(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 June 2006 (01.06.2006)

PCT

(10) International Publication Number
WO 2006/057481 A1

(51) International Patent Classification:
H05B 33/10 (2006.01)

(21) International Application Number:
PCT/KR2005/000247

(22) International Filing Date: 28 January 2005 (28.01.2005)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2004-0097873
26 November 2004 (26.11.2004) KR

(71) **Applicant** *(for all designated States except US)*: **DOOSAN DND CO., LTD.** [KR/KR]; B3-22, 397-2, Moknae-dong, Danwon-gu, Ansan-city, Kyunggi-do 425-100 (KR).

(72) **Inventors; and**

(75) **Inventors/Applicants** *(for US only)*: **HWANG, Chang-Hun** [KR/KR]; #304-203 Hanil APT. Mokryeon Maeul, Yatop-dong, Boondang-gu, Sungnam-shi 463-942 (KR). **KIM, Seung-Han** [KR/KR]; #104-904 LG 1st APT., Yongho Maeul, Dang-dong, Gunpo-shi, Kyunggi-do 435-010 (KR). **KIM, Do-Gon** [KR/KR]; #127-1204, Daewoo 3rd APT., Jangkok-dong, Siheung-shi, Kyunggi-do 429-732 (KR). **KIM, Beom-Jae** [KR/KR]; #904-404 Joogong APT., 672, Kojan-dong, Danwon-gu, Ansan-shi, Kyunggi-do 425-020 (KR). **BACK, Ju-Hyun** [KR/KR]; #306-1504 Daewoo 3rd APT., Eunhaeng-dong, Siheung-shi, Kyunggi-do 429-902 (KR).

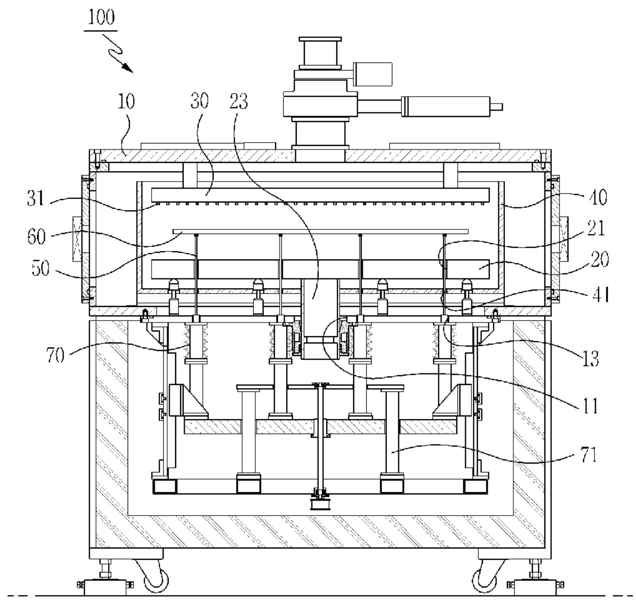
(74) **Agent: KIM, Inhan**; Room 901, Doorea Bldg.,, Yeouido-dong, Yeongdeungpo-gu,, Seoul 150-877 (KR).

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

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR HEATING GLASS



(57) Abstract: Apparatus and method for heating glass to perform drying and baking processes of a patterned thin film on the glass, and more particularly apparatus and method for heating glass to perform a drying process using a heating plate prepared in a lower portion of the inside of a chamber and provided with a hot wire wound therein and perform a baking process using a sheath heater prepared in an upper portion of the inside of the chamber. The apparatus includes a chamber, in which drying and baking processes of the glass are performed, including a first through hole formed through the central portion of the lower wall thereof and a plurality of second through holes formed through the lower wall thereof such that the second through holes are spaced from each other by a designated distance; a heating plate having a platy structure installed in a lower portion of the inside of the chamber, including a plurality of first pin holes formed through designated positions thereof perpendicularly to the second through holes, and supported by power supply means inserted from the outside of the chamber thereinto through the first through hole; a sheath heater having a platy structure installed in an upper portion of the inside of the chamber, and provided with a hot wire formed thereon in a designated pattern; reflecting means prepared along the inner side surface of the chamber and a virtual horizontal plane between the inner lower wall of the chamber and the heating plate, and including a plurality of second pin holes formed through the horizontal plane perpendicularly to the second through holes; a plurality of glass support pins passing through the second through holes and the first and second pin holes and vertically moving; and support pin ascending and descending means for vertically moving the glass support pins.

WO 2006/057481 A1

FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Description

APPARATUS AND METHOD FOR HEATING GLASS

Technical Field

[1] The present invention relates to an apparatus and method for heating glass to perform drying and baking processes to a patterned thin film on the glass, and more particularly to an apparatus and method for heating glass to perform a drying process using a heating plate prepared in a lower portion of the inside of a chamber and provided with a hot wire wound therein and a baking process using a sheath heater prepared in an upper portion of the inside of the chamber.

Background Art

[2] In order to keep pace with the rapid progress of data communication technology and the expansion of a market thereof, flat panel displays are increasingly used as display elements. The flat panel displays include liquid crystal displays, plasma display panels, and organic light emitting diodes (OLEDs).

[3] Organic light emitting diodes, which exhibit a rapid response speed, a power consumption rate lower than that of the conventional liquid crystal display, and a light weight, and do not require a back light device, are advantageous in that they are manufactured to an ultra thin thickness and exhibit a high luminance, thus being increasingly used next generation display elements.

[4] Such an organic light emitting diode emits light due to a difference of energy formed in an organic thin film by coating a substrate with an anode film, the organic thin film, and a cathode film and applying voltage between obtained anode and cathode. That is, light is emitted from excitation energy remaining after injected electrons and holes are recombined. Here, since the wavelength of the light is adjusted by the amount of a dopant made of an organic substance, the organic light emitting diode exhibits full colors. the size of a glass substrate used for manufacturing a display has been gradually increased so as to improve productivity and increase the size of the display.

[5] The organic light emitting diode is formed by sequentially stacking an anode, a hole injection layer, a hole transfer layer, an emitting layer, an electron transfer layer, an electron injection layer, and a cathode on a substrate. Here, the anode mainly employs indium tin oxide having a low sheet resistance and a high permeability. In order to increase efficiency in emitting light, the organic thin film has a multilayered structure including the hole injection layer, the hole transfer layer, the emitting layer, the electron transfer layer, the electron injection layer. The emitting layer is made of an organic substance, such as Alq_3, TPD, PBD, m-MTDATA, or TCTA. The cathode

employs a metal layer made of LiF-Al. Since the organic thin film is weak to moisture and oxygen in air, in order to increase the life time of the diode, a sealing layer is formed on the uppermost layer of the diode.

[6] Regardless of the above several advantages, since equipment for mass-producing large-size organic light emitting diodes is not yet standardized, the organic light emitting diode does not yet secure a position as a next generation display element. That is, the size of a liquid crystal display or a plasma display panel is rapidly increased and equipment for mass-producing the liquid crystal display or the plasma display panel having large dimensions is under development and standardization. Accordingly, the development of equipment for mass-producing the large-size organic light emitting diode has been required.

[7] In order to manufacture the above organic light emitting diode, a series of processes is performed. The series of processes include a process for drying a patterned thin film on glass and a process for baking the patterned thin film.

[8] Conventionally, the drying process and the baking process are performed in a single chamber or in different chambers.

[9] That is, the drying process and the baking process are sequentially performed on a glass substrate placed on a heating plate prepared in a single process chamber, or the drying process is first performed in a drying process chamber and then the baking process is performed in a baking process chamber.

Disclosure of Invention

Technical Problem

[10] However, when the drying process and the baking process are performed in different process chambers, two chambers and additional devices are required, thereby complicating the overall layout of the equipment for manufacturing the organic light emitting diode and increasing costs for installing the equipment.

[11] Further, when the drying process and the baking process are performed on the heating plate in a single process chamber, the heating plate is deformed and the time for cooling the heating plate is long.

[12] That is, in order to bake a glass substrate placed on the heating plate, a high temperature of 200℃ is required. The above temperature easily deforms the heating plate, and a long time is taken to cool the heated heating plate.

Technical Solution

[13] Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide an apparatus for heating glass, which performs a process for drying the glass and a process for baking the glass in a single chamber using a heating plate prepared in a lower portion of the chamber and a sheath

heater prepared in an upper portion of the chamber.

[14] It is another object of the present invention to provide an apparatus for heating glass, which adjusts the height of the glass placed in a single chamber, thereby adjusting the temperature of heat transferred to the glass.

[15] In accordance with an aspect of the present invention, the above and other objects can be accomplished by the provision of an apparatus for heating glass comprising: a chamber, in which drying and baking processes of the glass are performed, including a first through hole formed through the central portion of the lower wall thereof and a plurality of second through holes formed through the lower wall thereof such that the second through holes are spaced from each other by a designated distance; a heating plate having a platy structure installed in a lower portion of the inside of the chamber, including a plurality of first pin holes formed through designated positions thereof perpendicularly to the second through holes, and supported by power supply means inserted from the outside of the chamber thereinto through the first through hole; a sheath heater having a platy structure installed in an upper portion of the inside of the chamber, and provided with a hot wire formed thereon in a designated pattern; reflecting means prepared along the inner side surface of the chamber and a virtual horizontal plane between the inner lower wall of the chamber and the heating plate, and including a plurality of second pin holes formed through the horizontal plane perpendicularly to the second through holes; a plurality of glass support pins passing through the second through holes and the first and second pin holes and vertically moving; and support pin ascending and descending means for vertically moving the glass support pins.

[16] Preferably, a hot wire heated by the power supply means is wound on the inner surface of the heating plate, the power supply means includes cooling means for cooling the heating plate, and a cooling pass, along which cooling water transmitted from the cooling means moves, is formed in the heating plate. That is, since the hot wire is wound on the inner surface of the heating plate, when the heating plate is heated once, it takes a long time to cool the heating plate. The cooling pass serves to rapidly cool the heated heating plate, thereby facilitating the process of the next glass.

[17] Further, preferably, the pattern of the hot wire of the sheath heater is divided into a first pattern having a winding shape provided at the central portion of the sheath heater, a second pattern having a winding shape provided outside the first pattern, and a third pattern 31c having a winding shape provided outside the second pattern. Accordingly, a problem caused by the temperature of the edge portion of the glass, which is lower than that of the central portion of the glass, is solved by properly controlling the divided patterns of the hot wire of the sheath heater.

[18] Preferably, the number of each of the glass support pins, the second through holes,

the first pin holes and the second pin holes is sixteen, and each of the glass support pins, the second through holes, the first pin holes and the second pin holes are spaced from each other by a designated distance. Further, a plurality of supporters for supporting the heating plate are installed on the lower wall of the inside of the chamber. Here, preferably, the number of the supporters is sixteen, and the supporters are spaced from each other by a designated distance.

[19] The support pin ascending and descending means includes support pin connection portions vertically installed below the chamber such that ends of the support pin connection portions are fixedly connected to the glass support pins; a support plate having a platy structure fixedly connected to the other ends of the support pin connection portions; driving means for vertically moving the support plate; and guide means for guiding the vertical movement of the support plate by the driving means.

[20] A nut hole provided with a screw thread formed thereon is formed through the central portion of the support plate; and the driving means includes: a ball screw engaged with the nut hole and rotated; a first pulley connected to one end of the ball screw; a second pulley connected to the first pulley by a belt; and a servo motor connected to the second pulley for generating driving force.

[21] Preferably, bellows are respectively connected to designated parts of the lower outer surface of the chamber and the support pin connection portions. The hermetic sealing state of the inside of the chamber is maintained by the bellows so that the drying and baking processes are performed under a vacuum condition.

[22] In accordance with another aspect of the present invention, there is provided a method for heating glass comprising inserting the glass to a chamber and placing the glass on a heating plate; performing a drying process by separating the glass from the heating plate by a small distance using glass support pins; performing a baking process by more upwardly moving the glass support pins so that the glass moves close to a sheath heater after the drying process is completed; and taking the glass out of the chamber after the baking process is completed.

[23] Preferably, the drying process is performed for 2 minutes, and the baking process is performed for 8 minutes. Further, preferably, in the drying process, conditions of the inside of the chamber are maintained such that the vacuum degree of the chamber is 0.01 Torr and the temperature of the chamber is 30~100℃, and in the baking process, conditions of the inside of the chamber are maintained such that the vacuum degree of the chamber is 0.01 Torr and the temperature of the chamber is 180~220℃.

[24] The glass is vertically moved on the glass support pins so that the temperature of the glass is adjustable. That is, since the glass support pins are vertically moved by the support pin ascending and descending means, a control unit receives data inputted from a temperature sensor provided at a designated position of the chamber, and

calculates the movement distance of the support pins, thereby controlling the support pin ascending and descending means.

Advantageous Effects

[25] The apparatus and method for heating glass of the present invention, in which drying and baking processes are performed in a single process chamber, simplify the layout of the apparatus and reduce costs taken to manufacture light emitting diodes.

[26] Further, since a sheath heater obtained by winding a hot wire on the thin plate bakes a thin film on a glass substrate and is then rapidly cooed, the apparatus and method for heating glass of the present invention shorten the time taken to manufacture light emitting diodes and improve yield of the light emitting diodes.

[27] Moreover, since the height of the glass substrate in the chamber is adjustable, the drying and baking processes of the glass substrate are achieved by proper heat.

Brief Description of the Drawings

[28] The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[29] FIG. 1 is a sectional view of an apparatus for heating glass in accordance with the present invention;

[30] FIG. 2 is a plan view of a sheath heater of the apparatus of the present invention;

[31] FIG. 3 is a sectional view of support pin ascending and descending means of the apparatus of the present invention; and

[32] FIG. 4 is a plan view of a heating plate of the apparatus of the present invention.

Best Mode for Carrying Out the Invention

[33] Now, a preferred embodiment of apparatus and method for heating glass of the present invention will be described in detail with reference to the accompanying drawings.

[34] FIG. 1 is a sectional view of the apparatus for heating glass in accordance with the present invention.

[35] As shown in FIG. 1, the apparatus 100 of the present invention comprises a chamber 10, in which the method for heating glass is performed, a heating plate 20 having a platy structure installed in a lower portion of the inside of the chamber 10, a sheath heater 30 having a platy structure installed in an upper portion of the inside of the chamber 10, reflecting means 40 prepared along the inner side surface of the chamber and a virtual horizontal plane between inner lower surface of the chamber 10 and the heating plate 20, glass support pins 50 for supporting a glass substrate 60, and support pin ascending and descending means 80 for vertically moving the glass support pins 50.

[36] The chamber 10 is a space, in which processes for drying and baking the glass substrate 60 to be processed are performed. The chamber 10 has a frame structure similar to that of a general process chamber. A shutter (not shown), through which the glass substrate 60 is inserted into and taken out of the chamber 10, is formed through the side wall of the chamber 10, and pumping means (not shown) for vacuumizing the chamber 10 is installed at a designated position of the chamber 10. Various sensors including a temperature sensor are provided in the chamber 10.

[37] Various holes are formed through the lower wall of the chamber 10. That is, a first through hole 11 having a designated size is formed through the central portion of the lower wall of the chamber 10, and a plurality of second through holes 13 spaced from each other by a designated interval are formed through the lower wall of the chamber 10 separately from the first through hole 11.

[38] Power supply means 23 is inserted into the first through hole 11, and the glass support pins 50 for supporting the glass substrate 60 vertically move through the corresponding second through holes 13.

[39] The heating plate 20 and the sheath heater 30, which are main components for achieving the present invention, are installed in the chamber 10. That is, the heating plate 20 having a platy structure is installed in the lower portion of the inside of the chamber 10 so as to perform the drying process on the glass substrate 60, and the sheath heater 30 having a platy structure is installed in the upper portion of the inside of the chamber 10 so as to perform the baking process on the glass substrate 60.

[40] The heating plate 20 has the platy structure, and a hot wire in a designated pattern for emitting heat of a designated temperature is wound in the heating plate 20. The hot wire in the designated pattern is inserted into the chamber 10 through the first through hole 11 formed through the lower wall of the chamber 10, and is heated by the power supply means 23 supporting the heating plate 20.

[41] Although the heating plate 20 is supported by the power supply means 23, the heated heating plate 20 may be deformed or warped. Accordingly, as shown in FIG. 1, a plurality of supporters 25 for supporting the heating plate 20 are installed on the lower wall of the chamber 10. In the case that the supporters 25 are installed, supporter holes 27 prepared in a designated number, through which the supporters 25 pass, are formed through a portion of the reflecting plate 40 located between the heating plate 20 and the lower wall of the chamber 10.

[42] The number of the supporters 25 may vary according to the structure of the chamber 10. Preferably, in order to properly prevent the warpage of the heating plate 20, the supporters 25 are arranged in four lines and four rows such that the total number of the supporters 25 is sixteen. Further, preferably, the supporters 25 are spaced from each other by a designated distance. When the number of the supporters

25 for supporting the heating plate 20 is sixteen, the number of the support holes 27 formed through the reflecting plate 40 is sixteen.

[43] The heating plate 20 includes a plurality of first pin holes 21, through which the glass support pins 50 pass. The first pin holes 21 are prepared in the same number as that of the second through holes 13. That is, the first pin holes 21 are formed through predetermined positions of the heating plate 20 perpendicularly to the second through holes 13. Accordingly, the glass support pins 50 pass through the second through holes 13 and the first pin holes 21, and vertically move.

[44] The power supply means 23 supporting the heating plate 20 cools the heated heating plate 20 as well as supplies power to the hot wire wound in the heating plate 20. That is, the power supply means 23 includes means (not shown) for cooling the heating plate 20 and a cooling pass, along which cooling water transmitted from the cooling means (not shown) moves, is formed in the heating plate 20, thereby cooling the heated heating plate 20.

[45] The sheath heater 30 is installed in the upper portion of the inside of the chamber 10 such that the sheath heater 30 faces the heating plate 20. The sheath heater 30 has a platy structure, and a hot wire in a designated pattern is formed on the sheath heater 30. The glass substrate 60 is baked by the hot wire 31 in the designated pattern.

[46] The hot wire 31 formed on the sheath heater 30 may have various patterns. FIG. 2 illustrates one example of the pattern of the hot wire 31. That is, such a pattern of the hot wire 31 is divided into a first pattern 31a having a winding shape provided at the central portion of the sheath heater 30, a second pattern 31b having a winding shape provided outside the first pattern 31a, and a third pattern 31c having a winding shape provided outside the second pattern 31b.

[47] By baking the glass substrate 60 using the hot wire 31 having the above three patterns 31a, 31b, and 31c, the baking process is performed more selectively and efficiently. That is, the temperature of the edge portion of the glass substrate 60 is generally lower than the temperature of the central portion of the glass substrate 60. Thus, the baking process on the glass substrate 60 is uniformly performed by increasing the temperature of heat emitted from the third pattern 31c rather than the first and second patterns 31a and 31b.

[48] In addition to the heating plate 20 and the sheath heater 30, the reflecting means 40 is prepared in the chamber 10. The reflecting means 40 is installed along the inner side surface and the inner lower surface of the chamber 11 so that heat emitted from the heating plate 20 or the sheath heater 30 is concentrated on the glass substrate 60.

[49] As shown in FIG. 1, the reflecting means 40 is prepared along the inner side surface of the chamber 10 and the virtual horizontal plane between the inner lower surface of the chamber 10 and the heating plate 20. Accordingly, the reflecting mean 40 prevents

the heat emitted from the heating plate 20 or the sheath heater 30 from flowing towards the side or lower wall of the chamber 10, and reflects the emitted heat to be concentrated onto the glass substrate 60.

[50] The reflecting means 40 installed on the virtual horizontal plane includes a plurality of second pin holes 41 formed through the horizontal plane thereof located at positions corresponding to the plural second through holes 13 formed through the lower wall of the chamber 10 and the first pin holes 21 formed through the heating plate 20. By forming the second pin holes 41 through the reflecting means 40, the glass support pins 50 for supporting the glass substrate 60 vertically move through the second through holes 13 and the first and second pin holes 21 and 41.

[51] The vertical movement of the plural glass support pins 50 through the second through holes 13 and the first and second pin holes 21 and 41 is achieved by the support pin ascending and descending means 80 installed below the chamber 10.

[52] Preferably, the glass support pins 50 are arranged in four lines and four rows such that the total number of the glass support pins 50 is sixteen. Accordingly, the second through holes 13, the first pin holes 21, and the second pin holes 41, through which the glass support pins 50 pass, are respectively arranged in four lines and four rows such that the total numbers of the second through holes 13, the first pin holes 21, and the second pin holes 41 are respectively sixteen.

[53] That is, as shown in FIG. 4, the sixteen first pin holes 21 arranged on the heating plate 20 in four lines and four rows are spaced from each other by a designated distance. Further, the second through holes 13 formed through the lower wall of the chamber 10 and the second pin holes 41 formed through the reflecting means 40 have the same arrangement as that of the first pin holes 21 shown in FIG. 4.

[54] FIG. 3 illustrates the constitution of the support pin ascending and descending means 80 for driving the glass support pins 50 vertically moving through the second through holes 13, the first pin holes 21, and the second pin holes 41.

[55] As shown in FIG. 3, the support pin ascending and descending means 80 includes support pin connection portions 81 vertically installed below the chamber 10 such that ends of the support pin connection portions 81 are fixedly connected to the glass support pins 50 shown in FIG. 1, a support plate 82 having a platy structure fixedly connected to the other ends of the support pin connection portions 81, driving means 88 for vertically moving the support plate 82, and guide means (71 in FIG. 1) for guiding the vertical movement of the support plate 82 by the driving means 88.

[56] The support pin connection portions 81 fixedly connected to the glass support pins 50 is vertically erected on the support plate 82. When the glass support pins 50 are arranged in four lines and four rows such that the total number of the glass support pins 50 is sixteen, the number of the support pin connection portions 81 is sixteen. Here, the

sixteen support pin connection portions 81 are fixedly connected to the glass support pins 50 under the condition that the support pin connection portions 81 on the support plate 82 in erected states are spaced from each other by a designated distance.

[57] Since the support pin connection portions 81 vertically move below the chamber 10, the support pin connection portions 81 cannot achieve the hermetic sealing of the chamber 10. Accordingly, in order to maintain hermetic sealing condition of the chamber 10, preferably, bellows 70 are respectively connected to designated parts of the lower outer surface of the chamber 10 and the support pin connection portions 81, as shown in FIG. 1.

[58] The driving means 88 may have various configurations for vertically moving the support plate 82. That is, a vertical bar (not shown) attached to the lower part of the central portion of the support plate 82 is vertically moved by an air cylinder (not shown). However, in the present invention, in order to precisely control the vertical movement of the support plate 82, the support plate 82 is vertically moved by rotating a ball screw using a servo motor.

[59] That is, a nut hole 82a provided with a screw thread formed thereon is formed through the central portion of the support plate 82, and the driving means 88 includes a ball screw 83 engaged with the nut hole 82a and rotated, a first pulley 84 connected to one end of the ball screw 83, a second pulley 86 connected to the first pulley 84 by a belt 85, and a servo motor 87 for driving the second pulley 86, thereby vertically moving the support plate 82.

[60] Accordingly, when a control unit (not shown) transmits a control signal for vertically moving the glass support pins 50 to the servo motor 87, the servo motor 87 generates driving force, and the second pulley 86 and the first pulley 84 linked with the second pulley 86 by the belt 85 are rotated by the driving force. Then, the ball screw 83 connected to the first pulley 84 is rotated, and the support plate 82 engaged with the ball screw 83 vertically moves. Thereby, the support pins 50 connected to the support pin connection portions 81 fixedly connected to the support plate 82 vertically move in the chamber 10.

[61] Hereinafter, a method for performing drying and baking processes on glass using the above apparatus will be described.

[62] First, the glass substrate 60 to be processed is introduced into the chamber 10, and is placed on the heating plate 20. The glass substrate 60 is inserted into the chamber 10 by a robot arm (not shown) through the shutter (not shown) formed through the side surface of the chamber 10.

[63] When the glass substrate 60 is inserted into the chamber 10, the support pin ascending and descending means 80 is driven by the control of the control unit (not shown). Thereby, the glass support pins 50 separate the glass substrate 60 from the

heating plate 20 by a small distance, and then the drying process is performed on the glass substrate 60.

[64] When the drying process is performed on the glass substrate 60, the drying process is performed for a proper time under proper conditions of the inside of the chamber 10. That is, preferably, the drying process is performed for 2 minutes, and the conditions of the inside of the chamber 10 are maintained such that the vacuum degree of the chamber 10 is 0.01 Torr and the temperature of the chamber 10 is 30~100℃.

[65] When the temperature of heat reaching the glass substrate 60 is excessively high, the glass support pins 50 move more upwardly so that the temperature of the glass substrate 60 is lowered, and when the temperature of heat reaching the glass substrate is excessively low, the glass support pins 50 move more downwardly so that the temperature of the glass substrate 60 is raised. That is, during the drying process, the glass substrate 60 is vertically moved by the glass support pins 50 so that the temperature of the glass substrate 60 is adjustable. Thereby, the drying process of the glass substrate 60 is properly performed.

[66] The glass substrate 60, after passing through the drying process under the above conditions of the inside of the chamber 10, is moved close to the sheath heater 30 by upwardly moving the glass support pins 50, and then goes through the baking process. That is, after the drying process is completed, the glass support pins 50 are moved more upwardly by the control of the control unit (not shown), thereby moving the glass substrate 60 close to the sheath heater 30 so as to perform the baking process.

[67] When the baking process is performed on the glass substrate 60, the baking process is performed for a proper time under proper conditions of the inside of the chamber 10. That is, preferably, the baking process is performed for 8 minutes, and the conditions of the inside of the chamber 10 are maintained such that the vacuum degree of the chamber 10 is 0.01 Torr and the temperature of the chamber 10 is 180~220℃. Most preferably, the temperature of the chamber 10 is 200℃.

[68] When the temperature of heat reaching the glass substrate 60 is excessively high, the glass support pins 50 move more downwardly so that the temperature of the glass substrate 60 is lowered, and when the temperature of heat reaching the glass substrate is excessively low, the glass support pins 50 move more upwardly so that the temperature of the glass substrate 60 is raised. That is, during the baking process, the glass substrate 60 is vertically moved by the glass support pins 50 so that the temperature of the glass substrate 60 is adjustable. Thereby, the baking process of the glass substrate 60 is properly performed.

[69] After the baking process is completed, the heating plate 20 is cooled and the glass substrate 60 is taken out of the chamber 10. Then, the next glass substrate 60 is inserted into the chamber 10, and goes through the drying and baking processes.

Industrial Applicability

[70] As apparent from the above description, the present invention provides apparatus and method for heating glass, in which drying and baking processes are performed in a single process chamber, thereby simplifying the layout of the apparatus and reducing costs taken to manufacture light emitting diodes.

[71] Further, since a sheath heater obtained by winding a hot wire on the thin plate bakes a thin film on a glass substrate and is then rapidly cooed, the apparatus and method for heating glass of the present invention shorten the time taken to manufacture light emtting diodes and improve yield of the light emitting diodes.

[72] Moreover, since the height of the glass substrate in the chamber is adjustable, the drying and baking processes of the glass substrate are achiebed by proper heat.

[73] Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

[1] An apparatus for heating glass comprising:
a chamber, in which drying and baking processes of the glass are performed, including a first through hole formed through the central portion of the lower wall thereof and a plurality of second through holes formed through the lower wall thereof such that the second through holes are spaced from each other by a designated distance;
a heating plate having a platy structure installed in a lower portion of the inside of the chamber, including a plurality of first pin holes formed through designated positions thereof perpendicularly to the second through holes, and supported by power supply means inserted from the outside of the chamber thereinto through the first through hole;
a sheath heater having a platy structure installed in an upper portion of the inside of the chamber, and provided with a hot wire formed thereon in a designated pattern;
reflecting means prepared along the inner side surface of the chamber and a virtual horizontal plane between the inner lower wall of the chamber and the heating plate, and including a plurality of second pin holes formed through the horizontal plane perpendicularly to the second through holes;
a plurality of glass support pins passing through the second through holes and the first and second pin holes and vertically moving; and
support pin ascending and descending means for vertically moving the glass support pins.

[2] The apparatus as set forth in claim 1, wherein a hot wire heated by the power supply means is wound on the inner surface of the heating plate.

[3] The apparatus as set forth in claim 2, wherein the power supply means includes cooling means for cooling the heating plate, and a cooling pass, along which cooling water transmitted from the cooling means moves, is formed in the heating plate.

[4] The apparatus as set forth in claim 1, wherein the pattern of the hot wire of the sheath heater is divided into a first pattern having a winding shape provided at the central portion of the sheath heater, a second pattern having a winding shape provided outside the first pattern, and a third pattern having a winding shape provided outside the second pattern.

[5] The apparatus as set forth in claim 1, wherein the number of each of the glass support pins, the second through holes, the first pin holes and the second pin holes is sixteen, and each of the glass support pins, the second through holes, the

first pin holes and the second pin holes are spaced from each other by a designated distance.

[6] The apparatus as set forth in claim 1, wherein a plurality of supporters for supporting the heating plate are installed on the lower wall of the inside of the chamber.

[7] The apparatus as set forth in claim 6, wherein the number of the supporters is sixteen, and the supporters are spaced from each other by a designated distance.

[8] The apparatus as set forth in claim 1, wherein the support pin ascending and descending means includes:
support pin connection portions vertically installed below the chamber such that ends of the support pin connection portions are fixedly connected to the glass support pins;
a support plate having a platy structure fixedly connected to the other ends of the support pin connection portions;
driving means for vertically moving the support plate; and
guide means for guiding the vertical movement of the support plate by the driving means.

[9] The apparatus as set forth in claim 8, wherein:
a nut hole provided with a screw thread formed thereon is formed through the central portion of the support plate; and
the driving means includes:
a ball screw engaged with the nut hole and rotated;
a first pulley connected to one end of the ball screw;
a second pulley connected to the first pulley by a belt; and
a servo motor connected to the second pulley for generating driving force.

[10] The apparatus as set forth in claim 8, wherein bellows are respectively connected to designated parts of the lower outer surface of the chamber and the support pin connection portions.

[11] A method for heating glass comprising:
inserting the glass to a chamber and placing the glass on a heating plate;
performing a drying process by separating the glass from the heating plate by a small distance using glass support pins;
performing a baking process by more upwardly moving the glass support pins so that the glass moves close to a sheath heater after the drying process is completed; and
taking the glass out of the chamber after the baking process is completed.

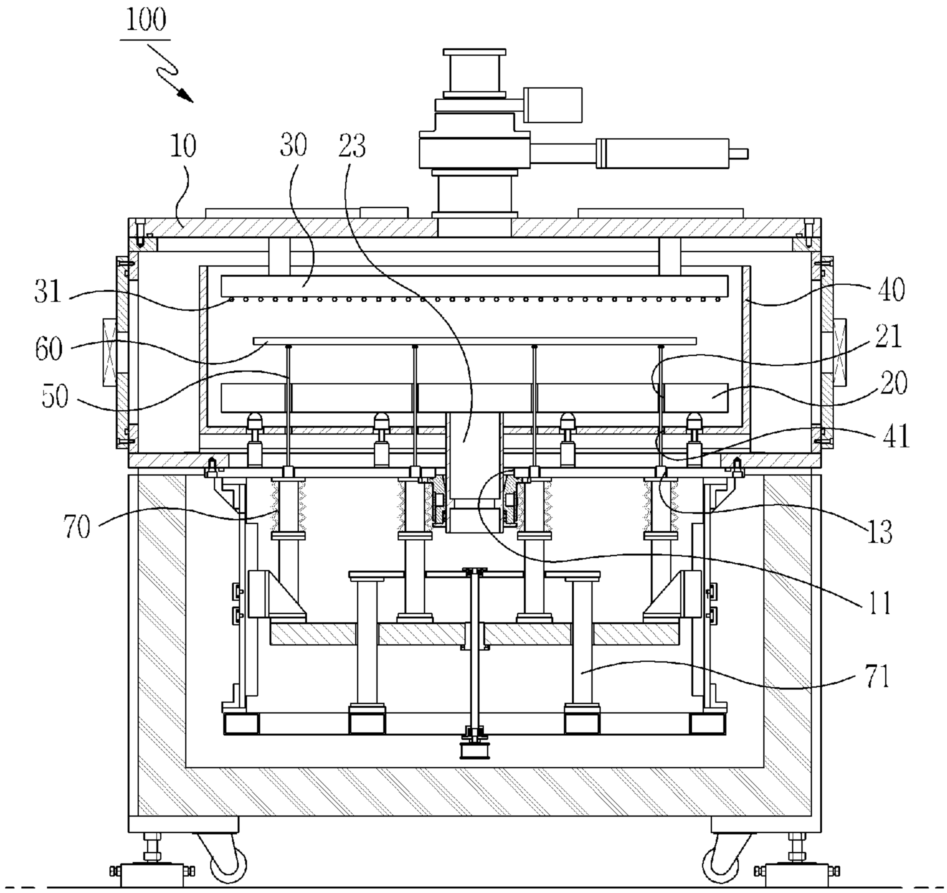
[12] The method as set forth in claim 11, wherein the drying process is performed for 2 minutes, and the baking process is performed for 8 minutes.

[13] The method as set forth in claim 12, wherein, in the drying process, conditions of the inside of the chamber are maintained such that the vacuum degree of the chamber is 0.01 Torr and the temperature of the chamber is 30~100℃.

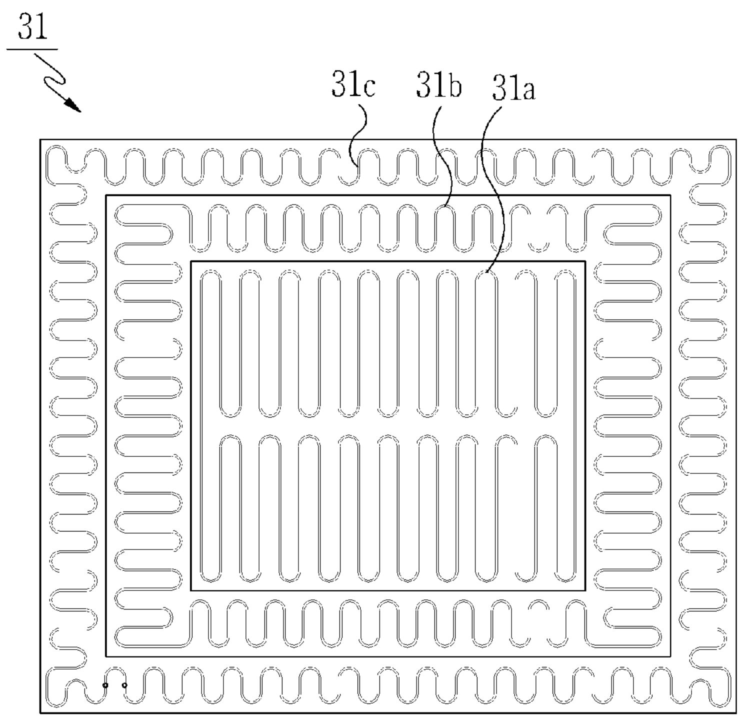
[14] The method as set forth in claim 12, wherein, in the baking process, conditions of the inside of the chamber are maintained such that the vacuum degree of the chamber is 0.01 Torr and the temperature of the chamber is 180~220℃.

[15] The method as set forth in claim 11, wherein the glass is vertically moved on the glass support pins so that the temperature of the glass is adjustable.

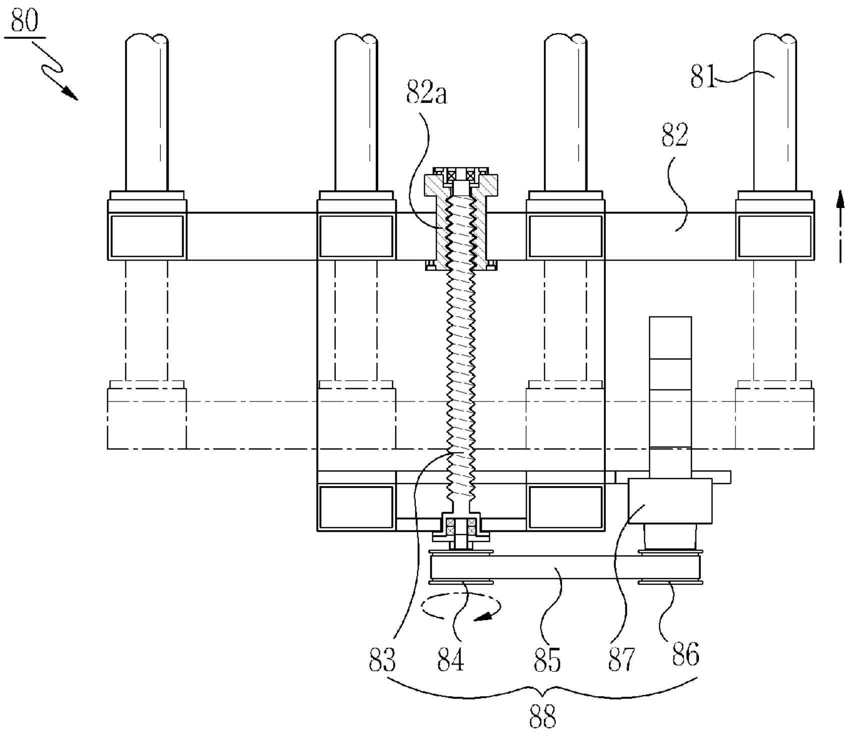
[Fig. 1]



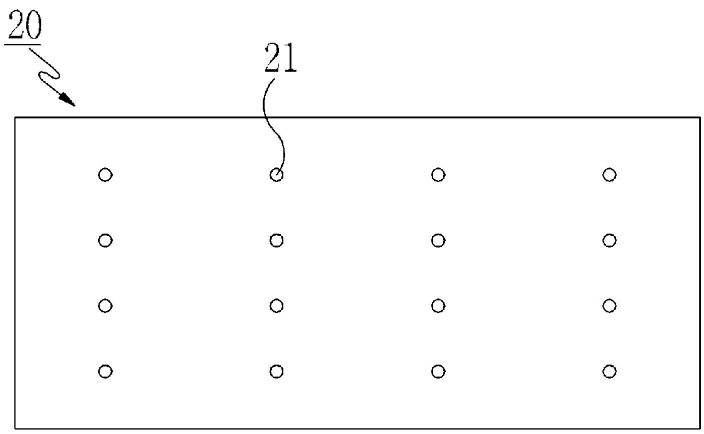
[Fig. 2]



[Fig. 3]



[Fig. 4]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/000247

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H05B 33/10

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)
IPC7 H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR, JP: class as above

Electronic data base consulted during the intertnational 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.
A	JP 13-319885A(HITACHI KOKUSAI ELECTRIC INC) 16 November 2001 See the whole document	1-15
A	JP 08-136937A(MITSUBISHI ELECTRIC CORP) 31 May 1996 See the whole document	1-15
A	US 6120661A(Sony Corporation) 19 September 2000 See the whole document	1-15

☐ 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 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	Date of mailing of the international search report
27 SEPTEMBER 2005 (27.09.2005)	**28 SEPTEMBER 2005 (28.09.2005)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
SEO, Jin Won
Telephone No. 82-42-481-5655

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2005/000247

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP13319885	16.11.2001	JP13319885	16.11.2001
		JP2001319885A2	16.11.2001
		KR1020010087293	15.09.2001
		TW497198B	01.08.2002
		TW497198A	01.08.2002
		US20010035124A1	01.11.2001
		US2001035124AA	01.11.2001
JP08136937	31.05.1996	JP08136937	31.05.1996
		JP3053535B2	19.06.2000
		JP8136937A2	31.05.1996
		KR1019960018655	17.06.1996
US06120661	19.09.2000	JP11354504A2	24.12.1999
		JP11354504	24.12.1999
		KR1020000006012	25.01.2000
		KR2000006012A	25.01.2000
		US6120661A	19.09.2000