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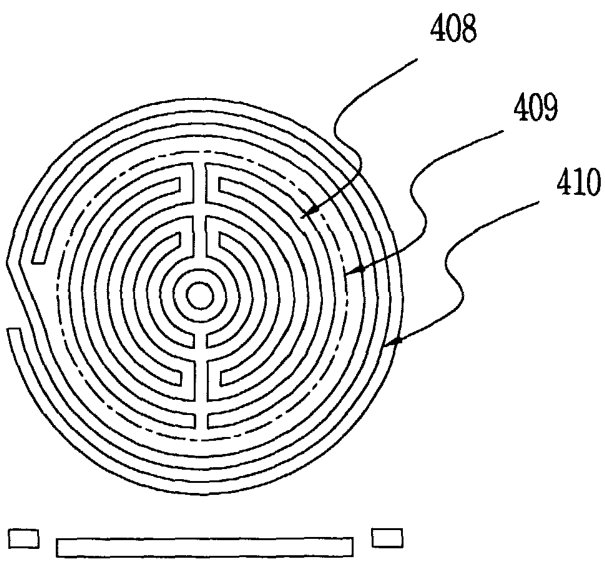
(54) Title: CVD THIN FILM MANUFACTURING APPARATUS



(57) Abstract: Disclosed is a CVD apparatus for fabricating thin films capable of enhancing the uniformity, minimizing the formation of reaction products or by-products in the chamber, having a long cleaning cycle of the chamber and increasing the yield of semiconductor fabricating processes. The CVD apparatus for fabricating thin films comprises a double heater unit including an inner heater having a diameter smaller than that of the wafer; and an outer heater having a inside diameter larger than that of the wafer, which is formed on the position perpendicularly higher than the inner heater and whose temperature is controlled independently with the inner heater in order to keep the temperature of the surface of the wafer uniform while progressing processes. The CVD apparatus further comprises a first nozzle and a second nozzle for injecting the nitrogen gas of the lower side, wherein the first nozzle is arranged in the lower side of a vacuum port, and the second nozzle is arranged to introduce the nitrogen gas from the lower side to the upper side in the chamber so as to distribute uniformly the nitrogen gas.

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CVD THIN FILM MANUFACTURING APPARATUS

Technical Field

The present invention relates to a chemical vapor deposition(CVD) apparatus for depositing a thin film on a surface of a wafer, more particularly to a heating unit and a lower nitrogen gas nozzle of the CVD apparatus and the controlling of the nitrogen gas of the lower side.

Background Art

In general, a method for forming thin films in semiconductor manufacturing processes is roughly divided into chemical vapor deposition(CVD) and physical vapor deposition(PVD). A CVD apparatus for fabricating thin films is divided into thermal CVD and plasma enhanced chemical vapor deposition(PECVD) according to the methods for obtaining activation energy, and into atmosphere pressure chemical vapor deposition(APCVD), sub-atmosphere chemical vapor deposition(SACVD), low pressure chemical vapor deposition (LPCVD) and high pressure chemical vapor deposition(HPCVD) according to atmosphere pressure.

The CVD thin films, which are made of various materials on a wafer by the CVD apparatus, perform various functions and roles in semiconductor devices.

There are various CVD thin films, for example, a poly silicon and metal(W, Cu, Tin and WSix) wire films for conducting electricity, SiO_2 insulating films for insulating between layers and wires, flat films such as boron phosphorous silica glass(BPSG) for flattening before wiring, high dielectric films such as Si_3N4, Ta_2O_5, BST, PZT and AL_2O_3 used for increasing a dielectric constant in forming capacitors, and passivation films such as SiON used for preventing impurities from permeating and protecting from external shocks.

As described above, the CVD apparatuses for fabricating thin films on silicon wafers are divided into a batch type for performing at once after loading several wafers simultaneously and a single wafer chamber type for performing the wafers one by one.

With the high integration of semiconductor devices, the shrinkage of design rules is more and more accelerated. In recent years, a photolithography process is realized up to the line width of 0.2~0.15 micron by using a KrF light source. It is expected that the high integration is continued and a next generation technology for light sources such as ArF, X-ray or laser is put to practical use. Owing to the high integration, from now on, it will be difficult to fabricate high-quality devices with the current furnace system. Since the current furnace exposes wafers to high temperature for a long time(4 ~ 6 hours), it will be difficult to obtain a processing margin in the next devices. Such a long time may cause the unnecessary diffusion and the seeping of impurities, so that a leakage current is generated in the devices, thereby deteriorating the electrical characteristics of the devices.

The conventional apparatuses for fabricating thin films have problems that the uniformity of the thin films may be deteriorated and reaction products or by-products may be formed in the undesired portion of the reaction chamber according to the method for fabricating the thin films. It follows that the cleaning cycle of the chamber is shortened and the reaction products are functioned as particles on the substrate in progress, thereby deteriorating the yield of semiconductor fabricating processes.

Disclosure of Invention

It is therefore an object of the present invention to provide an improved apparatus for fabricating semiconductor devices capable of solving the problems with the prior art.

It is another object of the present invention to provide an improved CVD apparatus for fabricating thin films capable of enhancing the uniformity.

It is still another object of the present invention to provide an improved CVD apparatus for fabricating thin films capable of minimizing the formation of reaction products or by-products in the chamber.

It is further another object of the present invention to provide an improved CVD apparatus for fabricating thin films capable of having a long cleaning cycle of the chamber and increasing the yield of semiconductor fabricating processes.

It is still further another object of the present invention to provide an CVD apparatus capable of improving the uniformity of the thin films in the structural aspect and minimizing the generation of additional reaction products according to the methods for progressing new process.

To achieve the above-mentioned objectives, according to one aspect of the present invention, there is provided a CVD apparatus for fabricating thin films including a double heater unit. The double heater unit comprises an inner heater whose diameter is smaller than that of the wafer and an outer heater whose inside diameter is larger than that of the wafer. The outer heater is formed on the position perpendicularly higher than the inner heater and its temperature is controlled independently with the inner heater in order to keep the temperature of the surface of the wafer uniform while progressing processes.

The CVD apparatus further comprises a first nozzle for injecting the nitrogen gas of the lower side which is arranged in the lower side of a vacuum port and a second nozzle for injecting the nitrogen gas of the lower side which is arranged to introduce the nitrogen gas from the lower side into the upper side of the chamber so as to distribute the nitrogen gas uniformly.

Brief Description of the Drawings

Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is an overall structural view showing a CVD apparatus according to the present invention.

Fig. 2A, 2B and 2C are detailed views related to an upper chamber of the CVD apparatus.

Fig. 3A, 3B and 3C are detailed views related to a lower chamber of the CVD apparatus.

Fig. 4A, 4B, 4C and 4D are detailed views related to a heater unit of the CVD apparatus.

Fig. 5A 5B, 5C and 5D are detailed views related to a gas nozzle for inhibiting reaction gas and the controlling of the nozzle.

Best mode for Carrying Out the Invention

Referring now to attaching the drawings, a CVD apparatus for fabricating thin films according to an embodiment of the present invention will be described in detail. It is noted that like parts are designated by like reference numerals throughout the accompanying drawings.

Fig. 1 shows the whole structure of a CVD apparatus for fabricating thin films according to the present invention. A process chamber is divided into five parts: a remote plasma unit 10, a shower head unit 30, 40, a chamber lid unit, a chamber body 50 and a chamber moving unit.

A remote plasma cleaning kit 10 is arranged to clean without opening the chamber lid 202, and radical gas excited by the remote plasma is introduced through a gas line.

The shower head unit 30, 40 having an improved structure are arranged in the top of the chamber so as to keep the quantity of the gas reached at the surface of a wafer uniform. The reaction gas firstly passes through the plate of the first shower head 30 having a plurality of holes from the external gas line, and secondly passes through the plate of second shower head 40 at a distance. The distance between the plates of the two shower heads is set to optimize the uniformity of processes. One of the plates is formed movable to maintain the distance optimally. Preferably, the number of the holes formed in the plate of the second shower head is greater than that of holes in the plate of the first shower head, and the size of the holes is different each other. The shower heads is made of materials such as pure aluminum, nickel(Ni), oxidized aluminum, inconel and the like.

Referring to the figures, the upper chamber has the form of a chamber lid, which comprises the plates of two shower heads 30, 40 having the holes of a defined shape. The reaction gas introduces into the reaction chamber through the holes of the shower heads, so that the uniformity of the gas reached on the surface of the lower wafer is improved.

The lower chamber of a perpendicular cylindrical shape has a predetermined volume from the top of the chamber. In the center of the bottom of the chamber, an inclined hole having a defined shape is formed at the position to be placed a heater. In the one side of the cylindrical chamber, a slit for loading/unloading the wafer is formed.

A vacuum guide for keeping the inside of the chamber vacuum is arranged on the sidewall of the chamber, and a vacuum port is formed on the opposite side of the slit. Further, an inner vacuum plate and an outer vacuum plate are arranged to keep the inside of the chamber vacuum, and a nitrogen gas slit is arranged in the inner vacuum plate. To control the pressure and the quantity of the lower nitrogen gas, the size of the slit is varied and the direction of the plate may be changed from side to side.

A lower nitrogen gas nozzle 110 is arranged to restrain the reaction gas from feeding to the heater unit 90. A nitrogen gas slit is formed on the inner vacuum plate for controlling the passage of the nitrogen gas of the lower side. An asymmetric vacuum guide is formed to guide radically the stream of the gas.

Now, a description will be given to the heater unit 90.

The heater unit is a heat source for supplying thermal activation energy to form CVD thin films and comprises heaters for transforming an externally applied electrical energy into the thermal energy. The heater block for surrounding the heaters, which is made of ceramic materials such as aluminum nitride(AIN), aluminum oxide(Al_2O_3) and the like, transfers the generated heat to the upper side.

In the inside of the heater, a thermal couple for measuring temperature is arranged to control the temperature of the inside. The zone for heating is divided into an inner heater zone and an outer heater zone, which are controlled independently, so that its surface temperature is controlled uniformly by the thermal couple. There is a step coverage between the inner heater and the outer heater to compensate the temperature in the outside of the heater unit. That is to say, the outer heater is mounted higher than the inner heater and its temperature is also controlled slightly higher than that of the inner heater.

The surface on the top of the heater on which the wafer is placed is called " susceptor", which comprises a susceptor guide for seating the wafer safely and a lift pin 100 for moving the wafer. On the surface of the susceptor, a regular pattern of protrusions is formed to prevent the transferred wafer from sliding. Further, a heater up/down unit is arranged. The detailed structure of the heaters is described later with reference to the Fig. 4A to 4D.

Now, a detailed description will be given to the lower nitrogen gas nozzle 110.

First, it is described the necessity of the lower nitrogen gas nozzle 110. To form the CVD thin films, the nitrogen gas is introduced and the chemical reaction is performed in the chamber. It follows that reaction products and by-products are formed in undesired parts. Therefore, it requires preventing the reaction gas from feeding to the bottom of a chuck heater.

By dividing the injecting direction of the nitrogen gas nozzle into a side inlet and a bottom inlet, the lower nitrogen gas nozzle has two inlets. A control valve is arranged in a wall of the chamber so as to control the quantity of the nitrogen gas of the lower side flowing from each inlet according to the reaction gas and the pressure of the chamber. Therefore, the nitrogen gas of the lower side can be distributed uniformly in the outside of the heater.

This will be described below with reference to the Fig. 5A and 5B.

According to the present invention described with reference to Fig. 1, the heaters compensate the thermal loss in the outside, and the lower nitrogen gas nozzle and the control valve prevent the reaction gas from flowing to the lower side and keep the reaction gas at a uniform pressure in the upper side.

Fig. 2A is a perspective view showing the three dimensional shape of the upper chamber and shows a chamber lid 202, the inside of a Kettle-type chamber and a hole part 203 on which the heater is placed. The chamber lid 202 on which a gas shower head and a gas line 201 of a regular size are attached is arranged in the top of a hexahedral chamber body 50.

Fig. 2B is a plan view of the top of the upper chamber and shows the chamber inner wall 52 of a Kettle-type, the first and the second shower heads 30, 40 having holes of a defined shape, and a gas line 201 for introducing external gas. The number, the diameter and the arrangement of the holes formed in the shower heads 30, 40 can be optimized to improve the uniformity of the process, and the first shower head is different in form from that of the second shower head according to the characteristics of the CVD thin films to be deposited. The gas line 201 for introducing gas into the inside of the chamber is connected to the top of the shower head via the chamber lid 202.

Fig. 2C shows a cross sectional view of the chamber lid 202 placed on the chamber. The first and second shower heads are apart from each other at a distance for optimizing the uniformity of processes. One of plates of the first and the second shower heads is formed moveable to keep the distance. Preferably, the material of the shower head is nickel, or may be other materials depending on the material of the CVD film to be deposited or the type of remote plasma cleaning gas.

With the cylindrical chamber wall and the shower head, as shown the drawings, the reaction gas introduced in the chamber flows straight or radially such as Kettle cover wall type until arriving the surface of the wafer, which enhances the uniformity of the surface of the wafer. Therefore, the deposited film is excellent in the uniformity and the stoichiometric respect.

Fig. 3A, 3B and 3C are a three-dimensional perspective view, a plan view and a cross sectional view of the lower chamber, respectively.

Referring to the Fig. 3A, a recess 300 for inserting an O-ring is formed in the top of the chamber to maintain vacuum sealing. A Kettle-type chamber wall 52 is formed to have a predetermined volume ranging from the top of the chamber. A taping chamber wall 303 tapering down from a predetermined height to the bottom 304 of the chamber at a predetermined angle is formed in the center of the bottom of the chamber. An inclined hole 305 having a defined shape is formed in the position where a heater used as a heat source will be positioned, and a slot 301 is formed on a side of the cylindrical chamber for loading/unloading the wafer. A vacuum port 302 is formed on the opposite side of the slot 301 to keep the pressure of the inside of the chamber uniform in cooperation with the vacuum guide.

Fig. 3B is a plan view from the lid of the chamber, where the position of the vacuum port 302 is connected with a pump to keep the pressure uniform. A slot valve 301-1 for inputting/outputting the wafer is placed in the opposite side of the vacuum port 302. A vacuum guide 302-1 forms a flow passage for gas or by-products flowed uniformly from the shower head. A heater is arranged on the inclined hole 305 placed on the bottom of the chamber. The vacuum guide 302-1 sets the position of the heater unit on which the wafer is placed, forms the flow passage radially, and keeps the pressure of the inside of the chamber uniform, so that the uniformity is improved.

Fig. 3C is a cross-sectional view showing the lower side of the chamber, and shows a load/unload unit 301-2 for loading/unloading the wafer, a vacuum guide line 302-2 for keeping the pressure of inside of the chamber stable as a whole and setting a flow passage to the vacuum port, a bellows unit 120-1 for moving the heater up and down and isolating from the outside of the chamber, and a vacuum port 302.

Fig. 4A to Fig. 4D shows the heater unit in detail.

Fig. 4A is a cross-sectional view of the heater unit where the inner heater 401 is slightly smaller in diameter than the wafer. Since the outside of the heater block 405 is close to the chamber wall 303, the heat loss is heavy. Therefore, the outer heater 402 is arranged as another heat source to compensate the heat loss and keep the temperature of the surface of the wafer uniform. The outer heater 402, which is made of molybdenum(Mo) or ceramic, controls the temperature of the outer side of the heater independently. The heater block 405 for enclosing the heaters, which is made of ceramic materials such as aluminum nitride, transfers the heat generated from the heaters to the upper susceptor 400. There is a lift pin-hole 406 for loading/unloading the wafer on the upper side of the heater, and a lift pin is made of ceramic materials such as aluminum oxide. To control the temperature of the inside, a thermal couple 403, 404 for measuring temperature are arranged the center of the inside and the edge of the outside.

Fig. 4B is a plan view showing a heating element of the inner heater 401, where the maximum outside diameter of the inner heater is slightly smaller than the diameter 409 of the wafer. Fig. 4C is a plan view showing a heating element of the outer heater, where the minimum inside diameter of the outer heater is slightly larger than the diameter 409 of the wafer.

Preferably, it is minimized that the inner heater affects the outer heater in its temperature by optimizing the distance between the outside diameter of the inner heater and the inside diameter of the outer heater under the condition of maintaining the uniformity. Since the heat loss generated from the part close to the chamber wall 303 is compensated with the outer heater 402, it is ensured that the temperature uniformity is optimized on the surface of the wafer.

Fig. 4D is a plan view of the heater and a cross-sectional view of a heating element taken along its central axis. Referring to the cross-sectional view, the heating device of the outer heater is arranged slightly high than that of the inner heater in order to minimize the heat loss of the outer heater. With a like heat, therefore, the temperature is increased in the top of the outer heater and the corresponding part of the wafer. The temperature range of the heater is controlled roughly from 300℃ to 850℃.

According to above embodiment, the thermal efficiency of the outer heater due to the heat loss of outer side of the heater is improved and the temperature deviation between the inner heater and the outer heater is reduced to compensate the heat in the outer side of the heater. Therefore, it prevents the error occurring in sensing the temperature with the inner thermal couple. On the wafer, substantially, the temperature of the outer side is lower than that of the other side because of the heat loss through the chamber wall. To solve this problem, the heater according to the present invention comprises two parts: the inner heater and the outer heater, and controls independently.

Fig. 5A to 5C are detailed views showing a lower nitrogen gas nozzle and a lower nitrogen gas control valve for distributing the nitrogen gas of the lower side uniformly, and a cross-sectional view showing a control circle plate taken along the center of a control circle plate.

Fig. 5A shows a lift plate for supporting two lower nitrogen gas nozzles and the lift pin, and lower nitrogen gas nozzle. Preferably, reaction products are formed only on the wafer, but undesired by-products are formed by the reaction occurring on another places. The by-products have an effect as particles in processes. Therefore, the lower nitrogen gas nozzle is arranged to prevent the reaction gas from flowing to the lower side of the heater. The lower nitrogen gas nozzle comprises an upper nozzle and a lower nozzle, where the number of holes in the upper nozzle is greater than that of the holes in the lower nozzle. The holes of lower nitrogen gas nozzle are formed toward the outer side of the heater to prevent the reaction gas from flowing between the heater and the inner plate.

In the conventional apparatuses, the lower side is asymmetric in structure, that is, the vacuum port is arranged in the same direction as the lower nitrogen gas inlet and also formed in the opposite side of the slot valve, so that the nitrogen gas of the lower side is highly distributed in the opposite side of the lower nitrogen gas inlet. In the lower side, the distribution of the nitrogen gas of the lower side varies according to the kinds of reaction gas, the pressures by process steps and the shapes of the structure of the apparatus. Since the non-uniformity of the nitrogen gas of the lower side affects the reaction for the upper side, it is difficult to obtain the uniformity of processes.

To solve this problem, the lower nitrogen gas nozzle is arranged right under the vacuum port and the nitrogen gas of the lower side is injected to two directions including the additional direction directed from the bottom to the top. A lower nitrogen gas control valve is formed to control the quantities of the nitrogen gas introducing from each inlet. The ratio between the quantities by each inlet varies to obtain the uniformity of the processes according to the kinds of reaction gas, the process pressures and process steps. In addition, the ratio varies according to the shape of the lower nitrogen gas nozzle, the direction for injecting the nitrogen gas of the lower side, the shape of the vacuum guide line and the size of the hole formed in the nitrogen gas slit of the inner plate. This variation is controlled by the lower nitrogen gas control valve.

Fig. 5B shows the lower nitrogen gas control valve for controlling the quantity of the nitrogen gas of the lower side introducing from the inlet in detail. The lower nitrogen gas inlet comprises a side inlet and a bottom inlet, and a control circle plate is arranged to control the quantity ratio introducing through the two inlets or to change the injecting direction. The control circle plate is formed rotatable on its axles from A, B to C. As shown the drawings, if the control circle plate is placed in the A point, the nitrogen gas of the lower side is flowed down and distributed more in the vacuum port than the other side, if placed in the B point, distributed 50 to 50 for two sides, and if placed in the C point, flowed to the side and distributed more in the slot valve opposite to the vacuum port than the other side. It is preferable that the quantity ratio for injecting to each direction is controlled by placing the control circle plate in the range of A to B. Therefore, it is possible for the nitrogen gas to be distributed uniformly according to the kinds of gas, the variation of the pressure and the variation of the process depending on the process steps. Further, according to atmosphere by the kinds of reaction gas, process steps and process pressures, the uniformity of the process can be ensured.

Fig. 5C is a plan view showing a cross-section taken along the center of a control circle plate in the lower nitrogen gas control valve. A, B and C of the Fig. 5C correspond to A, B and C of the Fig. 5B, respectively. The control circle plate includes a connecting screw for connecting with an external motor so as to rotate. The connecting screw is fixed on the inside of the circle plate and a proper motor should be selected to obtain rotation power.

In order to inject the nitrogen gas to only one direction, when the control circle plate is placed in the A and C points, an O-ring is inserted in the front and back surfaces of the outer side of the control circle plate for the purpose of sealing. Therefore, it is solved that the nitrogen gas of the lower side is distributed non-uniformly.

In case of using a single reaction gas to fabricate CVD thin films, generally, the reaction gas is introduced through the shower head of the upper side. The process for above case is divided into two cases. First, if SiH_4 or Si_2H_6 gas is introduced into the chamber and reacted at 450℃ to 650℃, then amorphous silicon or polycrystalline silicon films may be deposited by a LPCVD process. Second, SiH_4 or Si_2H_6 gas is introduced into the chamber and reacted at 450℃ to 650℃ with the pressure keeping in 10E−5 Torr, then a selective hemispherical silicon grain may be formed.

In case of using at least two reaction gases to fabricate CVD thin films, a first reaction gas and a second reaction gas are separately or simultaneously introduced into the chamber. Now, seven embodiments of above cases will be described.

First, a nitride film(Si_3N_4) is deposited from NH_3 and SiH_2Cl_2 by introducing N_2O and then successively NH_3 and SiH_2Cl_2 into the chamber with the internal temperature of the chamber at 500 to 800 ℃ and the pressure of less than 300 Torr.

Second, a nitride film is deposited from NH_3 and SiH_4 by introducing N_2O and then simultaneously NH_3 and SiH_4 into the chamber with the internal temperature of the chamber at 500 to 800 ℃ and the pressure of less than 300 Torr.

Third, a nitride film is deposited from NH_3 and $SiCl_4$ by introducing N2O and then simultaneously NH_3 and $SiCl_4$ into the chamber with the internal temperature of the chamber at 500 to 800 ℃ and the pressure of less than 300 Torr.

Fourth, a nitride film is deposited from NH_3 and $SiCl_6$ by introducing N_2O and then successively NH_3 and $SiCl_6$ into the chamber with the internal temperature of the chamber at 500 to 800 ℃ and the pressure of less than 300 Torr.

Fifth, an oxide (SiO_2) film is deposited from O_2 and SiH_4 by introducing N_2O and then simultaneously O_2 and SiH_4 into the chamber with the internal temperature of the chamber at 300 to 800 ℃ and the pressure of less than 300 Torr.

Sixth, an oxide film is deposited from N_2O and SiH_2Cl_2 by introducing N_2O and then successively N_2O and SiH_2Cl_2 into the chamber with the internal temperature of the chamber at 300 to 800 ℃ and the pressure of less than 300 Torr.

Seventh, an oxide film is deposited from N_2O and SiH_4 by introducing N_2O and then successively N_2O and SiH_4 into the chamber with the internal temperature of the chamber at 300 to 800 ℃ and the pressure of less than 300 Torr.

In case of using at least three reaction gases to form CVD films, one or two gases are firstly introduced before the rest one or two gases. It follows that the process induced particle is reduced and the flowing of the process gas is improved, so that the uniformity of the process is improved.

The present invention has the effects as follows.

First, the flowing of the reaction gas introduced into the chamber is uniformed by using the cylindrical chamber wall and shower heads, so that the uniformity and the deposition characteristics of the thin films are improved and the wafer loading effect, the thickness of deposition varies according to the pattern density as against the planer without patterns within the wafer, is improved.

Second, the heat loss from the chamber wall is compensated by the heater of a double structure, so that the temperature uniformity of the surface of the wafer is increased, thereby improving the characteristics of the thin films to be deposited on the wafer and the uniformity of the deposited thin films.

Third, the heat loss of the outer heater is minimized by arranging the outer heater higher than the inner heater, so that the temperature is increased in the outer heater and the wafer. Therefore, the difference of temperature between the inner and the outer side for compensating the heat of the outer heater is reduced, so that the temperature of the inner thermal couple is controlled stably.

Fourth, the generation of reaction products is minimized by preventing the reaction gas from introducing into the bottom of the heater due to the introducing of the nitrogen gas of the lower side, so that the generation of by-products is restrained and the period for rinsing is extended greatly.

Fifth, by changing the injecting direction of the nitrogen gas of the lower side, it is solved that the nitrogen gas is non-uniformly distributed by placing the vacuum port and the direction for injecting nitrogen gas in the same direction.

Sixth, by arranging the control valve for controlling the nitrogen gas of the lower side and controlling the quantity of the gas flowing from each inlet, the uniformity of process is ensured optimally according to the kinds of the reaction gas, the process step, the process pressure and the process atmosphere.

Although the present invention has been fully described by way of examples with reference to the accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. Therefore, unless such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

What Is Claimed Is:

1. A chemical vapor deposition apparatus for fabricating thin films which comprises:

a double heater unit including

an inner heater having a diameter smaller than that of the wafer; and

an outer heater having a inside diameter larger than that of the wafer, which is formed on the position perpendicularly higher than the inner heater and whose temperature is controlled independently with the inner heater in order to keep the temperature of the surface of the wafer uniform while progressing processes.

2. The chemical vapor deposition apparatus according to claim 1, wherein the material of the outer heating device for receiving a heater is made of molybdenum(Mo) or ceramic(Sic).

3. The chemical vapor deposition apparatus according to claim 1, further comprising:

a first nozzle for injecting the nitrogen gas of the lower side, which is arranged in the lower side of a vacuum port; and

a second nozzle for injecting the nitrogen gas of the lower side, which is arranged to introduce the nitrogen gas from the lower side to the upper side of the chamber so as to distribute the nitrogen gas uniformly.

4. The chemical vapor deposition apparatus according to claim 3, wherein the number of holes formed in the first nozzle is more than that of

the second nozzle.

5. The chemical vapor deposition apparatus according to claim 3, wherein a control valve for controlling the quantity of the gas injected from each direction is arranged in the first and the second nozzle.

6. A chemical vapor deposition apparatus for fabricating thin films which comprises:

a shower head unit capable of moving, which comprises a first shower head having a plate for firstly passing the reaction gas within the cylindrical chamber and a second shower head having a plate for secondly passing the reaction gas from the first shower head;

a double heater unit comprising an inner heater having a diameter smaller than that of the wafer; and an outer heater having a inside diameter larger than that of the wafer, which is formed on the position perpendicularly higher than the inner heater and whose temperature is controlled independently with the inner heater in order to keep the temperature of the surface of the wafer uniform while progressing processes; and

an injecting nozzle unit comprising a first nozzle and a second nozzle for injecting the nitrogen gas of the lower side, wherein the first nozzle is arranged in the lower side of a vacuum port, and the second nozzle is arranged to introduce the nitrogen gas from the lower side to the upper side in the chamber so as to distribute uniformly the nitrogen gas.

Fig 1

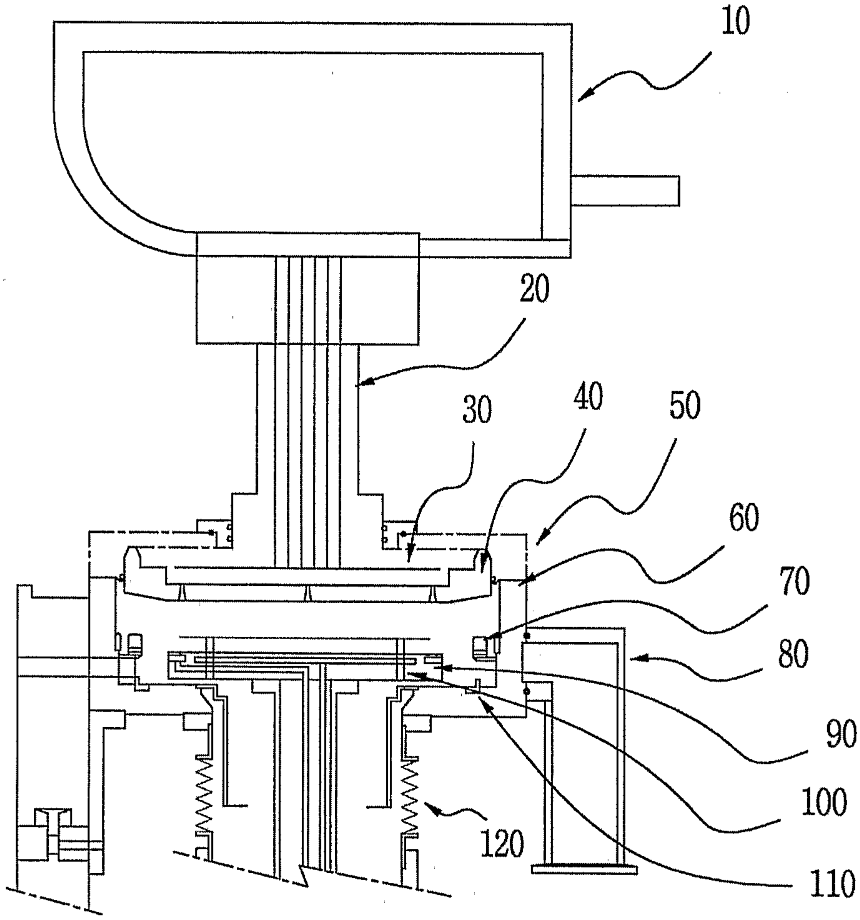


Fig 2A

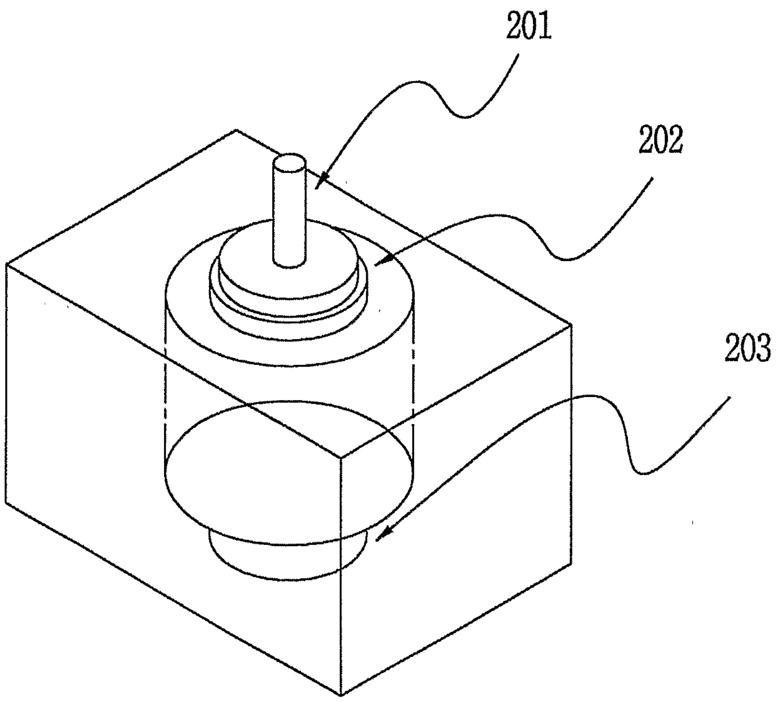


Fig 2B

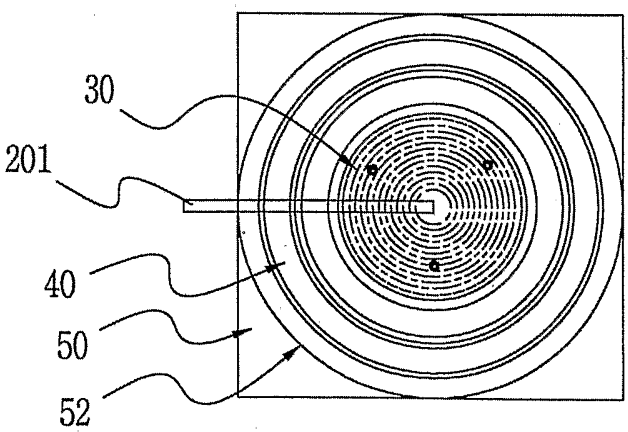


Fig 2C

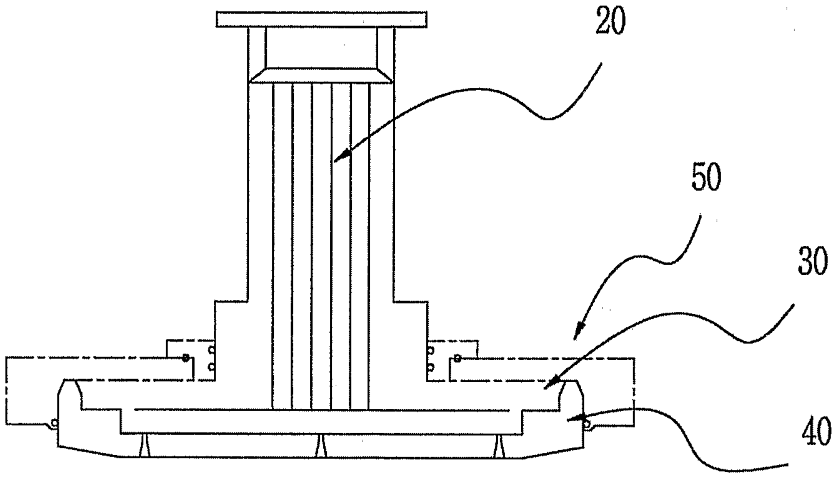


Fig 3A

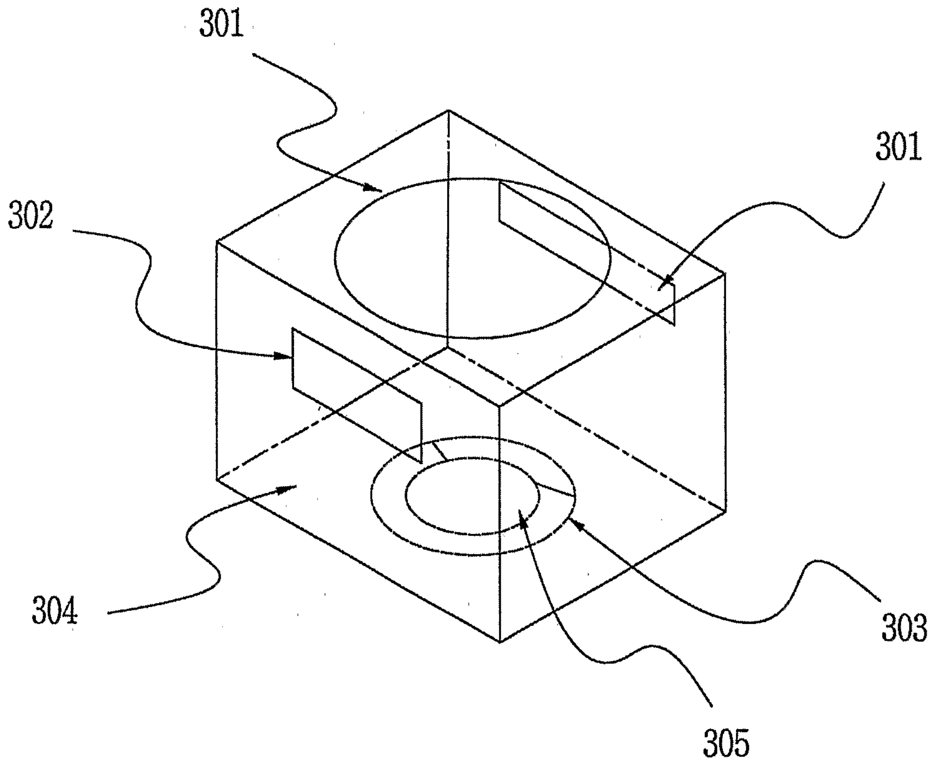


Fig 3B

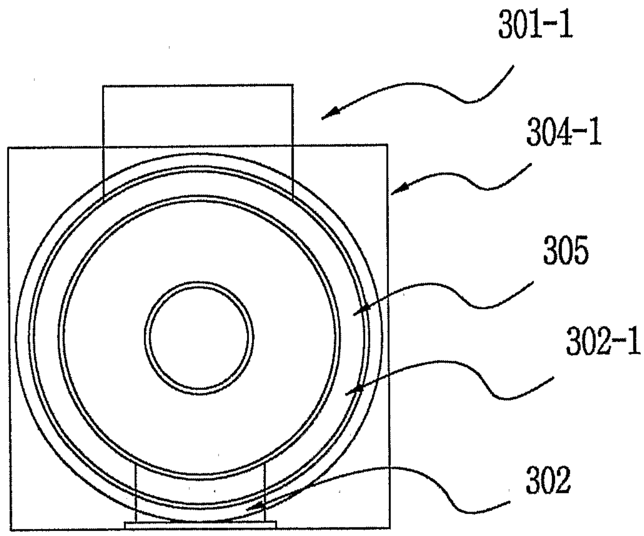


Fig 3C

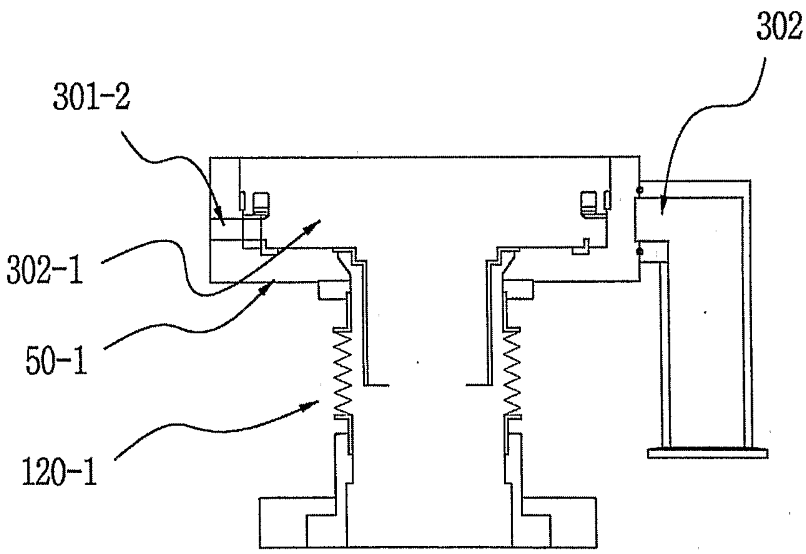


Fig 4A

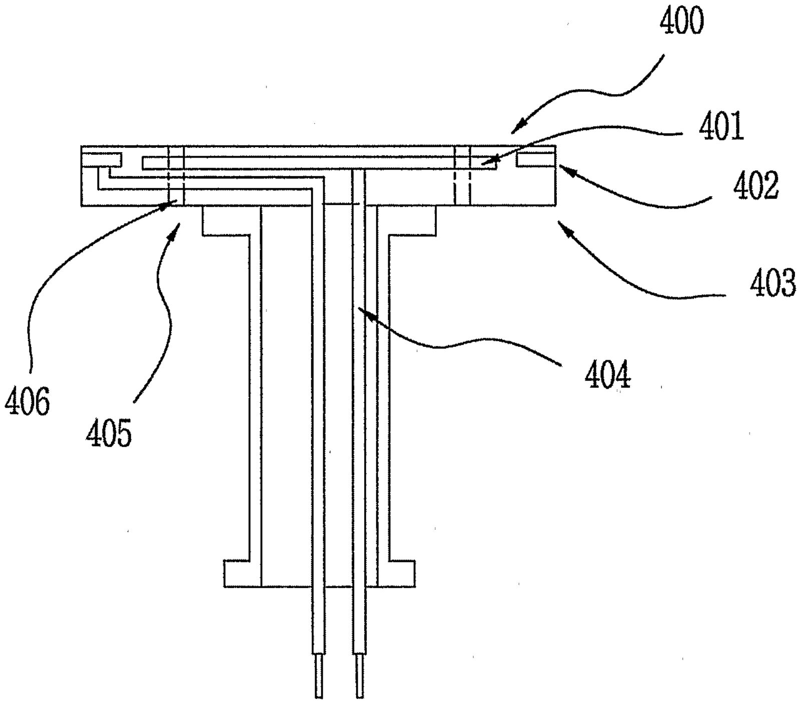


Fig 4B

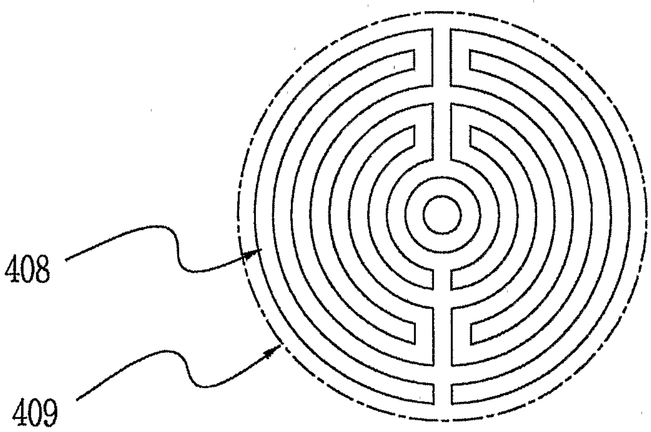


Fig 4C

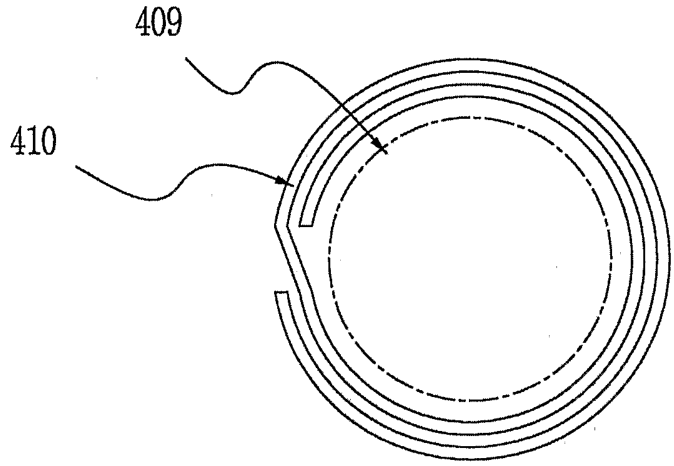


Fig 4D

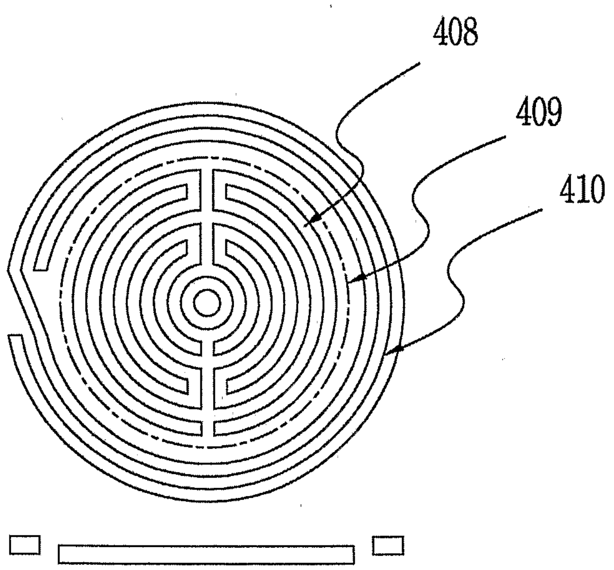


Fig 5A

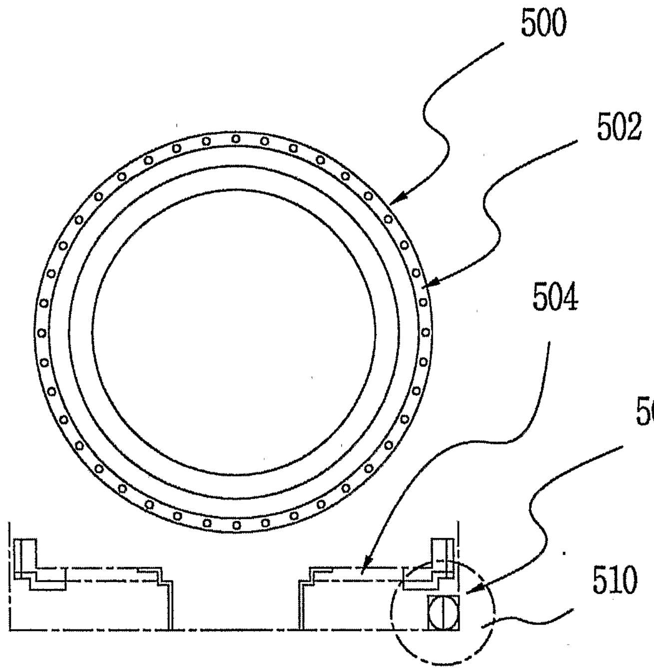


Fig 5B

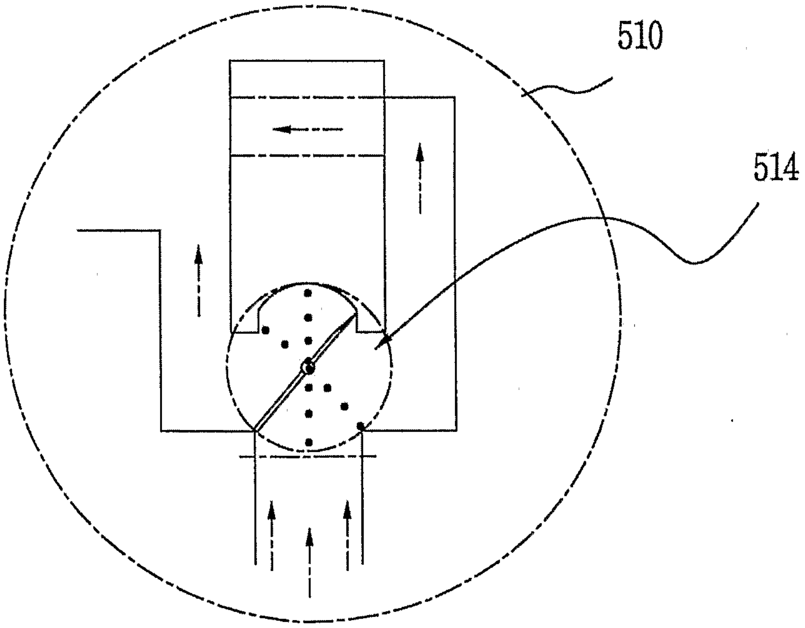
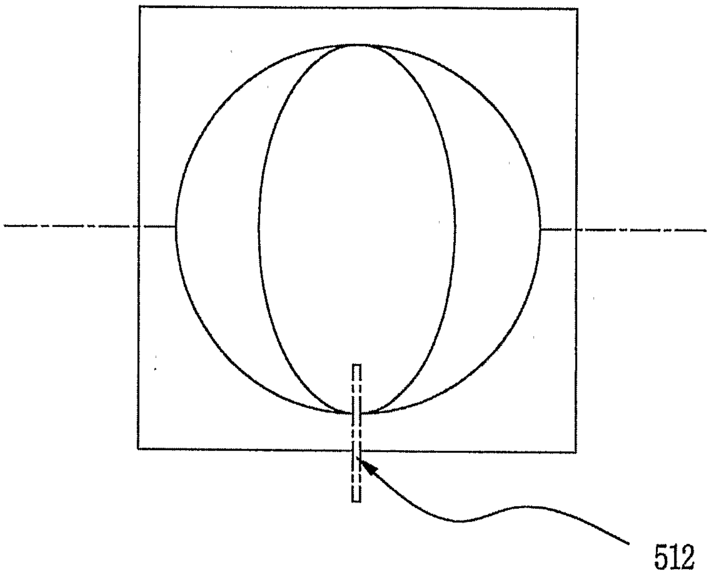


Fig 5C



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/01946

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H01L 21/205

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 H01L 21/20, H01L21/02, H01L21/205, C23C16/00, H01L21/324,H01L21/30

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

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

KIPONET

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5592581 A (Tokyo Electron Kabushiki Kaisha) 7.January.1997 see abstract, claims	1-2
A	US 5108792 A (Applied Materials Inc.) 28.April.1992 see the whole document	1-2
A	JP 01-248626 A (FUJITSU LTD) 4.October.1989 see the whole document	1-2
A	US 5592581 A (Tokyo Electron Kabushiki Kaisha) 12.October.1993 see the whole document	1-2

☐ 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 relevence
"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
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"Y" document of particular relevence; 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
13 AUGUST 2002 (13.08.2002)	13 AUGUST 2002 (13.08.2002)

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