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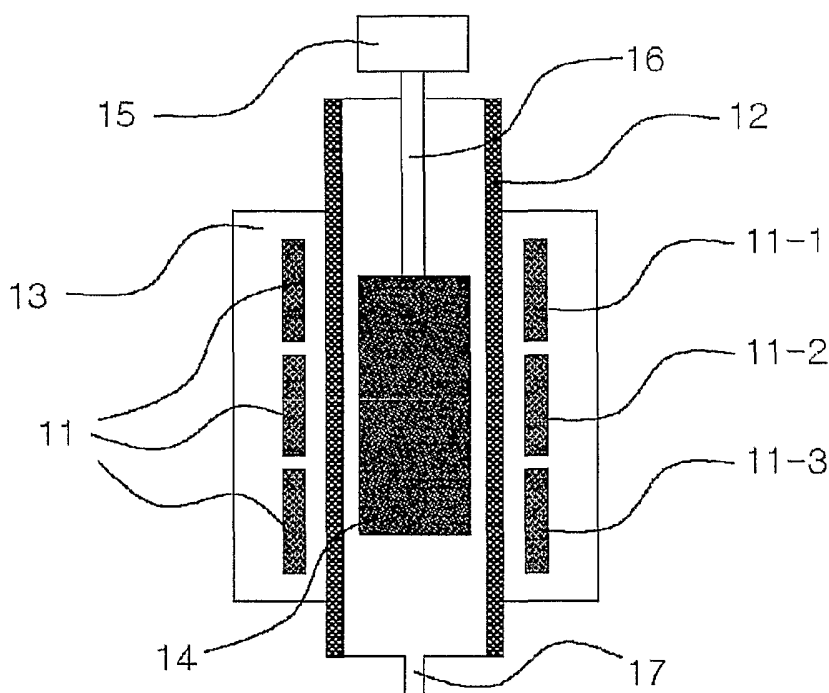
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(54) Title: APPARATUS FOR MANUFACTURING HIGH HEAT-RESISTANT QUARTZ GLASS



(57) Abstract: Disclosed is an apparatus for manufacturing high heat resistant quartz glass, specifically an apparatus for manufacturing high heat resistant quartz glass used for a high temperature Poly-Si TFT-LCD substrate and a semiconductor process.



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.

APPARATUS FOR MANUFACTURING HIGH HEAT-RESISTANT QUARTZ GLASS

Technical field

The present invention relates to an apparatus for manufacturing a high heat resistant quartz
5 glass used for a high temperature poly-Si TFT-LCD (Thin Film Transistor-Liquid Crystal Display)
substrate and in a semiconductor process.

Background Art

In manufacturing high heat resistant quartz glass, generally two heat treatment processes
10 should be carried out, each of which is an OH group removing process and a transparent glass
forming process. The OH group removing process is required since the heat resistance of quartz
glass, i.e. the viscosity at high temperature largely depends on the concentration of OH groups
contained in the quartz glass, in a way that the higher the concentration of OH groups, the lower the
heat resistance. Such heat resistance of quartz glass can be evaluated mainly by thermal
15 deformation, thermal shrinkage and the like, which have a close relation with the concentration of
OH group.

In conventional apparatus for manufacturing high heat resistant quartz glass, a device for
removing OH group and a device for forming transparent glass are separately provided. In the
heat treatment process of removing OH groups, a uniform temperature distribution should be made
20 over a wide area, that is wider than the porous silica to lower the concentration of OH groups in
porous silica in homogenous way, and thereby provide glass with uniform characteristics. On the
other hand, in the process of forming transparent glass, generally a uniform and narrow range of
high temperature area is provided, and then the porous silica is passed through said area (Japanese
patent laid-open 1993-319848).

25 Fig. 2 is a schematic view of a conventional heating device for removing OH groups

contained in porous silica. Commonly used heating device for removing OH groups contained in porous silica comprises a heat generator(21), a tube(22), a fire resistant material(23), porous silica(24), an elevating device(25), a supporting shaft(26), a bottom pipe(27) and the like.

Fig. 3 is a conventional heating device for forming transparent glass from silica porous, and comprises a heat generator(31), a tube(32), a fire resistant material(33), porous silica(34), an elevating device(35), a supporting shaft(36), a bottom pipe(37) and the like.

The conventional methods for removing OH groups and forming transparent glass with porous silica comprises: firstly loading the porous silica(24) inside the tube(22) of a heating device for removing OH groups as shown in Fig. 2 and heating the porous silica to a desired temperature while rotating it by using the elevating device(25) to remove OH groups; and subjecting the resulted porous silica(34) into a transparent glass forming device as shown in Fig. 3 to carry out a transparent glass forming process by passing the porous silica through a hot zone while rotating it by using the elevating device(35).

Disclosure of invention

Technical Problem

In the above method, while transferring the porous silica from the device for removing OH group after removing OH group from the porous silica is completed, to a device for forming transparent glass, OH groups derived from the moisture in the air are again attached to the porous silica and thus it makes the heat resistance deteriorated. As mentioned above, such deterioration in heat resistance of quartz glass is greatly affected by the moisture. In order to prevent the deterioration in heat resistance, it can be suggested to use a closed system in which the porous silica after the OH group removing process is transferred to a device for forming transparent glass while blocking the contact with the air, however the use of such closed system involves complex

and bulky apparatuses and increase in production cost.

Recently, in order to overcome such problems, a system where the OH group removing process and the transparent glass forming process can be conducted simultaneously, has been developed (see, Japanese Patent Laid-Open 2000-239036). In the system, an area for OH group removing and another area for transparent glass forming are provided on the upper part and the lower part of the system, respectively so that porous silica may be undergone the OH group removing process and then sent downward for transparent glass formation.

Fig. 4 is a schematic view of an apparatus designed to proceed removing OH groups contained in porous silica and the formation of transparent glass simultaneously, in which a heating device for removing OH groups and forming transparent glass comprises a heat generator(41), a tube(42), a fire resistant material(43), porous silica(44), an elevating device(45), a supporting shaft(46), a bottom pipe(47) and the like, wherein the heat generator(41) comprises the upper heat generator(41-1) for the heat treatment to conduct the OH group removing process and the lower heat generator(41-2) for the heat treatment to conduct transparent glass formation.

In the apparatus to conduct heat treatment for removing OH groups from porous silica and forming transparent glass, porous silica(44) is loaded in the tube(42), and its position in the apparatus is vertically adjusted to be in the area of the upper heat generator(41-1) for removing OH groups by using the elevating device(45). The upper heat generator(41-1) is controlled to set the desired temperature for removing OH groups, and the heating process for removing OH groups in the porous silica is carried out while rotating the porous silica(44) by using the elevating device(45). Afterwards, the temperature of the lower heat generator(41-2) for transparent glass formation is set to a desired temperature for transparent glass formation, and the heating process for transparent glass formation is carried out by descending the porous silica obtained from the upper heat generating area at a desired speed while rotating it by using the elevating device(45), and passing it through the narrow area having uniform temperature range for transparent glass formation.

However, the above-mentioned method involves a huge apparatus having a height of approximately twice as high as that of an apparatus manufactured according to the present invention, therefore the manufacture of a shaft, where high preciseness is required, becomes more difficult and the production cost also becomes increased. Further, when the length of the tube is longer, convection is occurred seriously owing to the temperature differences between the upper and the lower part in the tube, thereby uniform temperature control is hardly achieved. Moreover, since the inner volume of the tube is large, the amount of gas fed to heat the atmosphere becomes greater, thereby causing increase in production cost. Additionally, the height of the ceiling of a building where the apparatus is positioned, should be also concerned and restricted by the height of the apparatus. In order to improve the productivity of the quartz glass in the future, the size of a sample, particularly the length should be increased, and this makes the height of the apparatus greater, thereby making the problem worse.

The method includes an apparatus having greater height compared to the conventional ones and needs to use a tube and an elevating device part with prolonged length, thereby being hardly controllable. Further, when the length of the tube becomes longer, convection is occurred seriously owing to the temperature differences between the upper and the lower part in the tube, thereby uniform temperature control is hardly achieved. Moreover, since the inner volume of the tube is large, the amount of gas fed to heat the atmosphere becomes greater, thereby causing increase in production cost.

Naturally, there still has been a demand for developing a simple apparatus used for an OH removing process and a transparent glass forming process in manufacturing high heat resistant quartz glass.

Technical Solution

The object of the present invention to solve the problems of conventional arts, is to provide a cost-effective and simple apparatus for carrying out removing OH groups from porous

silica and transparent glass formation, thereby to provide high heat resistant quartz glass, which is used for high temperature poly-silicon TFT-LCD substrate or in a semiconductor process.

Description of Drawings

5 Fig. 1 is an illustrative view of an apparatus for manufacturing high heat resistant quartz glass, prepared according to the present invention.

Fig. 2 is an illustrative view of a conventional heat treatment device for removing OH groups in porous silica.

10 Fig. 3 is an illustrative view of a conventional device for transparent glass formation of porous silica.

Fig. 4 is an illustrative view of a conventional device for removing OH groups from porous silica and transparent glass formation simultaneously.

※ SYMBOLS MAINLY USED IN THE DRAWINGS

15	11,21,31,41 : heat generator	11-1 : upper heat generator
	11-2 : middle heat generator	11-3 : lower heat generator
	41-1 : heat generator for removing OH groups	
	41-2 : heat generator for transparent glass formation	
	12,22,32,42 : tube	13,23,33,43 : fire resistant material
20	14,24,34,44 : porous silica	15,25,35,45 : elevation device
	16,26,36,46 : supporting shaft	17,27,37,47 : bottom pipe

Best Mode

25 With a view to achieve above object, the inventors of the present invention developed an apparatus as shown in Fig. 1, and carried out the heat treatment process for removing OH groups

from porous silica and a transparent glass forming process simultaneously.

The present invention relates to a manufacturing apparatus for high heat resistant quartz glass, which can conduct an OH group removing process and a transparent glass forming process at once, and comprises: a tube(12) having a shape of a pipe, which is extended vertically in lengthwise direction to pass the porous silica through it; a series of three heat generators(11) around the tube(12); a fire resistant material (insulation substance)(13) which is disposed to surround the heat generators and the tube; an elevating device(15) equipped for moving the porous silica in rotative way and to the upward and downward direction; a supporting shaft(16) for connecting the elevating device(15) with the porous silica; a bottom pipe(17) for conditioning the atmosphere in the tube, and the like.

The series of three heat generators comprise an upper heat generator(11-1), a middle heat generator(11-2) and a lower heat generator(11-3), and the each heat generator is formed to be temperature-controlled separately. In a vertical furnace, which generally employs one unit type heat generator, owing to severe convection, it is hardly made to provide a uniform temperature area over a wide area of the furnace in lengthwise direction.

Further, in the process for removing OH groups contained in the porous silica(14) according to the present invention, all of the electric power of the heat generators in three different area, i.e. the upper heat generator(11-1), the middle heat generator(11-2) and the lower heat generator(11-3) is switched on, and controlled to have a uniform temperature distribution in all of the areas through the upper to the lower area. Generally, the temperature range for removing OH groups contained in the porous silica is 1000 ~ 1300°C. In the process, the position, i.e. the height of the porous silica is adjusted to be in the uniform temperature range by using the elevating device(15), and the porous silica is heated while being slowly rotated.

Furthermore, after completing the OH group removing process, the porous silica(14) is sent upward while switching off the power of the upper heat generator(11-1) and the lower heat

generator(11-3) but maintaining the power of the middle heat generator(11-2) on, thereby setting a desired temperature for transparent glass formation. When being reached to the desired temperature for transparent glass formation by using only the middle heat generator, the porous silica(14) is moved downward at a desired speed while being rotated, by using the elevating
5 device(15) to be undergone the heat treatment process for transparent glass formation. Generally, the temperature for transparent glass formation of the porous silica is 1450 ~ 1650°C. In the heating process for removing the OH groups contained in the porous silica, the temperature is controlled to have a uniform temperature distribution in a wide area, however, in the transparent glass forming process, the temperature is controlled to have a uniform temperature distribution in a
10 narrow area so that the heating is carried out to conduct transparent glass formation sequentially from the bottom part of the porous silica.

Industrial Applicability

The present invention has developed an apparatus, which can proceed a process for
15 removing OH groups from porous silica and a process for transparent glass formation together at once, to provide quartz glass. Therefore, quartz glass, which is used for a high temperature poly-Si TFT-LCD substrate or in a semiconductor process, can be manufactured by using the relatively simple apparatus for a reduced processing time, thereby economic mass production of the quartz glass becomes possible.

20 Further, according to the present invention, control for a uniform temperature area becomes convenient by reducing the height of the apparatus, and the amount of gas used for conditioning the atmosphere is reduced, thereby reducing the production cost. The apparatus is designed to be relatively less restricted by the height of the ceiling of a building where it is positioned, therefore it has potential great advantages in the manufacture of quartz glass in large
25 scale in the future.

CLAIMS

What is claimed is:

1. An apparatus for manufacturing high heat resistant quartz glass, which can conduct an OH group removing process and a transparent glass forming process together at once, and
5 comprises: a tube having a shape of a pipe, which is extended vertically in lengthwise direction to pass the porous silica through it; a series of three ring-shaped heat generators around the tube, which comprise an upper heat generator, a middle heat generator and a lower heat generator disposed sequentially; a fire resistant material which is disposed to surround the heat generators and the tube; an elevating device equipped for moving the porous silica in rotative way and the
10 upward and downward direction; a supporting shaft for connecting the elevating device with the porous silica; and a bottom pipe for conditioning the atmosphere in the tube.
2. The apparatus for manufacturing high heat resistant quartz glass according to claim 1, characterized in that the process for transparent glass formation is carried out by adjusting the temperature with the single use of the middle heat generator, while switching off the power of the
15 upper and the lower heat generators.
3. The apparatus for manufacturing a high heat resistant quartz glass according to claim 2, characterized in that the temperature for transparent glass formation is 1450 ~ 1650°C.
4. The apparatus for manufacturing high heat resistant quartz glass according to any one of claims 1 to 3, characterized in that when being reached to the desired temperature for transparent
20 glass formation by using the middle heat generator in the heat treatment process for transparent glass formation, the porous silica is moved upward or downward at a desired speed while being rotated, by using the elevating device.

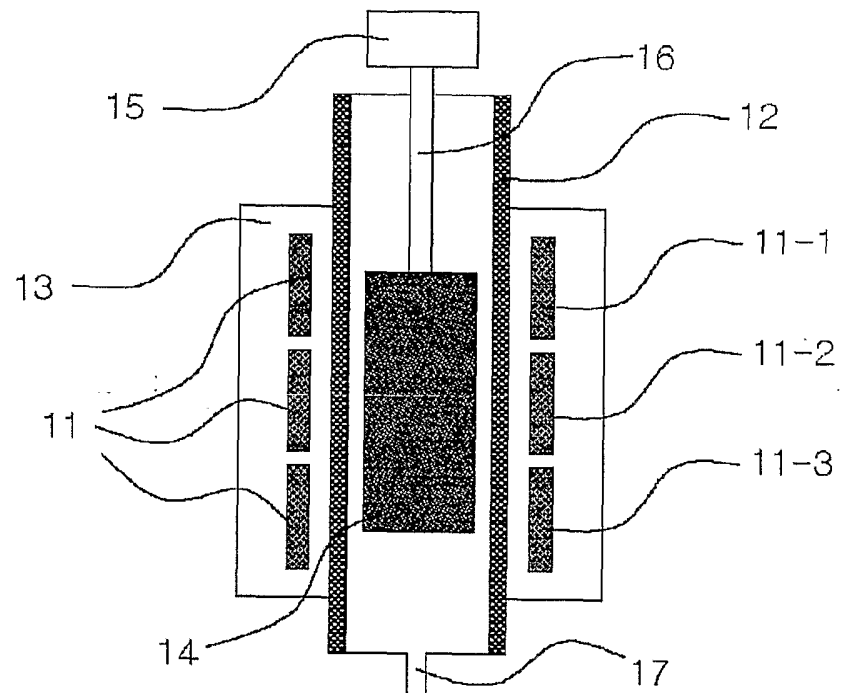
Fig. 1

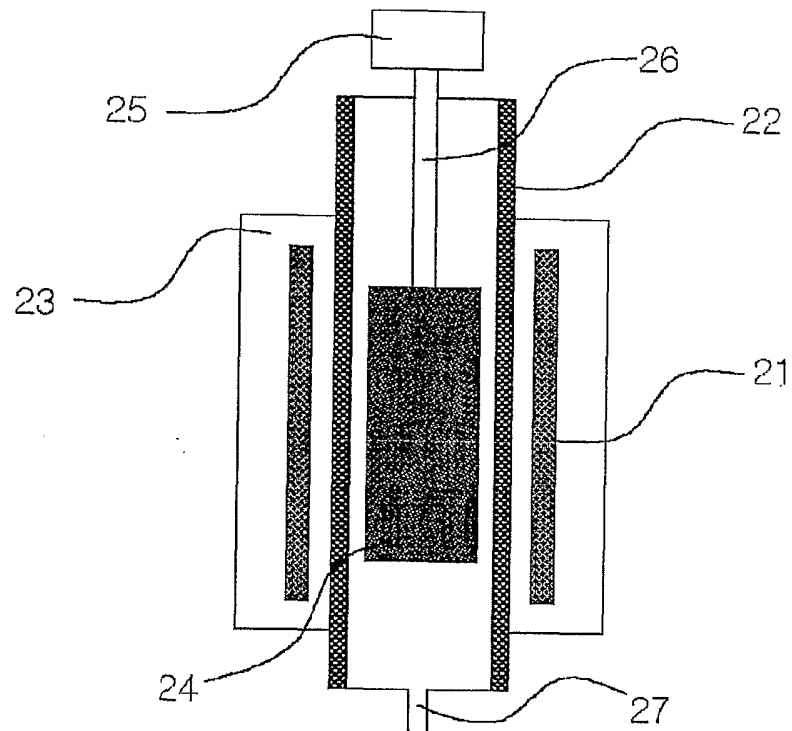
Fig. 2

Fig. 3

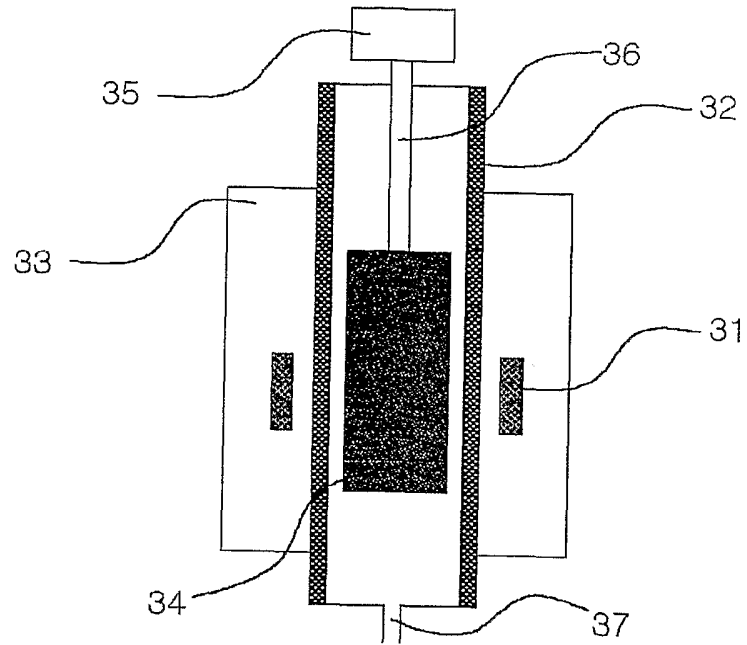
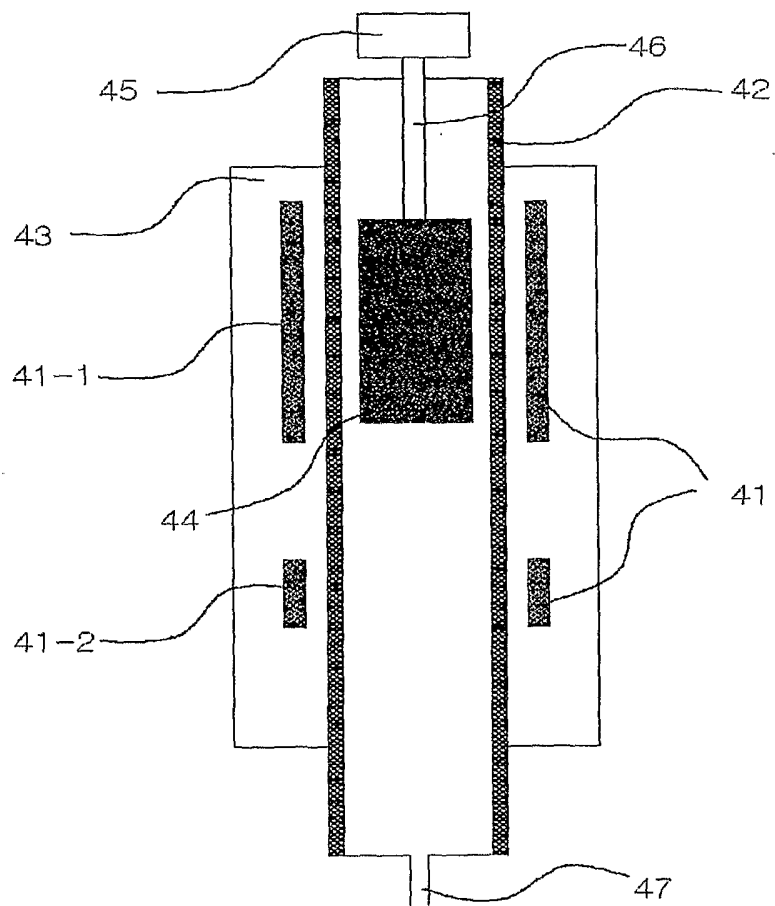


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2004/000845

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 C03B 37/014

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)

C03B 37/014

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

Korean Patents and applications for inventions since 1975

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

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

KIPASS, PAJ, USP

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,575,463 A (ITT Corporation) 11 Mar. 1986 See the whole document(especially, claim 1)	1-4
A	JP 2000-281358 A (Nikon Corp.) 10 Oct. 2000 See the whole document	1-4
A	JP 2003-165727 A (Carl-Zeiss-Stiftung) 10 Jun. 2003 See the whole document	1-4
A	JP 62-288129 A (Tatsuta electricwire&Cable Co., Ltd.) 15 Dec. 1987 See the whole document	1-4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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"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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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