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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 March 2010 (04.03.2010)

PCT

(10) International Publication Number
WO 2010/024678 A1

(51) International Patent Classification:
H01L 21/00 (2006.01) ***H01L 21/683*** (2006.01)

(21) International Application Number:
PCT/NL2009/050520

(22) International Filing Date:
1 September 2009 (01.09.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
08163415.6 1 September 2008 (01.09.2008) EP

(71) Applicant *(for all designated States except US)*: **NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-NATUURWETENSCHAPPELIJK ONDERZOEK TNO** [NL/NL]; Schoemakerstraat 97, NL-2628 VK Delft (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **VERMEER, Adrianus Johannes Petrus Maria** [NL/NL]; Haagdoorn 3, NL-5666 BW Geldrop (NL). **BROERS, Sander Christiaan** [NL/NL]; Kazernelaan 6, NL-6006 LW Weert (NL).

(74) Agent: **HATZMANN, M.J.**; Vereenigde, Johan de Wittlaan 7, NL-2517 JR Den Haag (NL).

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

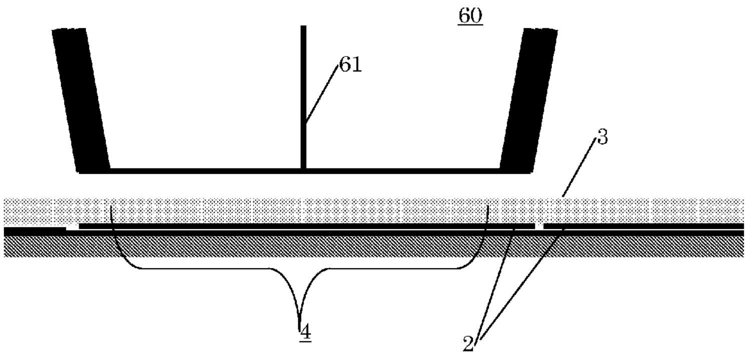
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS,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

Published:

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

(54) Title: CHIP DIE CLAMPING DEVICE AND TRANSFER METHOD

Figure 3



(57) Abstract: According to an aspect of the invention, there is provided a chip die clamping device (1) arranged for placement of chip dies (2) in a chip manufacturing process, comprising a carrier plate (3) comprising compartmented clamping zones (4) on a top face (5) arranged for placement of a diced wafer (20); and a vacuum circuit arranged for providing a vacuum clamping pressure to the clamping zones (4). A gas supply mechanism (6) is arranged to locally cancel the vacuum clamping pressure in a specified clamping zone (4) and a controller arranged for controlling the gas supply mechanism (6) to release a selected die (2') of the diced wafer (20) in response to received pick and place instructions. Advantages may include less breakdown risk in the pick and place process.

P89220PC00

CHIP DIE CLAMPING DEVICE AND TRANSFER METHOD

FIELD OF THE INVENTION

The invention relates to a chip die clamping device arranged for placement of chip dies in a chip manufacturing process.

BACKGROUND OF THE INVENTION

In the ongoing miniaturization process of integrated circuit devices, the latest developments involve the manufacture of multiple stacks of ultrathin silicon dies, which require great care in the handling process as the die thicknesses reduce to sub 100 micron, or even in the 10-50 micron zone. These thicknesses are generally incompatible with existing pick-up methods for semiconductor dies. Such methods are based on the fact that the stiffness of the die is much higher than the stiffness of the carrier tape that is attached to a face of the dies. The carrier tape is used to hold the wafer together in the dicing process and must be removed when isolating the dies. The conventional pick-up of a thin die from the tape is performed with help of a lifting needle that pushes through the tape against the die, thus creating stresses at the die edge that initiate peeling. First the chip is attached to a pickup tool through vacuum and then separated (peeled) from the adhesive tape.

The pushing action of the needles is required as the vacuum force alone is not strong enough to overcome the adhesion and 'squeeze-flow' forces. However, the pushing force, as well as the edge stresses as a result of the pushing needle only occur when the bending stiffness of the die is much higher than the bending stiffness of the foil. For very thin dies this is no longer valid.

Using slower peel speeds can help, but this will increase the cycle time and reduce productivity. Reducing chip thickness or increasing the size will result in an even greater chance of the chip breaking during peeling. And, even if the adhesive force is eliminated, the remaining fluid layer below the die may cause squeeze flow effects that - at relevant pick-up speeds - yield a required pick-up force that is much higher than what can be applied by a vacuum nozzle.

Additionally, any remaining adhesive has to be removed and is a source of package contamination.

A desire exists to provide an alternative to the conventional clamping methods. US2005/0019980 discusses vacuum clamping arrangements for chip dies. In this disclosure a chip die clamping device is arranged for placement of chip dies in a chip manufacturing process, comprising segmented clamping zones on a top face arranged for placement of the dies. A vacuum circuit is arranged for providing a vacuum clamping pressure to the clamping zones. The vacuum in the zones is individually controlled, which complexifies the vacuum system by a multitude of vacuum tubing.

SUMMARY OF THE INVENTION

According to an aspect of the invention, there is provided a chip die clamping device arranged for placement of chip dies in a chip manufacturing process, comprising a carrier plate comprising compartmented clamping zones on a top face arranged for placement of a diced wafer. A gas supply mechanism is arranged to locally cancel the clamping pressure in a specified clamping zone and a controller arranged for controlling the gas supply mechanism to release a selected die of the diced wafer in response to received pick and place instructions. According to another aspect, a method of placement of chip dies in a chip manufacturing process, comprising: providing a carrier plate comprising compartmented clamping zones on a top face arranged for placement of a diced wafer; providing a clamping pressure to the clamping zones; locally supplying gas on a bottom face opposite a specified clamping zone to locally cancel the clamping pressure; and controlling the gas supply mechanism to release a selected die of the diced wafer in response to received pick and place instructions.

In yet another aspect, a method of placement of chip dies in a chip manufacturing process is provided, comprising: providing a carrier plate comprising compartmented clamping zones on a top face arranged for placement of a diced wafer; providing a clamping pressure to the clamping zones; locally supplying gas on a bottom face opposite a specified clamping zone to locally cancel the clamping pressure; and controlling the gas supply mechanism to release a selected die of the diced wafer in response to received pick and place instructions.

Advantages may include less breakdown risk in the pick and place process.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a first embodiment according to an aspect of the invention;

Figure 2 shows a detail of the Figure 1 embodiment;

Figure 3 and Figure 4 show details of the nozzle and chip die transfer process;

Figure 5 shows a mechanism to limit gas flow 23 in a vacuum clamping system;

Figure 6 shows an application for selective transfer of dies; and

Figure 7 shows an embodiment incorporating the selected die transfer mechanism and local alignment system

DETAILED DESCRIPTION OF EMBODIMENTS

Now referring to Figure 1, there is provided a schematic side view of the chip die clamp according to an aspect of the invention. Prior to clamping, a diced wafer 20 is placed on the clamp, typically being held by a transport tape 22. By providing a clamping action, in the present embodiment by providing a vacuum clamping pressure, the wafer is held firm to the carrier plate 3.

The machine may comprise a peel off arrangement 19 for peeling of a transport tape 22 from the diced wafer 20, after clamping prior to release. Such transport tapes are commonly known and may be used to maintain integrity of a wafer after thinning and possible dicing and need to be removed at some point in the manufacturing process, for example, when stacking the dies in a 3D stack. Figure 1 illustrates a pickup nozzle arrangement 7 cooperating in synchronicity with a gas supply mechanism 6 that selectively releases the clamping pressure. Thus, in a timed movement, the die 2' is selectively released from the clamp 1, while picked up by the pickup nozzle 7. Thus, by proper construction, the handling forces on the fragile dies are reduced to a minimum. As illustrated herebelow, selective release of the die may be provided outside the pickup-nozzle 7 arrangement, for example, in a wafer to wafer alignment of Figure 6. Not illustrated is a controller arranged for controlling the gas supply mechanism 6 to release a selected die 2' of the diced wafer 20 in response to received pick and place instructions.

The clamp 1 may be made of silicon, glass or epoxy based substrate material. In an embodiment, the clamp 1 is a vacuum clamp, for example, of porous aluminum, where that a vacuum is provided underneath the carrier plate 3 and transferred to the clamping zones 4 via channels 11. The carrier plate 3 can be provided with a gas bearing 25 slidably arranged over a support 26.

Figure 2 shows a detail of the Figure 1 embodiment disclosing a combined action of a blowout nozzle 6 and a pick-up nozzle 7. In particular, the nozzle 60 on bottom face 8 opposite the clamping zones 4 on top face 5 is movable in a plane parallel to the carrier plate 3, and the carrier plate 3 is structured to allow gas flow 23 between both sides in the carrier plate 3. This provides a blowout gas flow 23 that pushes the die from the clamping chuck, towards pickup nozzle 7. In this embodiment, gas flow 23 may be relatively uncontrolled, since the transfer may be relatively inaccurate. Preferably, though, the clamping zone 4 comprises gas guiding structures 11 for guiding the gas flow 23 in a direction normal to the carrier plate 3. In addition to this, the gas guiding structure 11 comprises a walled porous structure. The walls have a typical dimension smaller than a die, for example, in a range of 0.1-1 times a die diameter. This enhances controlled blowout of a selected die 2'. The exact position of the die on the pick-up nozzle 7 is in this embodiment not crucial since in later placement actions, the pick-up nozzle 7 can be scanned by metrology systems for accurate placement.

Figure 3 and Figure 4 show details of the nozzle 60 and chip die transfer process, wherein the nozzle 60 and/or the clamping zone 4 are sectioned to provide a gradient gas flow 230 to provide an even more controlled release from a side of the die 2. In particular, nozzle 60 head comprises a section wall 61 so that a gas flow 23 can be tuned to a stronger flow on one side of the wall die to expel a squeeze flow from the underneath a die 2 when the die is selectively blown away from the carrier plate 3 towards an underlying substrate 30.

Figure 5 shows a mechanism to limit gas flow 23 due to exposed clamping zones 4. While in principle, the gas pressure can be tuned to provide a minimum clamping pressure, when the clamping zones 4 are exposed, this will be at the cost of increasing gas flows. By careful designing of gas flow channel diameter 11 the gas flow 23 can be limited to relative small volumes. Additionally, the flow can be controlled by providing a cover mechanism 17 for covering exposed clamping zones after release. In particular, the cover mechanism 17 may comprise a rolling foil 19 system including a reel 18 and a foil 19 attached to a side of the carrier plate 3, the foil 19 arranged around the reel 18 and the reel 18 being rollable over exposed clamping zones after release. Alternatively, the foil 19 may be rolled around the reel 18. By sectioning the reel 18, for example, by driving it from both axial sides, even more selective coverage can be provided and the reel 18 can be controlled to cover rows of clamping zones 4 after selective removal of the corresponding dies.

Figure 6 shows a further application for selective transfer of dies. In this concept, plural stacks of dies can be provided by aligning a clamped diced wafer 20 relative to another clamped wafer 200. To this end a base plate 13 is provided for carrying a second wafer 200; and an alignment system for aligning the carrier plate 3 relative to the base plate 13. The alignment system comprises a metrology system 15, 15' facing the base plate 13 and the carrier plate 3, the base plate 13 and carrier plate 3 separately movable along parallel planes and comprising markers 16 corresponding to the metrology system 15.

Prior to alignment, the dies are mapped so that their relative positions are known. During placement, the dies 2 are selectively transferred after individual alignment, corresponding to the mapped positions. The transfer distance is only a minimal gap height of about 10-100 micron, wherein the minimal distance is defined by the thickness of the die or stack of dies.

This can greatly speed up the stacking process relative to a conventional die to wafer process, wherein each die is individually placed by pick and place manipulation over significant distances of at least tens of centimeters. In comparison with a conventional wafer to wafer process, individual alignment is possible which can compensate for local aberrations, and which can also prevent placement of known good dies on marked bad dies. In this embodiment, a complete diced wafer 20 is picked up by a wafer size vacuum chuck 1 with relative high vacuum level, typically - 0,95 bar. The vacuum is provided by a housing 9 that is connected to a vacuum circuit, the housing 9 providing vacuum pressure to the face 8 of the carrier plate 3 opposite the clamping zones 4. Next, after necessary alignment steps, this diced wafer 20 is brought close to a carrier with stacks at the right position. Next, the dies are transferred one by one to the stacks. Before each individual transfer the position can be corrected. To this end, the alignment system comprises a coarse actuation system 12 controlled for global alignment of the carrier plate 3 relative to the base plate 13, and a fine actuation system 14 controlled for providing local alignment of a selected die 2' prior to release of the selected die 2'. In the disclosed embodiment, the fine actuation system 14 may be provided to move the carrier plate 3, while the coarse actuation system 12 may be provided to move the base plate 13. Other variations are possible. Importantly, the carrier plate 3 vacuum chuck and the base plate 13 with stacks need only to do slight relative correction movements. Because of the relative small movements this process can be significantly faster than conventional Die to Wafer placement. In addition, in view of the short travelling distances and limited handling actions, the reliability of chip manufacturing is enhanced, especially in the context of stacking dies in 3D electrically interconnected chip devices, wherein chip dies 2 will be more and more fragile and reduced in thickness dimensions typical dimension: 10-50 micron.

It is noted that in the case of 3D stacked silicon devices, loss due to malfunction of a single device layer will be multiplied by the number of device layers, so that the need to prevent malfunction ever increases.

Transfer can be done by local high air pressure induced by a blowing nozzle 60 with the same size as the die. This blowing nozzle 60 is moving under a vacuum cover, thus maintaining a moderate vacuum level, typically – 0,5 bar, for holding the other die. Between two individual die transfer actions only the blowing nozzle 60 needs to move one die pitch. Here, parallel operation of multiple nozzles can be provided, wherein, for instance, a first nozzle is moved, while a second nozzle is active in a selective blowout action. This can be performed in synchronicity with local alignment action of the vacuum chuck relative to the carrier. To this end a controller is present not shown.

Figure 7 shows a generic embodiment incorporating the selected die 2 transfer mechanism and local alignment system. While the preceding embodiment detailed chip die clamping via vacuum suction and chip die transfer via gas flow, other clamping and transfer methods are feasible, including electrostatic clamping, laser controlled transfer thermo-mechanical or goose-skin actuation. In this respect, the selective placement of dies on a wafer can be arranged with any suitable clamping or transfer method which still receives the benefits of the present die placement process for multiple stack dies. Accordingly, there is disclosed a method of transfer of chip dies in a chip manufacturing process, comprising:

- providing a carrier plate 3 comprising compartmented clamping zones on a top face (5) arranged for placement of a diced wafer 20;
- providing a base plate 13 for carrying a second wafer 200

- aligning the carrier plate 3 and the base plate 13 in a facing position towards the base plate 13 to match the diced wafer 20 with the second wafer;
- selectively releasing a die by movable release mechanism 600 of the diced wafer 20 from a clamping zone in response to received pick and place instructions; and
- transferring the released die to the second wafer via a bridging gap distance beween the facing carrier plates and base plates.

The movable release mechanism 600 may be designed for simultaneous parallel action, for example, by multifold blowout nozzles.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. In particular, unless clear from context, aspects of various embodiments that are treated in various embodiments separately discussed are deemed disclosed in any combination variation of relevance and physically possible and the scope of the invention extends to such combinations. Other variations to the disclosed embodiments can be understood and by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS

1. A chip die clamping device (1) arranged for placement of chip dies (2) in a chip manufacturing process, comprising:
   - a carrier plate (3) comprising compartmented clamping zones (4) on a top face (5) arranged for placement of a diced wafer (20);
   - a gas supply mechanism (6) arranged to locally cancel the clamping pressure in a specified clamping zone (4); and
   - a controller arranged for controlling the gas supply mechanism (6) to release a selected die (2') of the diced wafer (20) in response to received pick and place instructions.

2. A chip die clamping device (1) according to claim 1, wherein the gas supply mechanism (6) comprises a nozzle (60) on a bottom face (8) opposite the clamping zones (4), the nozzle (60) being movable in a plane parallel to the carrier plate (3).

3. A chip die clamping device (1) according to claim 2, wherein the nozzle (60) is comprised in a housing (9) that is connected to a vacuum circuit, the housing (9) providing vacuum pressure to the bottom face (8) of the carrier plate (3) and the carrier plate (3) structured to allow gas flow (23) between both sides in the carrier plate (3).

4. A chip die clamping device (1) according to claim 2, wherein the nozzle (60) and/or the clamping zone (4) are sectioned to provide a gradient gas flow (230) to provide controlled release from a side of the die (2').

5. A chip die clamping device (1) according to claim 2, wherein the clamping zone (4) comprises gas guiding structure (11) for guiding the gas flow (23) in a direction normal to the carrier plate (3).

6. A chip die clamping device (1) according to claim 5, wherein the gas guiding structure (11) comprises a walled porous structure.

7. A chip die clamping device (1) according to claim 1, further comprising a base plate (13) for carrying a second wafer; and an alignment system for aligning the carrier plate (3) relative to the base plate (13).

8. A chip die clamping device (1) according to claim 7, wherein the alignment system comprises a coarse actuation system (12) controlled for global alignment of the carrier plate (3) relative to the base plate (13), and a fine actuation system (14) controlled for providing local alignment of a selected die (2') prior to release of the selected die (2').

9. A chip die clamping device (1) according to claim 7, wherein the alignment system comprises a metrology system (15) facing the base plate (13) and the carrier plate (3), the base plate (13) and carrier plate (3) separately movable along parallel planes and comprising markers (16) corresponding to the metrology system (15).

10. A chip die clamping device (1) according to claim 1, further comprising a cover mechanism (17) for covering exposed clamping zones (4) after release.

11. A chip die clamping device (1) according to claim 10, wherein the cover mechanism (17) comprises a rolling foil (19) system including a reel (18) and a foil (19) attached to a side of the carrier plate (3), the foil (19) arranged around the reel (18) and the reel (18) being rollable over exposed clamping zones (4) after release.

12. A chip die clamping device (1) according to claim 1, further comprising a peel off arrangement (19) for peeling of a transport tape (22) from the diced wafer (20), after clamping and prior to release.

13. A chip die clamping device (1) according to claim 1, further comprising a pickup nozzle (7) arranged to cooperate in synchronicity with the gas supply mechanism (6).

14. A method of placement of chip dies (2) in a chip manufacturing process, comprising:

- providing a carrier plate (3) comprising compartmented clamping zones (4) on a top face (5) arranged for placement of a diced wafer (20);
- locally supplying gas on a bottom face (8) opposite a specified clamping zone (4) to locally cancel a clamping pressure; and
- controlling the gas supply to release a selected die (2') of the diced wafer (20) in response to received pick and place instructions.

15. A method of transfer of chip dies (2) in a chip manufacturing process, comprising:

- providing a carrier plate (3) comprising compartmented clamping zones (4) on a top face (5) arranged for placement of a diced wafer (20);
- providing a base plate (13) for carrying a second wafer;
- aligning the carrier plate (3) and the base plate (13) in a facing position towards the base plate (13) to match the diced wafer (20) with the second wafer;
- selectively releasing a die of the diced wafer (20) from a clamping zone (4) in response to received pick and place instructions; and
- transferring the released die to the second wafer via a bridging gap distance beween the facing carrier plate (3) and base plate (13).

DRAWINGS

Figure 1

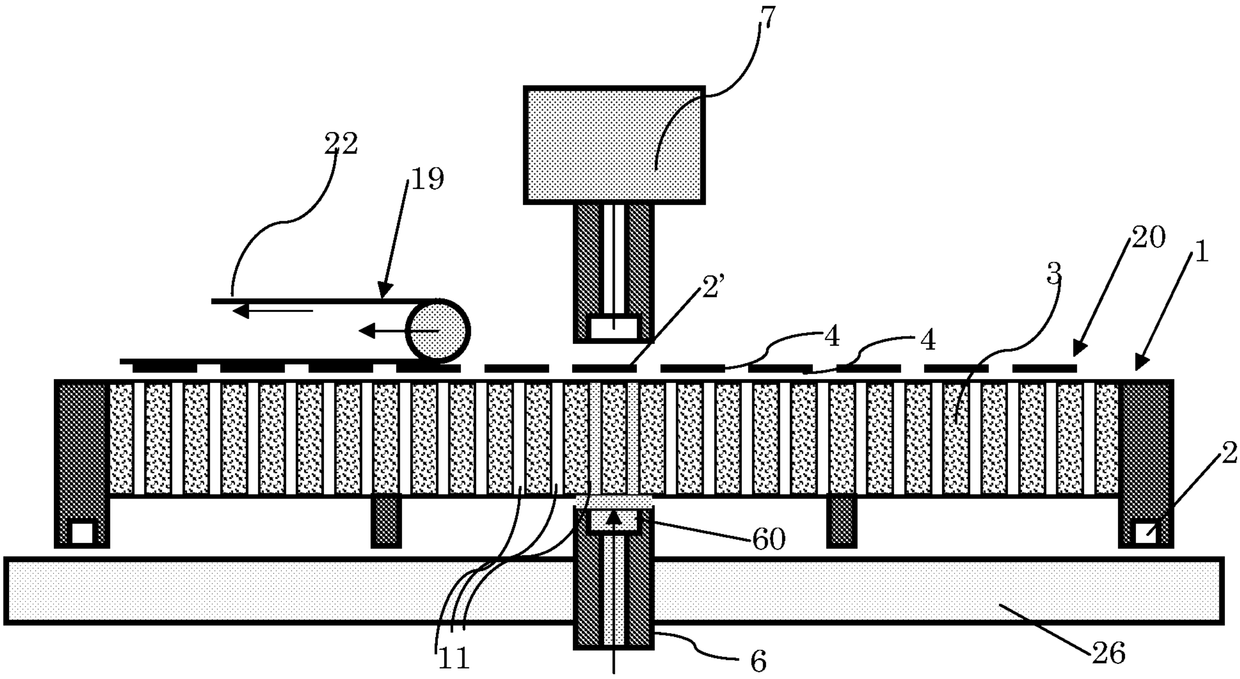


Figure 2

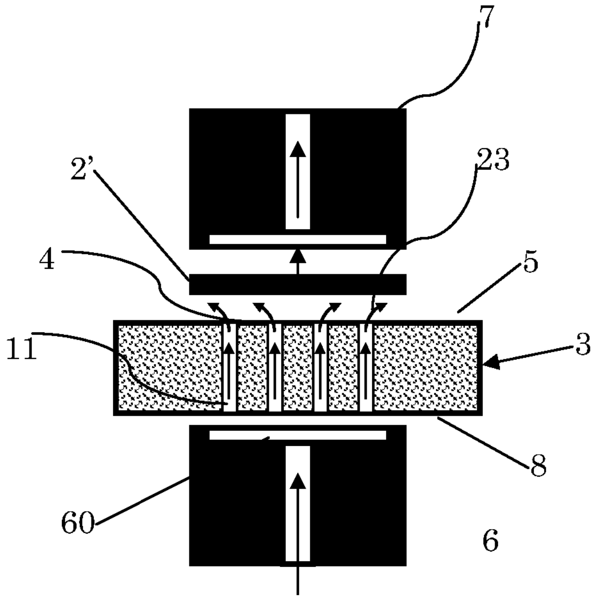


Figure 3

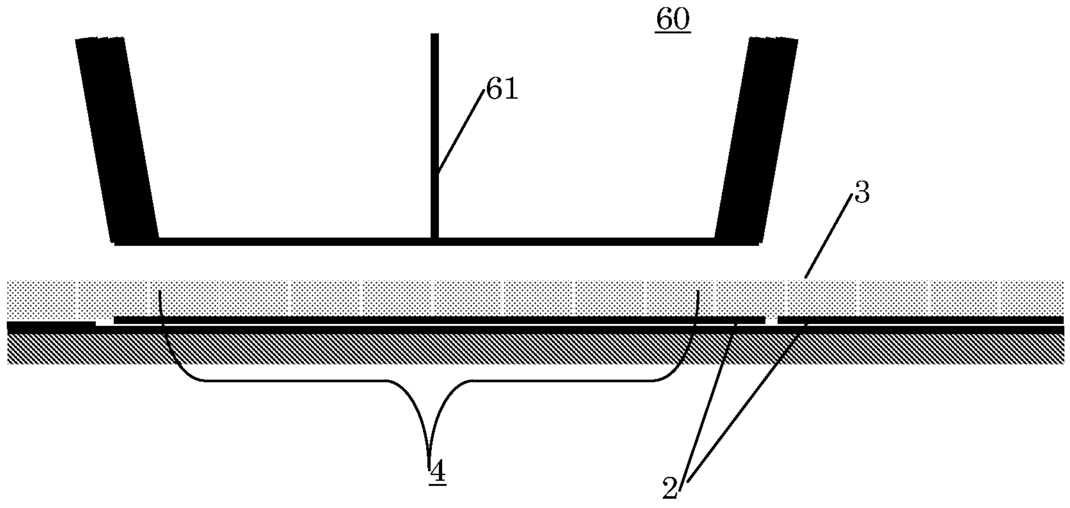


Figure 4

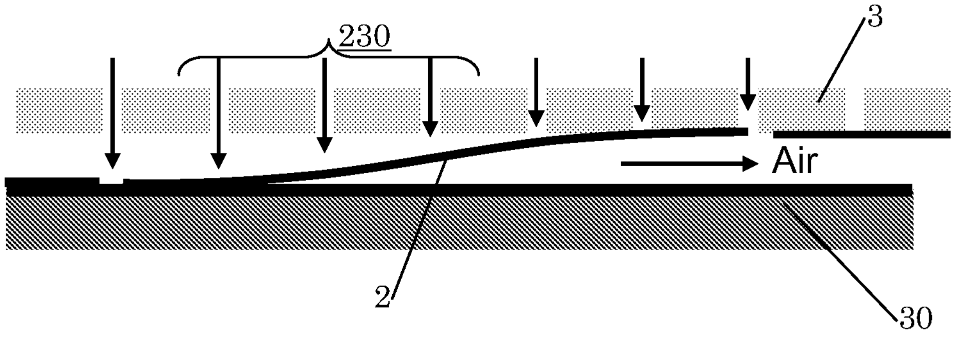


Figure 5

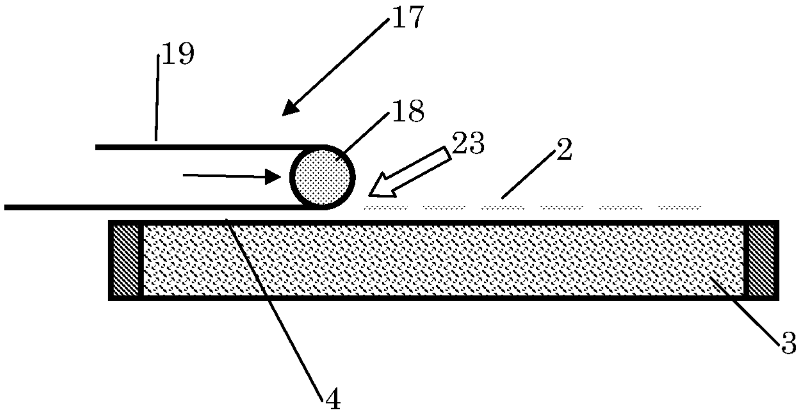


Figure 6

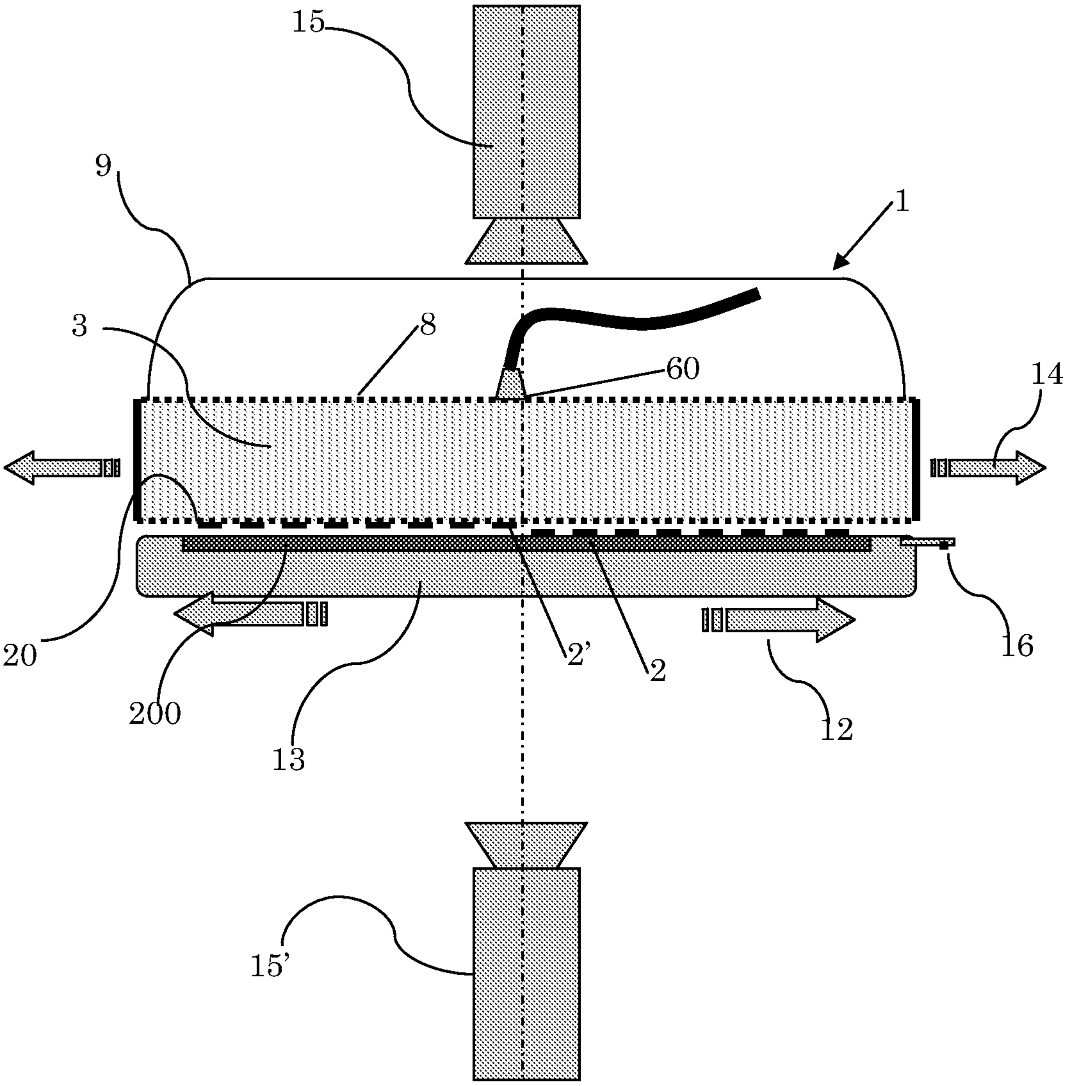
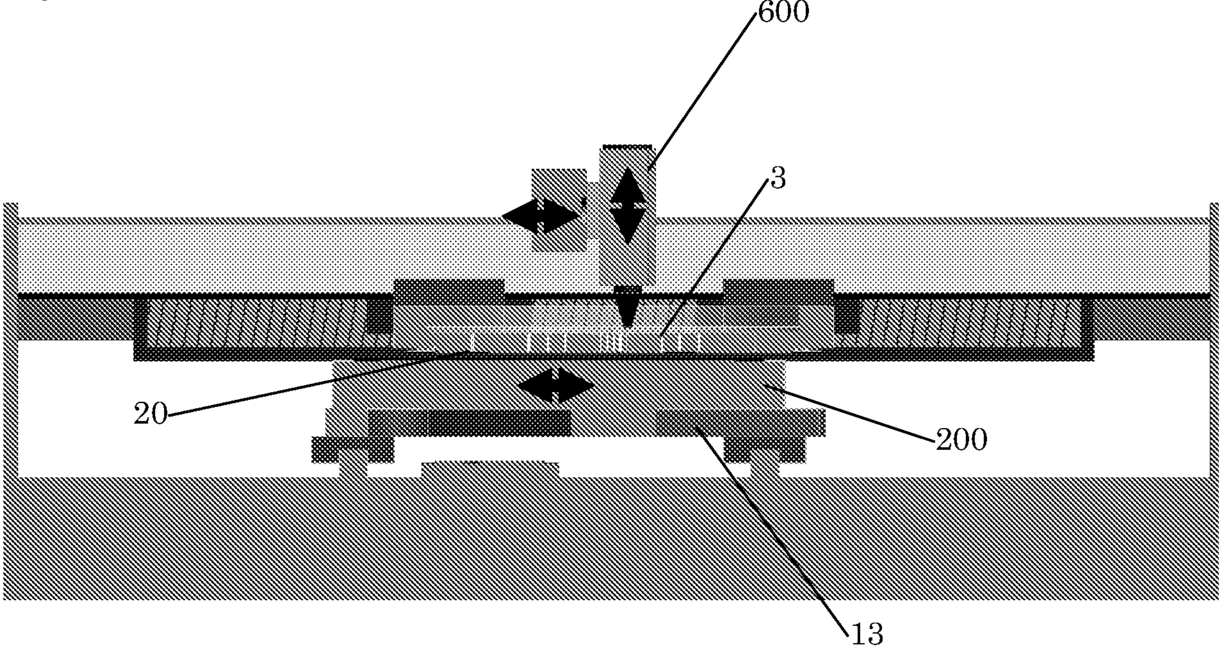


Figure 7



INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2009/050520

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L21/00 H01L21/683

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)
H01L

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/062301 A1 (YOO) 24 March 2005 (2005-03-24) abstract; figures 2-4	1-6,13, 14
Y		7-12
A		15

X	JP 2003 188195 A (NIDEC TOSOK CORP) 4 July 2003 (2003-07-04) abstract; figure 2	1,14
A		15

X	US 2005/153522 A1 (HWANG ET AL.) 14 July 2005 (2005-07-14) figures 9,10	15
Y		7-9
A		1,14

	-/--	

☒ 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 document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search
6 November 2009

Date of mailing of the international search report
16/11/2009

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2
NL – 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

1

Authorized officer
Oberle, Thierry

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2009/050520

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2004 193493 A (NEC MACHINERY CORP) 8 July 2004 (2004-07-08) abstract; figures 1,2	10,11
A		1,14,15
Y	US 2005/019980 A1 (KUROSAWA ET AL.) 27 January 2005 (2005-01-27) cited in the application figure 5	12
A		1,14,15
A	US 2007/158024 A1 (ADDISON ET AL.) 12 July 2007 (2007-07-12) paragraphs [0064] - [0066]; figure 6a	1,14,15

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2009/050520

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005062301 A1	24-03-2005	US 2005095100 A1	05-05-2005
JP 2003188195 A	04-07-2003	NONE	
US 2005153522 A1	14-07-2005	KR 20050073630 A	18-07-2005
JP 2004193493 A	08-07-2004	NONE	
US 2005019980 A1	27-01-2005	CN 1532900 A EP 1463094 A2 KR 20040084794 A SG 116533 A1 TW 278943 B	29-09-2004 29-09-2004 06-10-2004 28-11-2005 11-04-2007
US 2007158024 A1	12-07-2007	WO 2007081489 A2	19-07-2007