it is an object of the invention to provide a method of manufacturing glass substrates for information recording medium comprising steps to suppress flatness variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process using new-formulated or recycled slurry..

15 To achieve the above object, the present invention disclosed a method of manufacturing glass substrates for information recording medium comprising steps to suppress flatness variation of glass substrate among batches by maintaining a level of slurry concentration circulated in in lapping or polishing process. It is also the object of the present invention that the flatness variation among batches can be suppressed due to removal of glass sludge from the slurry circulation.

20 In one embodiment, the method of manufacturing glass substrates for information recording medium comprising steps of:

(A) removing at least a portion of polishing slurry including glass sludge from a slurry tank;

(B) adding another amount of newly-formulated slurry to the slurry tank

25 wherein the concentration of the added slurry of step (B) is higher than the concentration of the slurry of step (A) removed from the slurry tank so as to suppress flatness variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process.

In another embodiment, the method of manufacturing glass substrates for information recording medium comprising steps of:

(A) taking at least a portion of the slurry from a slurry tank to a retention tank;

5 (B) allowing the slurry in the retention tank separated into low concentration and high concentration;

(C) excluding the low concentration of slurry of step (B) from the retention tank;

(D) circulating residual slurry of step (C) from the retention tank to the slurry tank.

wherein the concentration of the taken slurry at step (E) is higher than the concentration of the residual slurry of step (C) circulated to the slurry tank tank so as to suppress flatness
10 variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process.

The foregoing and other features of the invention are hereinafter more fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the
15 various ways in which the principles of the present invention may be employed.

BACKGROUND OF THE INVENTION

Glass substrates are used in various industrial fields besides conventional applications. Recently, in the field of various electronic devices, demand for high recording density of magnetic disks to be mounted on information processing devices such as hard disk drives is
20 increasing. Additionally, various electric appliances such as small personal computer and portable audio-video recording/reproducing apparatus have been widespread, the demand for thinning, high- density recording and applicability in various use environments of a glass substrates for information recording medium is more increasing. In order to satisfy this requirement, a glass substrate having high impact resistance, rigidity/hardness and high
25 chemical durability has come to be widely used. When such a glass substrate is used for an information recording medium in the hard disk mode, this is generally advantageous also in that flatness suitable for low flying of the head on the magnetic recording surface, which is very important for realizing a high-density magnetic recording surface, should be obtained.

To meet such a demand, various proposals have been made with respect to a method of polishing the plane of the glass substrate with high precision. JPA2006-099943 disclosed a manufacturing method of the substrate for magnetic disk is characterized in that when a glass substrate is ground using a slurry supplied circularly from a slurry tank. The filter in a circulation path is provided between a grinding apparatus and the grinding slurry tank. Thereby, inspection equipment yield of the glass substrate and inspection equipment yield of the magnetic disk can be improved.

However, it has been found that the flatness of glass substrates among batches of any certain slurry life circulated in a polishing or lapping process due to decrease of slurry concentration at late stages of slurry circulation because of water input during load and unload glass substrate steps, smaller particle size of the slurry and increase of small particles of glass sludge in slurry tank, these glass sludge are unable to be filtered and undergo circulate in the process.

The invention is therefore aimed to solve the problems of flatness variation of the glass substrate by maintaining a level of grinding slurry concentration circulated in lapping or polishing process.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be described hereinafter with reference to the accompanying drawings, which form a part hereof, and which illustrate example embodiments by which the invention may be practiced. As used in the disclosures and the appended claims, the term "at least" is construed to mean a part or a portion but does not refer to total amount or all amount of the material of interest (by volume or by weight). The terms "%" and "part(s)" representing a quantitative proportion or ratio are those based on volume or weight, unless otherwise specifically noted. In accordance with the process of the invention, polishing slurry is circulated through a polishing system. Unless otherwise specifically noted, the polishing slurry term "polishing slurry" of this invention may be applied to newly-formulated slurry, recycled slurry or combinations.

Process for manufacturing glass substrate for information recording medium

In general, a substrate is manufactured by carrying out a plurality of the following processes in order:

- a) a process for forming a raw glass material into a disk-like shape;
- b) a process for chamfering the inner and outer peripheral portions of the disk-like glass product;
- c) a process for lapping the glass product to a predetermined plate thickness; d) a polishing process for making the surface of the glass product smooth by grinding; and
- e) a process for chemically strengthening the surface thereof.

A glass substrate for magnetic disk as an information recording medium (hereinafter, simply referred to as glass substrate) is made of a glass workpiece. A glass substrate can be formed of a glass comprising SiO₂ as a main component for forming a glass network structure. Other components such as Al₂O₃, ZrO₃, CaO, BaO, LiO₂ and Na₂O may be also used as the essential components to contribute an increasing glass transition temperature, an improved durability, stabilization of a glass structure and an improved rigidity of the glass substrate.

The polishing process includes a grinding and polishing operation for the purpose of obtaining a required flatness and surface smoothness of the surface where a recording layer is formed. Generally, this process may be carried out in several steps such as rough grinding, fine grinding, primary polishing, and secondary polishing steps.

Even the glass substrate has surface hardness, it can suffer flatness variation during a mechanical process such as polishing. Polishing of a glass substrate is conducted after lapping. The polishing machine comprises an upper polishing plate for pressing the substrate and a lower polishing plate for supporting the substrates. These polishing plates are arranged coaxially with each other. Additionally, a plurality of carries, which performs sun-and-planet rotation while holding the substrates, is arranged between the upper polishing plate and the lower polishing plate in the circumferential direction thereof. A substrate is fitted in a through-hole of each carrier and moved together with the carrier. By rotating the polishing plates, both surfaces of each substrate can be polished. Therefore, various studies have been made to prevent the problem of deterioration of the degree of flatness of the glass substrate.

The polishing slurry of the invention is a slurry dispersion of colloidal particles in water. The colloidal particles comprise metal oxide as the abrasive component. The metal oxide that may be used includes, but is not limited to, alumina, silica, copper oxide, iron oxide, nickel oxide, manganese oxide, silicon carbide, silicon nitride, tin oxide, titania, titanium carbide, tungsten oxide, yttria, zirconia, and combinations thereof. The metal oxide may be individual single particles or aggregates of individual particles.

The method for reducing variations in surface height of a glass substrate of the invention is applicable to various glass substrates to be processed with a polishing machine, such as color filter substrates, especially suitable for use in producing a glass substrate for electronic device, such as magnetic disk, which is required to have high precision and high quality.

Slurry recirculation is normally not preferred because glass sludge and other waste products of the slurry are practically impossible to distinguish from the original slurry particles, and it is extremely difficult to control their size and unable to be filtered and undergo circulated in the process. In consequence, the solid particle content of the re-circulated slurry continuously increases with time. The result of particle contamination in recycled slurry can be scratching of the glass substrate surface and increased surface roughness and also affect flatness variation. To avoid such the problems, the slurry is simply used once and then disposed of as a waste. As a result, the cost of information recording medium is increased due to the polishing slurry and slurry waste disposal.

Additionally, it has been found that the flatness of glass substrates among batches of any certain slurry life circulated in a polishing or lapping process due to decrease of slurry concentration at late stages of slurry circulation, especially when the slurry is used up to 75% of the slurry circulation, because of water input during load and unload glass substrate steps, smaller particle size of the slurry.

It is the object of the present invention to reduce flatness variation of the glass substrate among batches by maintaining a level of grinding slurry concentration circulated in lapping or polishing process.

According to the nature of non-homogeneous liquid mixture of slurry, slurry powder becomes precipitated after a period of time resulting in separation of slurry into multi-concentration levels, an above portion is low slurry concentration while and a bottom portion is high slurry concentration. The low concentration portion may be replaced by new-
5 formulated or recycled slurry so as to maintain the slurry concentration in the circulation system.

In addition, as discussed above, glass sludge derived from the polishing or lapping process normally mix into the slurry and will be circulated in the polishing or lapping process causing defect on flatness of the glass substrate. The glass sludge derived from the polishing or
10 lapping process can be eliminated from the slurry circulation by filtration. However, mesh size of the filtration must not to small because the grinding particles will be also stuck in the filtration. Therefore, only large particles of the glass sludge can be eliminated by the filtration, but small particles of glass sludge will be discharged. Since the small particles are light, it floats to a surface or the above portion of the slurry.

15 It is also another object of this invention to remove glass sludge from the slurry circulation.

The method disclosed herein can be applied to a variety of grinding slurry compositions which includes common compositions containing at least one chemically reactive agent.

According to the present invention, a multi-batch polishing process is carried out. However, regardless of whether or not a single-stage polishing process or a multi-stage polishing
20 process is carried out, the first polishing is preferably performed by newly-formulated slurry.

The polishing system contains a slurry tank connected to the polishing station and configured to receive recycled polishing slurry including rinse fluid, such as water, glycol or others. In one embodiment, the slurry tank may be coupled to multiple polishing stations and configured to collect recycled polishing slurry and rinse fluid from multiple polishing
25 stations. In one embodiment, the method of manufacturing glass substrates for information recording medium comprising steps of:

(A) removing at least a portion of polishing slurry including glass sludge from a slurry tank;

(B) adding another amount of newly-formulated slurry to the slurry tank

wherein the concentration of the added slurry of step (B) is higher than the concentration of the slurry of step (A) removed from the slurry tank so as to suppress flatness variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process.

5 It is preferably the slurry is allowed to become precipitated prior to proceeding step (A).

In one aspect of this embodiment, not over 50 % (v/w) of the slurry in step (A) is removed from the slurry tank. Preferably, 25-45% (v/w) of the slurry in step (A) is removed from the slurry tank.

10 In another aspect of this embodiment, not over than 20 % (v/w) of the slurry in step (B) is added to the slurry tank. Preferably, 10-15% (v/w) of the slurry in step (B) is added to the slurry tank.

15 In another embodiment, the polishing system contains a slurry tank connected to the polishing station and a retention tank. The retention is configured to retain the polishing slurry taken from the slurry tank, reusable polishing slurry will be generated and recycled to the slurry tank.

In another embodiment, the method of manufacturing glass substrates for information recording medium comprising steps of:

- (A) taking at least a portion of the slurry from a slurry tank to a retention tank;
- 20 (B) allowing the slurry in the retention tank separated into low concentration and high concentration;
- (C) excluding the low concentration of slurry of step (B) from the retention tank;
- (D) circulating residual slurry of step (C) from the retention tank to the slurry tank.

wherein the concentration of the taken slurry at step (E) is higher than the concentration of the residual slurry of step (C) circulated to the slurry tank so as to suppress flatness variation of glass substrate among batches by maintaining a level of polishing slurry concentration circulated in the process.

- 5 In a preferable aspect, the slurry is allowed to become precipitated prior to proceeding step (A) in the slurry tank.

In another preferable aspect, the slurry is allowed to become precipitated prior to proceeding step (B) in the retention tank.

- 10 In one aspect of this embodiment, the method according to this embodiment further comprising a step of removing another amount of the above portion of the slurry including glass sludges from the slurry tank prior to conduct the step (D). Preferably, not over 50 % (v/w) of the slurry in this step is removed from the slurry tank. More preferably, 25-45% (v/w) of the slurry in this step is removed from the slurry tank.

- 15 In another aspect of this embodiment, not over than 20 % (v/w) of the slurry in step (D) is added to the slurry tank. Preferably, 10-15% (v/w) of the slurry in step (D) is added to the slurry tank.

In the embodiment described above, glass sludge can be removed out from the slurry circulation at either step (A) or (C).

- 20 In any embodiments of this invention, the method is applied to any batches at late stage of slurry circulation. It is preferably the method is applied to any batch when the slurry is used up to 75% of the slurry circulation.

It is preferably that the slurry removed from step (A) in any embodiments of this invention is an exceeding amount of the slurry concentration flowing out from the slurry tank.

EXAMPLES

- 25 The invention will be explained below in detail by reference to Examples of the invention and Comparative Examples. The invention should not be construed as being limited to the constitutions of the following Examples.

An example process of manufacturing large quantities of 2.5 inch (65 mm) glass substrates for use in high capacity information recording mediums will now be described hereinafter with references to some examples and comparative examples. In representing the production of large quantities of glass substrates, one hundred glass substrates were produced in each substrate production process, and each process was repeated for one hundred times so as to produce a total of 10,000 glass substrates for each of the examples and comparative examples. It is to be understood herein that example embodiments of said method are applicable to other types of substrates and those of other predetermined sizes and shapes, such as those that are 2.5 inches (65 mm), 1.8 inches (48 mm),.

Description is made on an example using a glass substrate with a disk shape having dimensions of an outer diameter of 65 mm, an inner diameter of 20 mm, and a thickness of 0.635 mm.

The flatnesses of glass substrates were measured for all batches by laser interferometric flatness tester.

Comparative Example

The slurry is circulated for 20 batches of glass substrates in lapping process. At last batch, the amount slurry is increased as compared initial state because water injection among batch.

After lapping process, Glass substrate is measured the flatness .And the flatness variations were measured per each batches .

Example 1

The slurry is circulated for 20 batches of glass substrates in lapping process. The following steps are applied to batch no. 15:

- allowing the slurry to become precipitated for 10-15 min;
- excluding 10 Liters of the above portion of slurry from a slurry tank;
- adding 3 Liters of newly-formulated slurry to the slurry tank.

Example 2

The slurry is circulated for 20 batches of glass substrates in lapping process. The following steps are applied to batch no. 15:

- allowing the slurry in the slurry tank to become precipitated for 10-15 min;
- 5 - letting at least 5 Liters of a above portion of the slurry flowing out from a slurry tank to the retention tank;
- allowing the slurry in the retention tank to become precipitated for 10-15 min;
- excluding an amount of the above portion in the retention tank until the slurry is decreased to be 3 Liters;
- 10 - removing another 10 Liters of the above portion of the slurry from the slurry tank;
- circulating 3 Liters from the retention tank to the slurry tank.

15

	Flatness variation ratio regarding Comparative Example
<u>Comparative Example</u>	1
Example 1	0.75
Example 2	0.80

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and illustrative examples shown and described herein.

Accordingly, various modifications may be made without departing from the spirit or scope
 20 of the general inventive concept as defined by the appended claims and their equivalents.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows polishing slurry circulation

Figure 2 shows polishing slurry circulation including retention tank

BEST MODE FOR CARRYING OUT THE INVENTION

- 5 As disclosed in the detailed description of the invention.

CLAIMS

1. A method of manufacturing glass substrates for information recording medium comprising steps of:

(A) removing at least a portion of polishing slurry including glass sludge from a slurry tank;

(B) adding another amount of newly-formulated slurry to the slurry tank

wherein the concentration of the added slurry of step (B) is higher than the concentration of the slurry of step (A) removed from the slurry tank so as to suppress flatness variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process.

2. The method according to claim 1 wherein the slurry is allowed to become precipitated prior to proceeding step (A) and then an amount of the above portion of slurry of step (A) is removed from a slurry tank.

3. The method according to claim 1 or claim 2 wherein not over than 50 % (v/w) of the slurry in step (A) is removed from the slurry tank.

4. The method according to anyone of preceding claims wherein the slurry removed from step (A) is an exceeding amount of the slurry flowing out from the slurry tank.

5. The method according to anyone of preceding claims wherein the method is applied to any batches of middle or late stage of slurry circulation.

6. The method according to claim 1 wherein the method is applied to any batch when the slurry is used up to 75% of the slurry circulation.

7. A method of manufacturing glass substrates for information recording medium comprising steps of:

(A) taking at least a portion of the slurry from a slurry tank to a retention tank;

(B) allowing the slurry in the retention tank separated into low concentration and high concentration;

(C) excluding the low concentration of slurry of step (B) from the retention tank;

(D) circulating residual slurry of step (C) from the retention tank to the slurry tank.

wherein the concentration of the taken slurry at step (E) is higher than the concentration of the residual slurry of step (C) circulated to the slurry tank tank so as to suppress flatness
5 variation of glass substrate among batches by maintaining a level of slurry concentration circulated in lapping or polishing process.

8. The method according to claim 7 wherein the slurry is allowed to become precipitated prior to proceeding step (A) in the slurry tank and then an amount of the above portion of slurry of step (A) is removed from a slurry tank.

10 9. The method according to claim 7 or claim 8 further comprising a step of removing another amount of the above portion of the slurry including glass sludges from the slurry tank prior to conduct the step (D)

10. The method according to claim 9 wherein the removed slurry is not over 50 % (v/w).

11. The method according to anyone of claims 7 to 10 wherein the slurry taken from step (A)
15 is an exceeding amount of the slurry flowing out from the slurry tank.

12. The method according to anyone of claims 7 to 10 wherein the method is applied to any batch when the slurry is used up to 75% of the slurry circulation.

13. The method according to anyone of claims 7 to 10 wherein glass sludge is removed out from the slurry tank at step (A).

20 14. The method according to anyone of claims 7 to 10 wherein glass sludge is removed out from the retention tank at step (C).

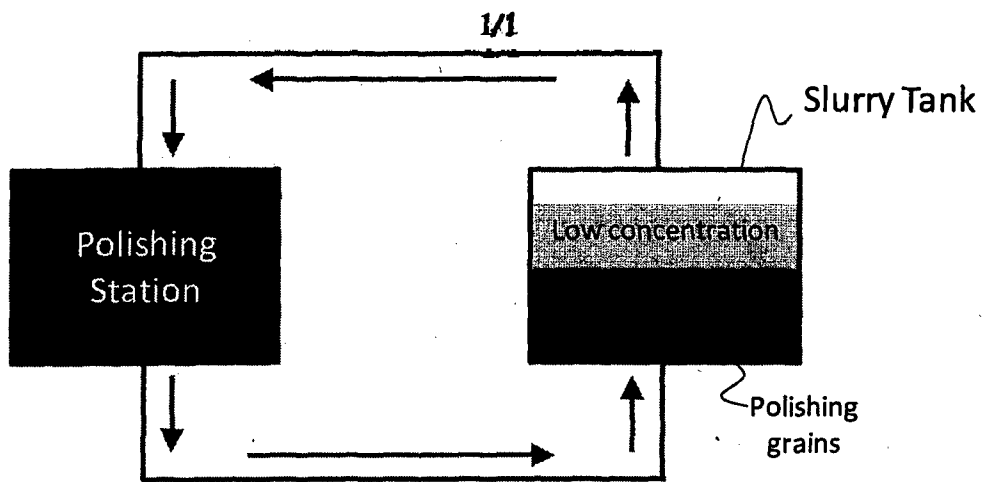


Figure 1

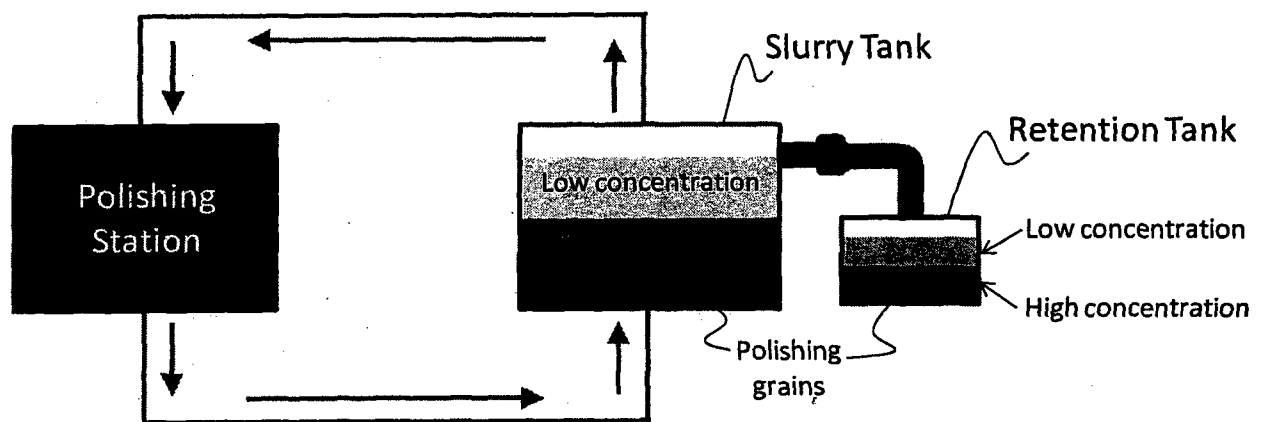


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/TH2011/000030

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. G11B5/84(2006.01)i, B24B1/00(2006.01)i, B24B57/02(2006.01)i,
C03C19/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. G11B5/84, B24B1/00, B24B57/02, C03C19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2011
Registered utility model specifications of Japan 1996-2011
Published registered utility model applications of Japan 1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2010-080026 A (HOYA Corporation) 2010.4.8,	1, 5-12
Y	paragraph 0018 - 0021, (No Family)	2-4, 13-14
Y	JP 2010-115751 A (Showa denko K.K.) 2010.5.27,	2-4
	paragraph 0042, (No Family)	
Y	JP 2010-076067 A (HOYA Corporation) 2010.4.8,	13-14
	claim 1 - 3, (No Family)	

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

26.10.2011

Date of mailing of the international search report

15.11.2011

Name and mailing address of the ISA/JP

Japan Patent Office

3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan

Authorized officer

Kazuhiko Nakano

Telephone No. +81-3-3581-1101 Ext. 3549

5D 3564