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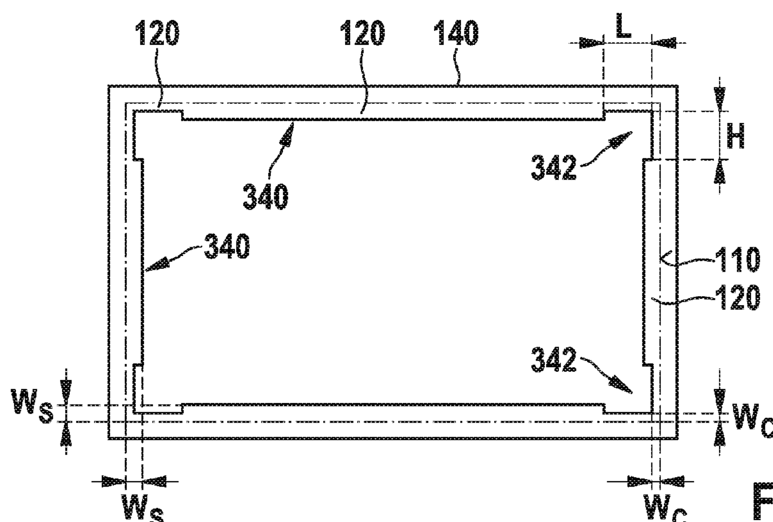

Fig. 3

(57) Abstract: A mask structure configured for deposition of a layer on a rectangular substrate, e.g. an edge exclusion mask configured for deposition of a layer on a rectangular substrate is described. The mask structure includes a mask frame adapted for masking the edge of the substrate during layer deposition, wherein the mask frame comprises at least two mask frame side portions forming a corner in a corner area there between, wherein the mask frame is shaped to overlap the edge of the rectangular substrate such that a first overlap width at the side portions is larger than a second overlap width in the corner area.

CORNER CUT MASK

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TECHNICAL FIELD OF THE INVENTION

[0001] Embodiments of the present invention relate to masks for layer deposition and methods of layer deposition utilizing masks. Embodiments of the present invention
10 particularly relate to edge exclusion masks and methods of depositing layers with an edge exclusion mask, specifically to mask structures configured for deposition of a layer on a rectangular substrate, apparatuses for depositing a layer on a rectangular substrate, and methods of depositing a layer over a rectangular substrate.

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BACKGROUND OF THE INVENTION

[0002] Several methods are known for depositing a material on a substrate. For instance, substrates may be coated by a physical vapor deposition (PVD) process, a chemical vapor deposition (CVD) process, a plasma enhanced chemical vapor deposition (PECVD) process etc. Typically, the process is performed in a process apparatus or process chamber, where the
20 substrate to be coated is located. A deposition material is provided in the apparatus. A plurality of materials, but also oxides, nitrides or carbides thereof, may be used for deposition on a substrate.

[0003] Coated materials may be used in several applications and in several technical fields. For instance, an application lies in the field of microelectronics, such as generating
25 semiconductor devices. Also, substrates for displays are often coated by a PVD process. Further applications include insulating panels, organic light emitting diode (OLED) panels, substrates with TFT, color filters or the like.

[0004] In coating processes, it may be useful to use masks, for instance, in order to better define the area to be coated. In some applications, only parts of the substrate should be coated
30 and the parts not to be coated are covered by a mask. In some applications, such as in large area substrate coating apparatuses, it can be useful to exclude the edge of the substrate from

being coated. With the exclusion of the edge, e.g. by an edge exclusion mask, it is possible to provide coating free substrate edges and to prevent a coating of the backside of the substrate. For examples, LCD TV layer deposition as one of many other applications, require a non-coated substrate edge. The above-described mask usually covers this area of the substrate. The
5 masking or blocking with the mask can, however, result in further, additional shadowing effects of arriving atoms, molecules and clusters, which can result in the layer thickness being unreliable and sheet resistance uniformity.

[0005] However, the mask in a material deposition process, which may be an edge exclusion mask, is also exposed to the deposition material due to the location of the mask in
10 front of the substrate. The influences of the non-coated and coated masks can be complex and may depend upon the material to be deposited.

[0006] In view of the above, it is an object of the present invention to provide a mask, particularly an edge exclusion mask, a deposition apparatus having a mask, and a method for masking the edges of a substrate which could overcome at least some of the problems in the
15 art.

SUMMARY OF THE INVENTION

[0007] In light of the above, a mask structure according to independent claim 1, an apparatus according to independent claim 11 and a method according to independent claim 13
20 are provided. Further aspects, advantages, and features of the present invention are apparent from the dependent claims, the description, and the accompanying drawings.

[0008] According to one embodiment, a mask structure configured for deposition of a layer on a rectangular substrate, e.g. an edge exclusion mask configured for deposition of a layer on a rectangular substrate, is provided. The mask structure includes a mask frame adapted for
25 masking the edge of the substrate during layer deposition, wherein the mask frame comprises at least two mask frame side portions forming a corner in a corner area there between, wherein the mask frame is shaped to overlap the edge of the rectangular substrate such that a first overlap width at the side portions is larger than a second overlap width in the corner area.

[0009] According to another embodiment, an apparatus for depositing a layer on a rectangular substrate is provided. The apparatus includes a chamber adapted for layer deposition therein, and a mask structure within the chamber, e.g. an edge exclusion mask configured for deposition of a layer on a rectangular substrate, wherein the mask structure
5 includes a mask frame adapted for masking the edge of the substrate during layer deposition, wherein the mask frame comprises at least two mask frame side portions forming a corner in a corner area there between, wherein the mask frame is shaped to overlap the edge of the rectangular substrate such that a first overlap width at the side portions is larger than a second overlap width in the corner area. The apparatus further includes a deposition source for
10 depositing material forming the layer.

[0010] According to a further embodiment, a method of depositing a layer over a rectangular substrate is provided. The method includes masking the substrate edge with a mask wherein the masking width is smaller in a corner of the substrate as compared to a side of the substrate, and depositing material of the layer on the substrate, particularly in substrate
15 regions not be masked by the mask.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized
20 above, may be had by reference to embodiments. The accompanying drawings relate to embodiments of the invention and are described in the following:

FIG. 1 shows a mask structure as commonly used for masking an edge of a substrate;

FIG. 2 shows cross-sectional side view of a mask structure, wherein
25 the cross section can correspond to a mask structure as shown in FIG. 1 or to a mask structure according to embodiments described herein;

FIG. 3 shows a mask structure, such as an edge exclusion mask, illustrating embodiments described herein;

FIG. 4	shows a yet further mask structure, such as an edge exclusion mask, illustrating embodiments described herein;
FIG. 5	shows a mask structure, such as an edge exclusion mask, and having a bar forming further corners according to embodiments described herein;
FIGS. 6A and 6B	show views of an apparatus for depositing a layer of material on a substrate utilizing a mask structure according to embodiments described herein and showing a scenario where no substrate is loaded;
FIG. 7	shows a flow chart illustrating a method for depositing material on a substrate according to embodiments described herein, wherein an edge exclusion mask is utilized.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] Reference will now be made in detail to the various embodiments of the invention, one or more examples of which are illustrated in the figures. Within the following description of the drawings, the same reference numbers refer to same components. Generally, only the differences with respect to individual embodiments are described. Each example is provided by way of explanation of the invention and is not meant as a limitation of the invention. Further, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. It is intended that the description includes such modifications and variations.

[0013] According to some embodiments, a mask structure or an “edge exclusion mask” should be understood as a mask which covers at least an edge of the substrate to be coated. Generally, a mask may be composed of several parts or portions, which can form a frame, which defines one or more apertures. The frame of a mask may again have several frame portions or frame parts. According to some embodiments, the term “mask” is used for a piece of mask material, such as a carbon fiber material or a metal like aluminum, titan, stainless steel or the like. The mask covers a part of the substrate to be coated. Typically, the mask is

located between the substrate to be coated and the source of the deposition material, such as a crucible, a target or the like.

[0014] Typically, an edge exclusion mask may cover from about 1‰ to about 5% of the area of the substrate, typically between about 5‰ to about 1% and even more typically between about 1% and about 2% of the area of the substrate. According to some embodiments, the area of the substrate covered, shadowed or masked by the edge exclusion mask is located at the periphery of the substrate.

[0015] An edge exclusion mask is desirable when the edge of a substrate should be kept free or substantially free from deposition material. This may be the case when only a defined area of the substrate should be coated due to the later application and/or handling of the coated substrate. For instance, a substrate which will be used as a display part, should have predefined dimensions. Typically, large area substrates are coated using an edge exclusion mask in order to shadow the edge of the substrate and/or to prevent backside coating of the substrate. This approach allows for reliable, constant coating on substrates.

[0016] According to some embodiments, large area substrates may have a size of typically about 1.4 m2 to about 8 m2, more typically about 2 m2 to about 9 m^2 or even up to 12 m^2. Typically, the rectangular substrates for which the mask structures, apparatuses, and methods according to embodiments described herein are provided are large area substrates as described herein. For instance, a large area substrate can be GEN 5, which corresponds to about 1.4 m2 substrates (1.1 m x 1.25 m), GEN 7.5, which corresponds to about 4.29 m2 substrates (1.95 m x 2.2 m), GEN 8.5, which corresponds to about 5.7m^2 substrates (2.2 m x 2.5 m), or even GEN 10, which corresponds to about 8.7 m2 substrates (2.85 m × 3.05 m). Even larger generations such as GEN 11 and GEN 12 and corresponding substrate areas can similarly be implemented.

[0017] FIG. 1 shows an example of a substrate in rectangular shape. An outermost border of the substrate is denoted with 110. Typically, the border 110 may also be described as the outermost line of the substrate, beyond which the material of the substrate ends.

[0018] As used herein and according to some embodiments, an edge 120 of the substrate may contain the periphery of the substrate. Typically, the edge 120 as used herein may be an area containing the border 110 of the substrate. The edge 120 may have a width w, which

extends onto the surface of the substrate 100 from the border 110. This edge 120 is typically defined on a processed substrate by the edge exclusion mask 40, which is utilized during deposition of one or more layers on the substrate 100.

[0019] The mask usually reduces or hinders deposition of materials on this edge area. The
5 masking or blocking with the mask can, however, result in further, additional shadowing effects of arriving atoms, molecules and clusters, which can results in an unreliable layer thickness and sheet resistance uniformity. Especially the four corners of the substrate are affected by additional shadowing effects because two shadowing parts meet each other at these points.

10 [0020] According to embodiments described herein, in order to compensate for these effects, one or more of the corners, typically the four corners, are provided less coverage or overlap of the mask. The aperture in the middle of the mask frame can have a protrusion, i.e. compared to the rest of the mask, the mask frame in the four corners can have a recess or a cut out. This is for example illustrated in corner areas 342 in FIG. 3, wherein the width Wc of the
15 overlap of the mask 140 and the substrate, i.e. the distance of the boundary of the mask forming the aperture and the edge 110 of the substrate, is smaller in the corner areas 342 as compared to the width Ws of the overlap of the mask 140 and the substrate, i.e. the distance of the boundary of the mask forming the aperture and the edge 110 of the substrate, at the side portions 340 of the mask frame.

20 [0021] FIG. 2 illustrates a side view of a substrate 100, which is positioned in a carrier 20, and wherein the edge of the substrate is shadowed by a mask 140. The cross-section shown in FIG. 2 can correspond to a common edge exclusion mask 140 as shown in FIG. 1 or to an edge exclusion mask 140 according to embodiments described herein and as shown in FIGS. 2 to 6A. The mask typically is provided to have a gap 42 of 2 mm to 8 mm from the
25 substrate, i.e. the portion of the mask shadowing the substrate surface is not in contact with the substrate surface. According to other embodiments, the mask can also be in direct contact with the substrate, e.g. there can be no gap or the gap can be from 0 mm to 8 mm.

[0022] According to embodiments described herein, there can be a further cover 250, which prevents portions of the carrier or other portions 252 of the masking structure to be coated
30 with material during deposition of the material on the substrate.

[0023] According to some embodiments, the edge 120, where an overlap between the edge exclusion mask and the substrate exists, may have a width, which extends on the surface of the substrate 100 from the border 110. Due to deviation from the rectangular shape of the mask aperture, the width of the overlap varies for embodiments described herein. Thereby, 5 the deviation can be described as a protrusion of the aperture or a recess of the mask frame. As will be understood by a person skilled in the art, overlap is defined by the overlapping areas of the substrate area and the mask frame area for a projection in a plane parallel to the substrate surface.

[0024] According to some embodiments, which can be combined with other embodiments 10 described herein, the first overlap, i.e. the first width Ws can be from 2 mm to 8 mm, typically from 3 mm to 6mm. As a further optional implementation thereof the second overlap, i.e. the width Wc can be from 0.0 mm to 4 mm, typically from 1 mm to 3 mm.

[0025] Typically, the width w may be symmetrical for the whole substrate, i.e. each corner area and each side portion has the same width, but may also vary from side to side, depending 15 on the application of the substrate. According to some embodiments, the edge of the substrate may be defined by the aperture of the mask used for coating the substrate. For instance, the aperture of an edge exclusion mask influences the area of the substrate which is coated and covers an area of the substrate such as the edge. Thus, the edge of a substrate may be defined as the area of the substrate which is covered by the edge exclusion mask and which is not 20 coated during the coating process in which the edge exclusion mask is used.

[0026] Typically, the edge of a substrate may be defined as an area of the substrate which should be kept substantially free of deposition material or where the layer thickness of deposited material is reduced to a value of at least 25 % as compared to the un-masked substrate portion.

25 [0027] Typically, a substrate may be made from any material suitable for material deposition. For instance, the substrate may be made from a material selected from the group consisting of glass (for instance soda-lime glass, borosilicate glass etc.), metal, polymer, ceramic, compound materials, carbon fiber materials or any other material or combination of materials which can be coated by a deposition process.

[0028] According to some embodiments, the term "mask aperture" should be understood as a window of a mask, through which the deposition material may pass during the deposition process. Typically, the "mask aperture" may also be denoted as a coating window as it defines the area of the substrate on which the coating material is deposited. The boundary or the inner boundary of the aperture is defined by the limitation of the coating window. For instance, if the mask is new or freshly cleaned and has not yet been used in a deposition process, the boundary of the aperture consists of mask material. If the mask is used in a deposition process and deposition material is deposited on the mask, the boundary of the aperture may be the limitation of the coating window by the deposited material on the mask.

[0029] According to different embodiments, an edge exclusion mask can be utilized for PVD deposition processes, CVD deposition process or combinations thereof. Thereby, the edge of the mask influences atoms, molecules, clusters in the vicinity thereof. These effects can be more complex as the "stream of material" can be affected by turbulences or the like and the edge cannot necessarily be regarding as a sharp cut-off edge. Particularly the more complex effects superimpose from neighboring side portions at the corners. Accordingly, the thickness uniformity at the corners of the coated area of the substrate can be improved by embodiments of the present invention and for applications utilizing embodiments of the present invention.

[0030] The embodiment shown in FIG. 3 shows rectangular recesses of the mask frame in the four corner areas 342. This corresponds to protrusions in the mask aperture or the coating window. These areas can have a length L and a width H, which can, for example be 2 cm to 6 cm, typically 3 cm to 5 cm. According to different implementations, the length and the width can be equal at the respective sides or they can be different. For example they can have about the same proportion of the overall side length of the respective mask. Typically, the dimensions of the recesses or protrusions, respectively, can be about 0.5 % to 5 % of the respective dimensions of the mask, typically the inner boundary of the mask that is the length of the aperture.

[0031] According to yet further embodiments, the corner areas can be formed to have a shape different from a rectangular form. Thereby, it is possible that the corner areas have a continuous reduction of the overlap width, i.e. a continuous reduction from the width Ws to the width Wc towards the corner formed by the mask frame portion. FIG. 4 illustrates

corresponding embodiments, wherein a protrusion is provided in the corner areas of the aperture as compared to a rectangular corner portion.

[0032] As can be seen from FIG. 4 this and similar shaped corner areas can result in an angle in the corners, which is defined by the tangents at the positions where the side portions 340 cross each other, which is smaller than 90°. For example, the angles can be from 65 ° to 95 °, typically from 80 ° to 90 °. Particularly, in the case where there is a small slope at the beginning of the decrease in overlap width, the length and width of the corner areas (length L and width H in FIG. 3) can be larger as described above, e.g. up to 10 cm or even 15 cm.

[0033] Embodiments described herein describe an edge exclusion mask with cut-outs at the corners. Thereby, shadowing effects of neighboring side portions of an edge exclusion mask at the corners, which can add up and which can, thus, result in an insufficient layer thickness even at portions of the substrate, which is intended for layer deposition, can be reduced. Thereby, according to some embodiments, which can be combined with other embodiments described herein, the overlap width Wc in the corner areas can even be as small as 0.5 mm or even 0 mm. Thereby, the overlap widths Wc close to the corner areas of the adjacent side portions are sufficient to generate the shadowing effect in the corners such that the actually deposited area on the substrate is substantially rectangular.

[0034] According to some implementations thereof, it is even possible that there is a negative overlap, i.e. a gap, in the corner areas. Generally, it is desired to have an area on the substrate, which is deposited within the non-coated or substantially non-coated edge of the substrate, wherein the deposited area has a rectangular shape. Thereby, an edge exclusion mask is provided, which slightly deviates from the rectangular form in order to compensate for higher order shadowing effects in the corners.

[0035] FIG. 5 illustrates further embodiments of mask structures or edge exclusion masks respectively. Therein a bar 540 is provided between two opposing side portions 340. According to further implementations more than one bar 540 can be provided. Yet further, optional further bars, which are perpendicular to the bar shown in FIG. 5 can be provided. Such perpendicular bars could be provided between a side portion and another bar, which might, however, also be considered as a side portion of a part of the mask structures.

[0036] Such bars can separate the area of the entire mask in different areas. Such areas can, for example, correspond to devices manufactured on the substrate. For example, the two regions 501 shown in FIG. 5 could correspond to two devices such as large area flat panel displays. Typically, there can be one or more devices, such as displays, manufactured on a
5 substrate. Considering current glass size generations and the size of a display of a mobile phone, there can be a plurality of displays on a substrate. A corresponding separation as shown in FIG. 5 would result in a plurality of bars separating areas for each display. According to yet further embodiments, bars can particularly be implemented for color filter manufacturing applications, wherein edges of areas corresponding to one display size of the
10 color filter are to be implemented.

[0037] Alternatively, the bars can separate areas wherein different substrates are provided on one carrier. For example, the mask shown in FIG. 5 could be used for an arrangement where two substrates are supported on one carrier. For example, one of the two substrates can be positioned in the left area 501 and the other one of the two substrates can be positioned in
15 the right area 501 of FIG. 5. Similarly, mask structures with additional bars could be used for substrates arrangement with two or more substrates.

[0038] Thereby, for each substrate edge exclusion can be provided as might be desired for further processing of the individual substrates. Accordingly, some method steps could be conducted on a larger arrangement of substrates including two or more substrates. Thereby, a
20 mask structure with a corresponding number of bars 540 could be provided such that the mask structure provides edge exclusion for each of the substrates. Thereafter, i.e. for subsequent method steps the substrate arrangement could be separated in individual substrates, wherein each substrate has a desired uncoated edge and further processing steps could be conducted on the substrates piece by piece. This could be particularly useful if some processing steps (early
25 processing steps) could be conducted on a larger scale whereas other method steps (subsequent method steps) cannot be conducted on the same size of carriers, i.e. are more difficult to control on the same scale or site of processing area, respectively.

[0039] According to different embodiments, which can be combined with other embodiments described herein, a mask frame with side portions and one or more further
30 portions such as bars 540, which can also be considered side portions of a (sub) mask structure, can be provided. The one or more bars from further corner areas, which can be

provided similar to the corner areas 342 described with respect to FIG. 3 and/or FIG. 4. Accordingly, the further corner areas can also be shaped such that the respective apertures have protrusions and/or such that the mask frames have recesses. Thereby, also overlap regions are provided, such that the corresponding, overlap widths with the substrate are
5 reduced in the corner areas. In other words, the width of the bar is reduced in the areas where corners are formed.

[0040] According to some embodiments, which can be combined with other embodiments described herein, the width of the bar at a central region can be from 10 cm to 20 cm and the width of overlap of the bar with the relevant portion of the substrate can be similar to the
10 above described overlap at a central region from 2 mm to 8 mm, typically from 3 mm to 6mm. The second overlap in the corner areas can be from 0.0 mm to 4 mm, typically from 1 mm to 3 mm.

[0041] FIGS. 6A and 6B show schematic views of a deposition chamber 600 according to embodiments. The deposition chamber 600 is adapted for a deposition process, such as a PVD
15 or CVD process. One or more substrates 100 are shown being located on a substrate transport device 620. According to some embodiments, the substrate support may be movable to allow for adjusting the position of the substrate 100 in the chamber 612. Particularly for large area substrates as described herein, the deposition can be conducted having a vertical substrate orientation or an essentially vertical substrate orientation. Thereby, the transport device can
20 have lower rollers 622, which are driven by one or more drives 625, e.g. motors. The drives 625 can be connected to a roller 622 by a shaft 623 for rotation of the roller. Thereby, it is possible that one motor 625 drives more than one roller, e.g. by connecting rollers with a belt, a gear system, or the like.

[0042] Rollers 624 can be used for support of the substrates in the vertical or essentially
25 vertical position. Typically, the substrates can be vertical or can slightly deviate from the vertical position, e.g. up to 5°. Large area substrates having substrate sizes of 1 m^2 to 9 m^2 and are typically very thin, e.g. below 1 mm, such as 0.7 mm or even 0.5 mm. In order to support the substrate and to provide the substrates in fixed position, the substrates are provided in a carrier during processing of the substrates. Accordingly, the substrates can be
30 transported by the transport system including, e.g., a plurality of rollers and drives while

being supported in a carrier. For example, the carrier with the substrates therein is supported by the system of rollers 622 and rollers 624.

[0043] A deposition material source 630 is provided in chamber 612 facing the side of the substrate to be coated. The deposition material source 630 provides deposition material 635 to be deposited on the substrate. As shown in FIG. 6A and according to embodiments described herein, the source 630 may be a target with deposition material thereon or any other arrangement allowing material to be released for deposition on substrate 100. Typically, the material source 630 may be a rotatable target. According to some embodiments, the material source 630 may be movable in order to position and/or replace the source 230. According to other embodiments, the material source may also be a planar target.

[0044] According to some embodiments, the deposition material, which is indicated by reference numeral 635 during layer deposition, may be chosen according to the deposition process and the later application of the coated substrate. For instance, the deposition material of the source may be a material selected from the group consisting of: a metal, such as aluminum, molybdenum, titanium, copper, or the like, silicon, indium tin oxide, and other transparent conductive oxides. Typically, oxide-, nitride- or carbide-layers, which can include such materials, can be deposited by providing the material from the source or by reactive deposition, i.e. the material from the source reacts with elements like oxygen, nitride, or carbon from a processing gas. According to some embodiments, thin film transistor materials like siliconoxides, siliconoxynitrides, siliconnitrides, aluminumoxide, aluminumoxynitrides may be used as deposition material.

[0045] Typically, the deposition chamber 600 includes a masking arrangement 640 including a mask structure 140. According to some embodiments, the mask 140 is an edge exclusion mask. The edge exclusion mask 140 ensures that the edges of the substrate 100 are not coated with deposition material 635. Dashed lines 665 show exemplarily the path of the deposition material 635 during operation of the chamber 600. As an example, the material 635 is sputtered or can also be vaporized and dashed lines 665 show schematically the path of the sputtered material vapor of the deposition material 635 to the substrate 100. As can be seen in Fig. 6A by the dashed lines 665, an edge of the substrate 100 remains free of deposition material due to the edge exclusion mask 140.

[0046] In Fig. 6B, the left edge exclusion mask is illustrated to include individual frame portions 601, 602, 603, 604, 605, 606, 607, 608, 609 and 610 which are connected to form the mask frame. Typically, a mask structure particularly for large area substrates, will be provided with by at least 4 corner portions 601, 603, 606, and 608, which can be essentially L-shaped and which will include the corner area or at least a significant portion of the corner area, and with side portions, which connect the corner parts to form the mask frame. Typically, the frame portions 601-610 may be arranged in a tongue-and-groove arrangement. The tongue-and-groove arrangement provides fixed positions of the frame portions relatively to one another. Further, according to some embodiments described herein, the tongue-and-groove arrangements of the frame portions allow the movement of the frame portions away from each other. Typically, a tongue-and-groove arrangement enables the frame portions to slide away from each other without causing a gap through which deposition material could pass. For reasons of simplicity, only the left mask structure 140 is shown with portions 601-610. Similarly more than one or all mask structures in a processing system can be provided with more than one portion to form the mask frame.

[0047] According to typical embodiments, which can be combined with other embodiments described herein, the one or more chambers 612 can be provided as vacuum chambers. Thereby, the chambers are adapted for processing and/or coating the substrates in vacuum environment. Typically, the pressure can be below 10 mbar, e.g. between 1x10-7 mbar and 1x10-1 mbar. Thus, deposition system may include a pumping system (not shown), which can be connected to vacuum flanges 613, and capable of achieving a pressure within processing chamber 612 sufficiently low for enabling the deposition system to be operable for a particular application, such as a pressure of 1x10-7 mbar. The pressure during deposition, such as PVD processes, (i.e. deposition pressure) may be between 0.1 Pa and 1 Pa. For particular embodiments, e.g. PVD applications, wherein the processing gas includes argon and at least one of oxygen or nitrogen, the argon partial pressure may be between 0.1 Pa and 1 Pa, and the oxygen, hydrogen and/or nitrogen partial pressure may be between 0.1 Pa and 1 Pa. Typically, the pressure ranges for CVD applications can be about 2 orders of magnitude larger, particularly at the high pressure end of the ranges given above.

[0048] According to some embodiments, a method is provided for depositing a deposition material layer on a substrate. Fig. 7 shows a flow diagram of the described method. Typically, a substrate is provided in a chamber of a deposition apparatus. According to some

embodiments, the substrate may be a large area substrate as described above and the deposition apparatus may be a deposition chamber as exemplarily shown in FIGS. 6A and 6B.

[0049] In step 702, a masking arrangement 640 (see, e.g. FIG. 6A) is moved towards the substrate within the chamber 612 and a portion of the substrate is covered by a mask. Typically, the mask covers an edge of the substrate. The masking is, according to embodiments described herein, provided with a corner cut edge exclusion mask as described herein. The mask typically provides an aperture with protrusions which allows deposition material to pass through during a deposition process. Examples of such a mask are described with respect to Figs. 2 to 5. After masking of the substrate, a layer is deposited on step 704, such that the edge is kept free of or substantially free of deposited material. According to some embodiment, which can be combined with other embodiments described herein, the method for depositing material, the deposition of the apparatus, and the mask for covering an edge of the substrate are used for large area substrates.

[0050] According to some embodiments, which can be combined with other embodiments described herein, the mask includes more than one frame portion to form the mask frame. Typically, the mask is adapted to be used in a deposition apparatus as described above.

[0051] According to different embodiments, which can be combined with other embodiments described herein, the mask frame can be made of materials like aluminum, Invar, titan and stainless steel.

[0052] In light of the above a plurality of embodiments are described. According to one embodiment, a mask structure configured for deposition of a layer on a rectangular substrate, e.g. an edge exclusion mask configured for deposition of a layer on a rectangular substrate, is provided. The mask structure includes a mask frame adapted for masking the edge of the substrate during layer deposition, wherein the mask frame comprises at least two mask frame side portions forming a corner in a corner area there between, wherein the mask frame is shaped to overlap the edge of the rectangular substrate such that a first overlap width at the side portions is larger than a second overlap width in the corner area. Typically, the mask frame can form at least one aperture with a protrusion in the corner area, more typically with protrusions in each of the corner areas. According to yet further, embodiments, which can be combined with other embodiments described herein, the first overlap can be from 2 mm to 8

mm, typically from 3 mm to 6 mm; the second overlap can be from 0.0 mm to 4 mm, typically from 1 mm to 3 mm; the corner area can have a length and/or a width being from 0.5 cm to 10 cm, typically from 2 to 6 cm; and/or the corner area can have a length and/or width being from 0.5 % to 5% of a corresponding length and/or width of the substrate. According to yet further additional or alternative modifications of embodiments, the at least two mask frame side portions can be four mask frame side portions, and the mask can further include at least one bar, e.g. with a bar side portion, connecting two mask frame side portions of the of the four mask frame side portions, wherein further corners in further corner areas are formed, and wherein the width of the bar is smaller in the corner areas as compared to the bar side portion. Typically, a corner in the corner area can have an angle from 70° to 90°. Yet further the overlap of embodiments described herein can be provided in a plane parallel to a surface of the rectangular substrate.

[0053] According to another embodiment, an apparatus for depositing a layer on a rectangular substrate is provided. The apparatus includes a chamber adapted for layer deposition therein, and a mask structure within the chamber, e.g. an edge exclusion mask configured for deposition of a layer on a rectangular substrate, wherein the mask structure includes a mask frame adapted for masking the edge of the substrate during layer deposition, wherein the mask frame comprises at least two mask frame side portions forming a corner in a corner area there between, wherein the mask frame is shaped to overlap the edge of the rectangular substrate such that a first overlap width at the side portions is larger than a second overlap width in the corner area. The apparatus further includes a deposition source for depositing material forming the layer. According to yet further embodiments, a transport system adapted for transportation of a carrier supporting the substrate can be provided in the apparatus.

[0054] According to a further embodiment, a method of depositing a layer over a rectangular substrate is provided. The method includes masking the substrate edge with a mask wherein the masking width is smaller in a corner of the substrate as compared to a side of the substrate, and depositing material of the layer on the substrate, particularly in substrate regions not masked by the mask. According to optional implementations thereof, which can be used additionally or alternatively to each other, the mask can be a mask structure according to embodiments described herein and/or the depositing can be provided by a PVD method, a CVD method, or a combination thereof.

[0055] While the foregoing is directed to embodiments of the invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

5

CLAIMS

1. A mask structure (140) configured for deposition of a layer on a rectangular substrate (100), comprising:

5 a mask frame adapted for masking the edge (120) of the substrate during layer deposition, wherein the mask frame comprises at least two mask frame side portions (340) forming a corner in a corner area (342) there between;

wherein the mask frame is shaped to overlap the edge of the rectangular substrate such that a first overlap width at the side portions is larger than a second overlap width in the
10 corner area.

2. The mask structure according to claim 1, wherein the mask frame has at least one aperture with a protrusion in the corner area (342), typically with protrusions in each of the corner areas.

15

3. The mask structure according to any of claims 1 to 2, wherein the first overlap (Ws) is from 2 mm to 8 mm, typically from 3 mm to 6 mm.

4. The mask structure according to any of claims 1 to 3, wherein the second overlap (Wc)
20 is from 0.0 mm to 4 mm, typically from 1 mm to 3 mm.

5. The mask structure according to any of claims 1 to 4, wherein the corner area (342) has a length (L) and/or width (H) being from 0.5 cm to 10 cm, typically from 2 to 6 cm.

6. The mask structure according to any of claims 1 to 5, wherein the corner area (342) has a length (L) and/or width (H) being from 0.5 % to 5% of a corresponding length and/or width of the substrate (100).

5 7. The mask structure according to any of claims 1 to 6, wherein the at least two mask frame side portions (340) are four mask frame side portions, the mask structure further comprising:

at least one bar (540) connecting two mask frame side portions of the four mask frame side portions, wherein further corners in further corner areas (342) are formed, wherein the
10 width of the bar is smaller in the corner areas as compared to the bar side portion.

8. The mask structure according to any of claims 1 to 7, wherein the corner in the corner area has an angle from 70° to 90°.

15 9. The mask structure according to any of claims 1 to 8, wherein the overlap is provided in a plane parallel to a surface of the rectangular substrate (100).

10. The mask structure according to any of claims 1 to 9, wherein the frame includes four corner elements (601, 603, 606, 608) and at least 4 side elements (602, 604, 605, 607, 609,
20 610), typically at least 6 side elements, which are adapted to be joined together for forming the mask frame.

11. An apparatus (600) for depositing a layer on a rectangular substrate (100), comprising:

a chamber (612) adapted for layer deposition therein,

25 a mask structure (140) according to any of claims 1 to 10 within the chamber; and

a deposition source (630) for depositing material forming the layer.

12. The apparatus according to claim 11, further comprising:

a transport system (620) adapted for transportation of a carrier supporting the substrate
5 (100).

13. A method of depositing a layer over a rectangular substrate (100), comprising:

masking the substrate edge (120) with a mask wherein the masking width is smaller in a corner of the substrate as compared to a side of the substrate; and

10 depositing material of the layer on the substrate, particularly in substrate regions not masked by the mask.

14. The method according to claim 13, wherein the mask is a mask structure according to any of claims 1 to 9.

15

15. The method according to any of claims 13 and 14, wherein the depositing is provided by a PVD method, a CVD method, or a combination thereof.

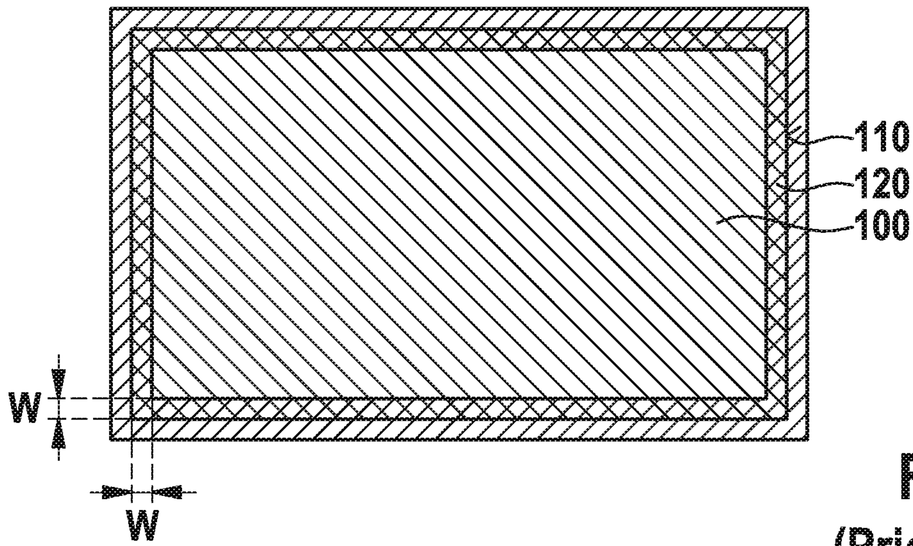

Fig. 1
(Prior Art)

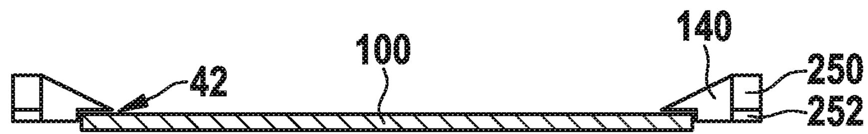

Fig. 2

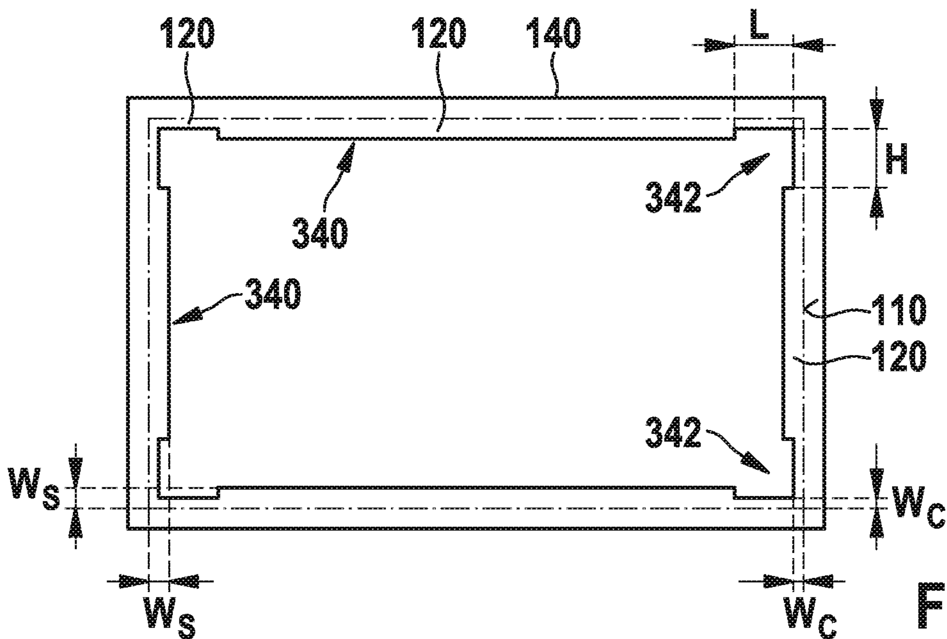

Fig. 3

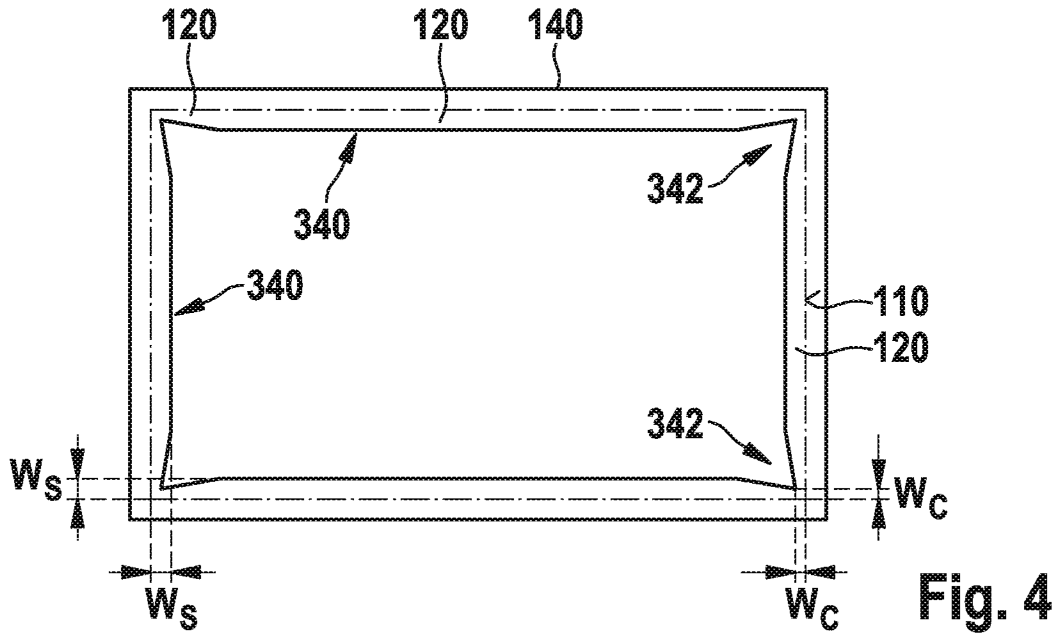

Fig. 4

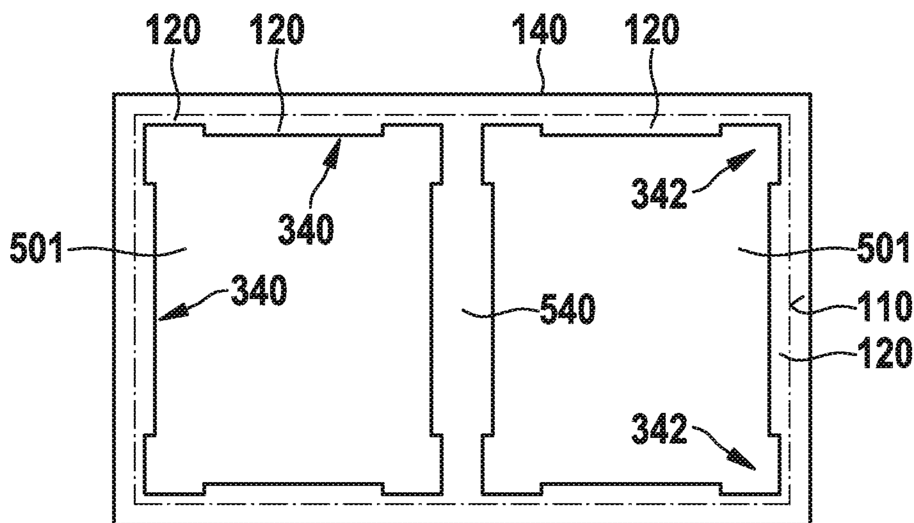

Fig. 5

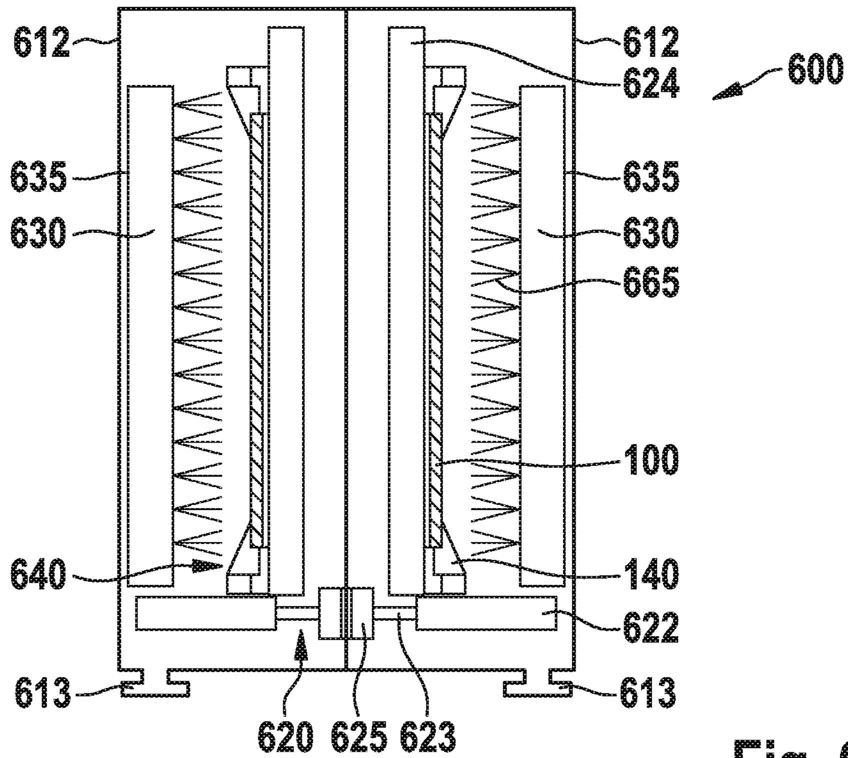

Fig. 6A

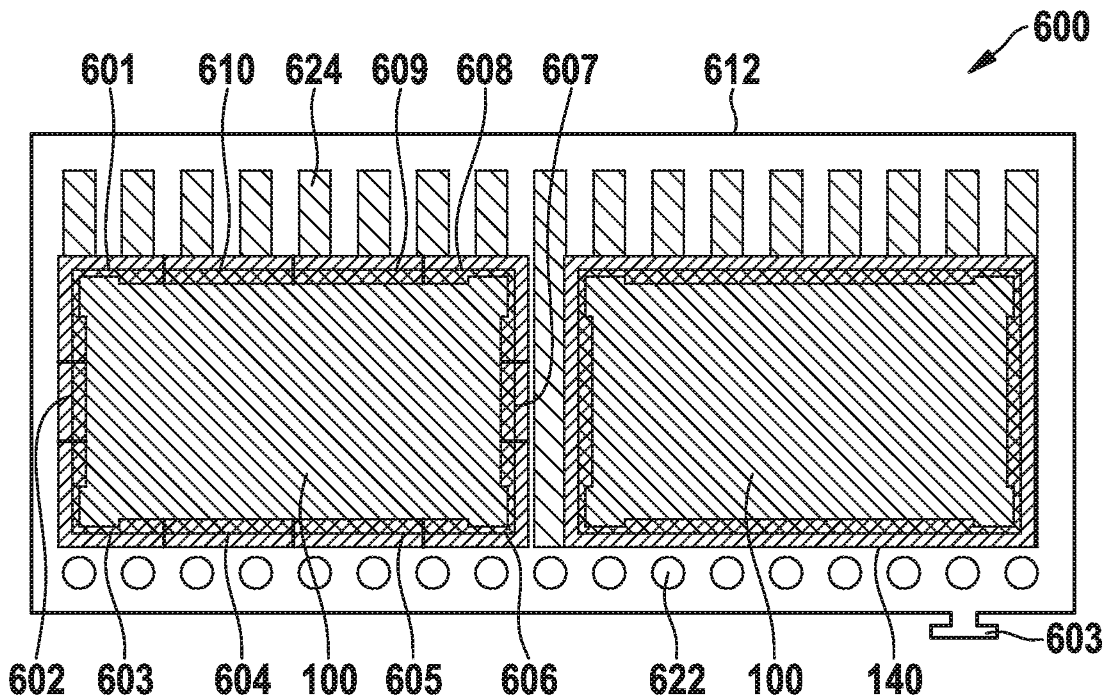

Fig. 6B

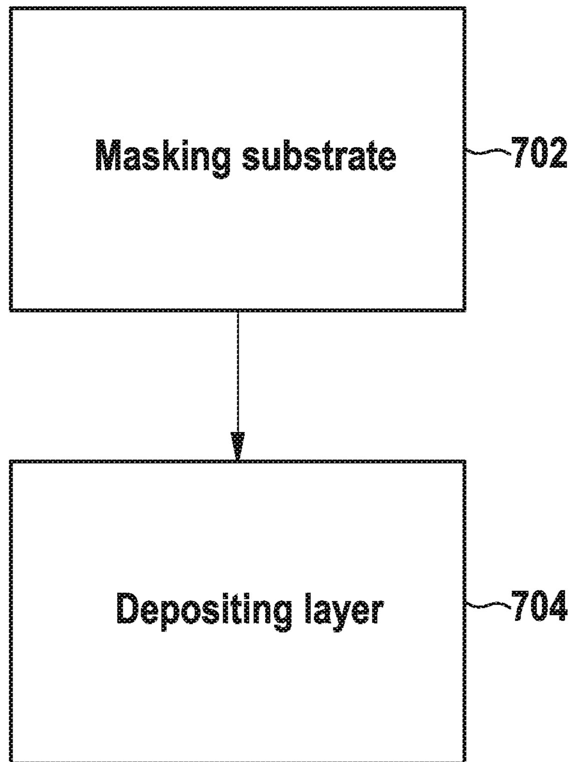

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/064670

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C14/04 C23C16/04 C23C8/04 C23C10/04 C23C2/00
C23C4/02 C23C4/00
ADD.

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)
C23C

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, INSPEC, IBM-TDB, 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	WO 03/004719 A1 (AIXTRON AG [DE]; SCHWAMBERA MARKUS [DE]; FRANKEN WALTER [DE]; KITTEL F) 16 January 2003 (2003-01-16) figures 6-8, 11 -----	1,2,8,9, 11,12
X	GB 1 058 050 A (STANDARD TELEPHONES CABLES LTD) 8 February 1967 (1967-02-08) figure 4B -----	1,2,8,9

☐ 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	Date of mailing of the international search report
19 April 2012	27/04/2012

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2011/064670

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 03004719	A1	16-01-2003	DE	10132348 A1	06-02-2003
			WO	03004719 A1	16-01-2003
GB 1058050	A	08-02-1967	NONE		