

SPECIFICATION

[Title of the Invention]

Mask for film-forming and mask assembling jig



\*159159\*

[Technical Field]

[0001]



\*G00002\*

This invention relates to a mask for film-forming which is used in a film-forming device such as sputtering device, and is so arranged on a film-forming surface of a substrate as to limit a film-forming area on the film-forming surface of the substrate and more particularly to a mask for film-forming which can be large-sized and is superior in quality and endurance, and a mask assembling jig for the mask for film-forming.

[Background of the Technique]

[0002]

Hitherto, a mask for film-forming as shown in FIG.9A and FIG.9B, is used in a film-forming process on a substrate such as semiconductor substrate and glass substrate. An opening P is formed to limit a film-forming area on the substrate by a mask M for film-forming. A single metal layer such as aluminum, titanium and stainless steel is used for the mask M for film-forming.

[0003]

Such a mask is so arranged on the substrate as to cover a specified portion of the surface of the substrate. Accordingly, a film-forming material is adhered onto the mask in the film-forming process. Adhered film-forming material or deposited material is chemically etched and removed from the mask to be cleaned and the mask is reused.

[0004]

The following patent document 1 discloses that plural mask elements are so arranged as to form a mask of annular frame. Positions of the mask elements can be individually changed on the substrate

[0005]

## Patent Document 1: JP10-60624A

[Disclosure of Invention]

[Problem to be solved by the Invention]

[0006]

5           As described above, the deposited film on the mask is removed by the chemical etching. The mask is damaged. The quality, the accuracy and the endurance are deteriorated. Thus, there have been several problems.

[0007]

10           When the deposited film is of aluminum, for example, the mask is cleaned by alkaline etching liquid. However, the mask of aluminum is inevitably damaged by the alkaline etching liquid. Accordingly, it is necessary that a mask of metal not dissolved by alkaline etching liquid is prepared. That is uneconomical.

[0008]

15           On the other hand, a mask for substrate for display is becoming larger. It is difficult to clean the large mask. When a mask of aluminum cannot be used because of film-forming material, any other material, for example, titanium or stainless steel should be used. However, these materials are heavy, so handling of the mask is difficult because of the weight. The handling cost is high.

[0009]

20           In the above patent literature 1, the mask consists of the plural mask elements. Accordingly, it is superior in cleaning operation in contrast to the mask of the single body. However, deposition films are adhered directly to the individual mask elements. The mask elements are damaged by the repeated cleaning operations. The mask material is limited in the relationship with the deposited film material. There is the same problem as  
25 the above.

[0010]

          This invention has been made in consideration of the above-mentioned problems. And the object of this invention is to provide a mask for film-forming in which deposited film can be removed without damage and which is superior in cleaning operation.

30           [Means for solving problem]

[0011]

A mask for film-forming characterized in that it is provided with a mask body arranged on a substrate, having an opening for limiting a film-forming region on said substrate; and

5 Cover means for covering a predetermined region on a surface of said mask body. The cover means is an assembly of segments or elements mountably and demountably attached to said mask body.

[0012]

Cover means covers a predetermined region of a mask body. Accordingly, the  
10 film-forming material is prevented to be adhered to the mask body. Cleaning of the cover means does not damage the mask body. Accuracy is not deteriorated. The mask body becomes durable. The cover segments can be easily manufactured by, for example, sheet metal cutting. The manufacturing cost is low and the manufacturing process can be simplified.

15 [0013]

The cover segments can be individually cleaned for removing the deposited films. The cleaning operation is simple. The mask body can be easily large-sized.

[0014]

The cover segments are fixed to the mask body for example by screw, nut and bolt  
20 etc. The deposition films are adhered to the upper surfaces of the cover segments. Accordingly, holding member such as nut is arranged on the backside of the mask body for holding the attachment of the cover segments to the mask body. Mounting and demounting operations are easy.

[0015]

25 The cover segments are attached to a region to be relatively easily deposited with film-forming material. At least, they are attached to the circumferential or marginal portion of the mask body around the opening. Their end portion is tapered toward the opening and the thickness thereof is gradually reduced toward the opening. Thus, mask accuracy can be improved.

30 [0016]

The attachment accuracy of the cover segments to the circumferential portion of the mask body or the positioning accuracy of the latter are important from the view point of the masking accuracy. In order to secure the attachment operability and the assembling accuracy of the cover segments, the segments are united integrally with each other as one body for each side of the opening.

[0017]

A mask assembling jig is characterized in that for a mask body having an opening for limiting a film-forming region, arranged on a substrate, and cover means covering a predetermined region on a surface of said mask body, said cover means being an assembly of segments, a mask mounting portion for mounting said mask body and a positioning projection are provided, said positioning projection passing through said opening of said mask body and top ends of said cover segments being attached to the inner circumferential region of the mask body, contacting with said positioning projection. The mask for film-forming of this invention can be easily and accurately assembled by the above jig.

[Effect of the Invention]

[0018]

As above described, the mask for film-forming is provided with a mask body arranged on a substrate, having an opening for limiting a film-forming region on said substrate. And cover means for covering, covers a predetermined region on a surface of said mask body. Said cover means is an assembly of segments or elements mountably and demountably attached to said mask body. Accordingly, the cleaning operation is required only for the cover. The mask body can be protected. The mask accuracy can be maintained. The endurance can be improved.

[0019]

The cover segments are individually cleaned for removing the deposited films. A cleaning machine of the large size is not needed. The cleaning process is simplified.

[Brief Description of the Drawings]

[0020]

FIG.1 shows views for explaining construction of a mask for film-forming according

to a first embodiment of this invention, A is a plan view and B is a cross-sectional view, taken along line B-B in A.

FIG.2 shows cross-sectional views of an important part for explaining attachment of cover means to a mask body and various construction examples (A, B and C) of inner  
5 circumferential regions around an opening portion 20.

FIG.3 shows views for explaining construction of a mask for film-forming according to a second embodiment of this invention. A is a plan view and B is a cross-sectional view, taken along line B-B in A.

FIG.4 shows views for explaining construction of a mask for film-forming according  
10 to a third embodiment of this invention. A is a plan view and B is a cross-sectional view taken along line B-B in A.

FIG.5 shows a cross sectional view of an important part of a fourth embodiment of this invention.

FIG.6 is a cross sectional view of an important part of a variation of the  
15 construction of FIG.5.

FIG.7 is a schematic plan view of a mask assembly jig, according to a fifth embodiment of this invention.

FIG.8 is a side cross sectional view for explaining mask-assembling process with the mask assembly jig.

FIG.9 shows views for explaining construction of a mask for film-forming according  
20 to a prior art. A is a plan view and B is a cross-sectional view taken along line B-B in A.

[Explanations of letters or numerals]

[0021]

|    |            |                |
|----|------------|----------------|
|    | 2          | mask body      |
| 25 | 3          | cover means    |
|    | 3A, 3B, 3C | cover segments |
|    | 5          | fixing member  |
|    | 6          | axial member   |
|    | 7          | holding member |
| 30 | 10         | concave        |

- 11, 12, 13 mask for film-forming
- 20 opening
- 21 inner circumferential portion around opening of mask body
- 31 end portion of cover element connecting to opening
- 5 32 engaging convex
- 33 engaging concave
- 34 elevated portion
- 35 inclined portion
- 40 mask assembling jig
- 10 41 mask mounting portion
- 42 positioning projection
- 43 annular concave
- W Substrate

[Best Embodiment of Invention]

15 [0022]

Next, embodiments of this invention will be described with reference to the drawings.

[0023] [First embodiment]

FIG.1 shows views for explaining construction of a mask for film-forming according to a first embodiment of this invention. A is a plan view and B is a cross-sectional view taken along line B-B in A. Mask for film-forming 11 is of double layer construction consisting of mask body 2 and cover 3 covering the whole surface of the mask body 2.

[0024]

The mask body 2 is made of metal such as aluminum, titanium or stainless steel. A rectangular opening 20 is formed almost in the center of the mask body 2. It is arranged on the substrate W. The opening 20 limits the film-forming area of the surface of substrate W.

[0025]

Inner circumferential or marginal portion 21 of the mask body 2 around the opening portion 20 is tapered as shown in FIG.1B. The height is gradually decreased

towards the opening 20. Thus, influence of the circumferential portion 21 on film-forming is made little. Accordingly, high film-forming accuracy can be obtained. The inner circumferential portion 21 may be stepwise as shown in FIG.5 and FIG.6 and as later described.

5 [0026]

The cover 3 consists of assembly of plural cover segments 3A---, 3B---, 3C---. The segments 3A in plan are rectangular and fixed on the inner circumferential portion 21 around the opening 20. Segment 3B (in plan) are rectangular and fixed on the flat surface of mask body 2. Segment 3C are triangular and fixed on the flat surface of the mask body  
10 2 adjacent to four corners of the opening portion 20. The segments 3C are of right isosceles triangle. It may be formed by bending rectangular segment diagonally. The segments 3A fixed on the inner circumferential portion 21 of the mask body 2 are shown as gray zones in FIG.1.

[0027]

15 The cover segments 3A are fixed on the tapered circumferential portion 21 of the mask body 2. Accordingly, they are tapered towards the film-forming surface of the substrate W. The height of the end portion 31 is gradually decreased toward the opening portion 20.

[0028]

20 The cover segments 3A are fixed on the tapered circumferential portion 21 of the mask body 2. Accordingly, they are tapered towards the film-forming surface or the opening 20 of the substrate W. The height of the end portion 31 is gradually decreased toward the opening portion 20. The segments 3A, 3B and 3C are made of metal such as aluminum, nickel, titanium or stainless steel by a press manufacturing machine.  
25 Ceramics or plastics may be used in accordance with the film-forming material. For example, when aluminum alloy film is formed on the substrate W, cover segments of aluminum are used. When chromium film is formed on the substrate W, the cover segments of titanium are used. When molybdenum or tungsten film is formed on the substrate W, cover segments of nickel are used. The materials of the cover segments are  
30 not limited to the same to each other, but they may be different from each other.

[0029]

It is preferable that the thermal expansion coefficient of the material of the cover 3 is nearer to that of the film-forming material than that of the mask body 2. Because the deposited film is harder to peel from the cover 3 or particles or dusts are hard to generate or made from the latter, in the film-forming process. The maintenance cycle is prolonged. It is preferable on the same ground that the adhering strength of the film-forming material to the cover 3 is higher than that of the mask body 2. The surface of the cover 3 may be blasted due to raise the adhering strength. Or as shown in FIG.5, elevated portions 34 may be formed to be made surface rough.

[0030]

The size of the segments 3A to 3C depends on the number of the divided cover segments. For example, the side is equal to 5cm to 50cm. The thickness is not particularly limited. For example, it is equal to 0.3mm. The segments 3A to 3C may be different from each other in thickness and shape. Segments of different sizes and shapes may be assembled to form the cover 3.

[0031]

The cover 3 is demontably attached to the mask body 2. FIG.2A is a cross sectional view of an important portion for explaining the attachment of the cover to the mask body.

[0032]

The cover segments 3A, 3B and 3C (only 3A and 3B are shown in FIG.2) are fixed to the surface of the mask body 2 by fixing members 5. The fixing member 5 consists of a bolt-like axial member 6 which passes through the holes of the segment and the mask body and on which screws are formed, and a nut-like holding member 7 which engages with the screw of the axial member 6 to hold the attachment of the segments to the mask body 2. The one to four or more fixing members 5 are used for one segment. The number of the fixing members 5 depends on the size of the segment.

[0033]

A part for preventing the fixing member 5 to loose, such as washer or spring washer may be interposed between the holding member 7 and the mask body 2. The hole of the segment or mask body for inserting the axial member 6 may be oblong in cross

section. In that case, the one of the segment and the mask body can be displaced relatively from each other. Thus, the attachment accuracy can be improved or relative position of the segment to the mask body can be changed.

[0034]

5           The holding member of the fixing member 5 is arranged in a concave 10 formed in the back of the mask body 2. Thus, segments with the deposited film can be easily demounted from the mask body 2. The demounting operation is good.

[0035]

10           The segments 3A cover the inner circumferential portion 21 of the mask body 2 around the opening 20. The ends 31 contact with the film-forming surface of the substrate W. Or they are adjacent or approximate to the film-forming surface. Thus, a mask boundary portion 20P is formed for defining the film-forming region and the film non-forming region. The end 31 of the segment 3A is tapered toward the mask boundary portion 20P. The film-forming accuracy can be decided by the mask boundary portion 20P.

15           [0036]

          As described above, the segment 3A attached to the mask body 2 defines the mask boundary portion 20P. The circumferential portion may be formed in the manner as shown in FIG.2B and FIG.2C. In the construction example of FIG.2B, the end of the segment 3A is more projected inwardly or toward the opening 20 than the circumferential portion 21 of the mask body 2. In the construction example of FIG.2C, the tapered portion of the mask body 2 is not formed and the end portion of the segment 3A is so bent as to be tapered toward the opening 20.

[0037]

25           In the mask for film-forming 11 according to the embodiment of this invention, plural cover segments 3A to 3C are attached to the whole surface of the mask body 2. The mask 11 is arranged on the substrate W. The film is formed on the substrate W in the film-forming chamber. A film of a predetermined material is formed on the defined area of the surface of the substrate W. The mask 11 may be mounted on a support mounted on a substrate (not shown).

30           [0038]

In the mask cleaning process, the mask 11 is taken out from the film-forming chamber, and thereafter the segments 3A, 3B and 3C all are taken out from the mask body 2. The holding member 7 of the fixing member 5 is arranged in the concave 10 of the back of the mask body 2. Accordingly, regardless of the amount of the deposited material, the segment can be easily taken out from the mask body 2.

[0039]

According to the embodiment, since the whole surface of the mask body 2 is covered with the segments 3A, 3B and 3C to constitute the cover 3, the film-forming material is prevented from directly adhering to the mask body 2. It is not required to clean the mask body 2, or the cleaning operation for the mask body 2 is simplified. Thus, it is avoided that the mask body 2 is damaged. And the lifetime of the mask body 2 is prolonged. The mask accuracy can be maintained and the endurance can be improved.

[0040]

According to the embodiment, the material of the mask body 2 can be selected regardless of the film-forming material. For example, even when the mask body is made of light aluminum alloy, aluminum film may be formed on the substrate since the cover 3 covers the mask body 2.

[0041]

When the cover segment is made of aluminum, it can be reused as Al scraps. When the cover segment is made of stainless steel, Al deposition is cleaned by alkaline liquid and it is reused.

[0042]

According to the embodiment, the cover consists of segments 3A, 3B and 3C which can be individually cleaned. The cleaning tank can be small-sized. The cleaning liquid amount is reduced. The cleaning installation can be simplified. The cleaning cost can be reduced.

[0043] [Second embodiment]

FIG.3A and FIG.3B show the second embodiment of this invention. The parts which correspond to those of the first embodiment are denoted by the same reference numerals, the detailed description of which will be omitted.

[0044]

The mask 12 for film-forming of this embodiment consists of a mask body 2 and a cover 3. The cover 3 is constituted by plural segments 3A, 3B and 3C. In this point, the construction is equal to that of the first embodiment. However, this embodiment is different  
 5 from the first embodiment in the region covered by the segments of 3A to 3C.

[0045]

In the mask for film-forming of this embodiment, the region relatively more deposited on the mask body 2 is covered with the cover 3. In other word, the inner circumferential portion of the mask body 2 is more deposited with the film-forming  
 10 material than the outer circumferential portion of the mask body 2. The cover 3 covers only the inner circumferential portion of the mask 2.

[0046]

According to this embodiment, the region covered by the cover 3 is smaller than that of the first embodiment. Accordingly, the number of the segments 3A to 3C is smaller. The  
 15 mounting and demounting operation of the segments 3A to 3C is reduced. Operation cost can be reduced. The productivity can be improved.

[0047] [Third embodiment]

FIG.4A and FIG.4B show the third embodiment of this invention. The parts which correspond to those of the first embodiment, are denoted by the same reference numerals,  
 20 the detailed description of which will be omitted.

[0048]

The mask 13 for film-forming consists of the mask body 2 and the cover 3 covering the whole surface of the mask body 2. The cover 3 consists of the segments 3A, 3B and 3C. In this point, the construction is equal to the first embodiment. However, this  
 25 embodiment is different from the above embodiment in the following point. The segments 3A attached to the circumferential portions 21 around the opening 20 are united integrally with each other as one body to form a single rectangular segment one side by one side.

[0049]

30 The end portion of the cover segment 3A forms a mask boundary portion for

defining a film-forming region of the substrate W. However, they are individual and independent from each other. With the assembling accuracy of the segments, the positional accuracy of the mask boundary portion 20P varies.

[0050]

5           In this embodiment, the segments 3A are united integrally with each other as one body in each side of the opening. Thus, variation of attachment accuracy to the mask body is reduced

[0051]

10           According to this embodiment, the mask boundary portion 20P is accurately defined with the united segments 3A. The mounting and demounting operation can be reduced. The productivity can be improved.

[0052] [Fourth embodiment]

15           In the above embodiments, the segments 3A, 3B and 3C constituting the cover are arranged without spacing from each other. Thus, the film-forming material is prevented from adhering to the mask body 2. However, it is difficult in some cases that the segments are arranged without spacing due to manufacturing error of the segments.

[0053]

20           Construction to overcome the above mentioned disadvantage is shown in FIG.5. An engaging projection 32 and an engaging concave 33 are formed in the adjacent segments 3A and 3B and they are engaged with each other as shown in FIG.5. Thus, the adjacent segments are so partially overlapped each other that they cover the whole surface of the mask body 2. The engaging projection 32 and the engaging concave 33 correspond to "overlapping portions" of this invention. The overlapping length is not limited to a certain value. The segments may be attached to the mask body 2 with some clearance.

25           [0054]

          Thus, the whole surface of the mask body 2 is covered without spacing, regardless of manufacturing error and size error. The mask body 2 is protected from being deposited with the film-forming material and the assembling accuracy can be relaxed. The operability can be improved.

30           [0055]

Elevated portion or bumps 34 may be formed on the segment 3B. The deposited film is hard to be peeled by the bump 34. Particles are hard to be generated or made by the bumps 34. The gaps G1 and G2 between the segments function as the bumps 34. Thus, the gaps G1 and G2 make the peeling of the deposited film more difficult together with the bumps 34. The thickness of the deposited film can be increased without peeling. Maintenance cycle can be prolonged.

[0056]

In FIG.6, inclined gaps 35 are made between the adjacent segments 3B so that the segments 3B are partially overlapped with respect to the surface of the mask body 2. The same effects as the above-mentioned can be obtained. The overlapping length can be adjusted with the angle of the gap 35, the thickness of the segment and the size of the gap. The inclined gap may be stepwise, not tapered.

[0057] [Fifth embodiment]

As above described, the segment 3A attached to the circumferential portion of the mask body 2 around the opening defines the mask boundary portion 20P for the film-forming region of the substrate. It decides the masking accuracy. In the embodiment shown in FIG.7 and FIG.8, a mask assembly jig 40 is used for assembling the segments 3A to the mask body 2 with accuracy.

[0058]

The mask-assembling jig 40 consists of a mask mounting part 41 for mounting the mask body 2, a positioning projection 42 formed inside of the mask mounting part 41 and a circumferential concave 43.

[0059]

The mask mounting part 41 has the same shape as the mask body 2 of the above embodiment. Positioning means (not shown) for holding the relative position to the mask body may be formed in the mask mounting part 41.

[0060]

When the mask body 2 is mounted on the mounting portion 41, the positioning projection 42 passes through the opening 20. The shape in plan corresponds to the film-forming region. The ends of the cover segments 3A attached to the mask body 2

contact with the side surface of the positioning projection 42 as shown in FIG.8. Thus, the cover segment 3A is positioned relative to the mask body 2.

[0061]

When the mask is assembled with the above mask assembly jig 40, the segments  
5 3A can be attached to the circumferential portion of the mask body 2 with a predetermined accuracy. Mask of high quality can be easily manufactured.

[0062]

While the preferred embodiments of the Invention have been described, without limited to this, variations thereto will occur to those skilled in the art within the scope of  
10 the present inventive concepts that are delineated by the following claims.

[0063]

For example, in the above embodiments, the shape of the opening 20 of the mask body 20 is rectangular. However it is not limited to the rectangular, but it may be in another geometrical shape. Further, the opening is not limited to one, but may be plural.

15 [0064]

The film-forming apparatus is not limited to the sputtering apparatus, but it may be another kind of the film-forming apparatus, such as CVD. A mask for film-forming, according to this invention can be used also for another object such as ion implanting and dry etching.

20 [0065]

In the above embodiments, the fixing member 5 is used for fixing the cover segments 3A, 3B and 3C to the mask body 2. The arrangement for attachment is not limited to that of the embodiments. A magnet may be used for attachment of the cover segments to the mask body if that has no influence on the vacuum processing such as the  
25 film-forming process.

## SCOPE OF DEMAND

1. A mask for film-forming characterized in that it is provided with a mask body arranged on a substrate, having an opening for limiting a film-forming region on said  
5 substrate; and

cover means for covering a predetermined region on a surface of said substrate,  
said cover means being an assembly of cover segments mountably and demountably attached to said mask body.

2. A mask for film-forming according to claim 1, characterized in that holding  
10 means for holding attachment of said cover segments to said mask body is arranged in the back of said mask body.

3. A mask for film-forming according to claim 1, characterized in that said cover means is attached to at least, an inner circumferential region of said mask body around said opening.

15 4. A mask for film-forming according to claim 3 in which said cover segments attached to said inner circumferential region of said mask body around said opening are tapered towards to said opening.

5. A mask for film-forming according to claim 3 in which the thickness of end portions of said cover segments attached to said inner circumferential region of said mask  
20 body around said opening is gradually reduced towards said opening.

6. A mask for film-forming according to claim 3 in which the thickness of said inner circumferential region of said mask body around said opening is gradually reduced towards said opening.

7. A mask for film-forming according to claim 3 in which said cover segments  
25 attached to said inner circumferential region of said mask body around said opening are more projected towards to said opening than said inner circumferential region of said mask body around said opening.

8. A mask for film-forming according to claim 3 in which said cover segments attached to said inner circumferential region of said mask body around said opening are  
30 united with each other as one body for each side of said opening.

9. A mask for film-forming according to claim 1 in which said cover segments have overlapping portions with adjacent one or ones of said cover segments.

10. A mask for film-forming according to claim 1 in which the thermal expansion coefficient of said cover means is nearer to that of film-forming material than that of said mask body.

11. A mask for film-forming according to claim 1 in which adhering strength of said cover segments to film-forming material is higher than that of said mask body.

12. A mask assembling jig characterized in that for a mask body having an opening for limiting a film-forming region; and

cover means covering a predetermined region on a surface of said mask body,  
said cover means being an assembly of segments,

a mask mounting portion for mounting said mask body and a positioning projection are provided, said positioning projection passing through said opening of said mask body and top ends of said cover segments attached to the inner circumferential region of the mask body contacting with said positioning projection for positioning said cover segment.