



- (51) International Patent Classification:
C25D 5/04 (2006.01) *C25D 21/10* (2006.01)
C25D 17/06 (2006.01)
- (21) International Application Number:
PCT/EP2014/062031
- (22) International Filing Date:
10 June 2014 (10.06.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
13171963.5 14 June 2013 (14.06.2013) EP
- (71) Applicant: **ATOTECH DEUTSCHLAND GMBH**
[DE/DE]; Erasmusstraße 20, 10553 Berlin (DE).
- (72) Inventors: **KLINGL, Heinz**; Schönblickstraße 3, 86356
Neusäß (DE). **WEINHOLD, Ray**; Habsburgerstraße 70a,
90475 Nürnberg (DE).
- (74) Agent: **WONNEMANN, Jörg**; ATOTECH DEUTSCH-
LAND GMBH, Erasmusstraße 20, 10553 Berlin (DE).
- (81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,

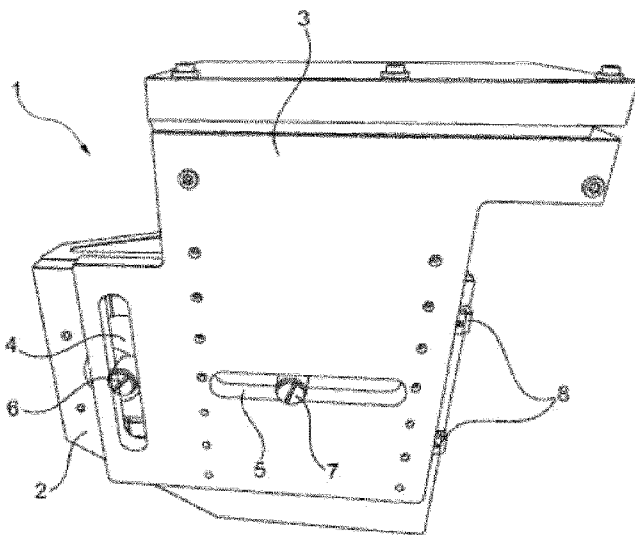
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, 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, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

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

- (54) Title: DEVICE FOR MOVING A SUBSTRATE HOLDER DURING A VERTICAL GALVANIC METAL DEPOSITION,
AND A METHOD FOR VERTICAL GALVANIC METAL DEPOSITION USING SUCH A DEVICE



- (57) Abstract: The present invention is related to device for moving a substrate holder, which comprises at least a substrate to be treated, during a vertical galvanic metal, preferably copper, deposition on such a substrate to be treated characterized in that the device comprises at least a first driving means, at least a second driving means, at least a first adjusting means and at least a second adjusting means; wherein the first driving means is in operative connection to the first adjusting means to generate a first axial deflection and the second driving means is in operative connection to the second adjusting means to generate a second axial deflection of the substrate holder; wherein said first axial deflection and said second axial deflection are continuously adjustable and/or controllable. The invention is further related to a method for vertical galvanic metal, preferably copper, deposition on a substrate using such a device.

Figure 1

DEVICE FOR MOVING A SUBSTRATE HOLDER DURING A VERTICAL GALVANIC METAL DEPOSITION, AND A METHOD FOR VERTICAL GALVANIC METAL DEPOSITION USING SUCH A DEVICE

Field of the Invention

The present invention relates to a device for moving a substrate holder, which comprises at least a substrate to be treated, during a vertical galvanic metal, preferably copper, deposition on such a substrate to be treated; and a method for vertical galvanic metal, preferably copper, deposition on a substrate using such a device.

Background of the Invention

It is well known in the galvanic industry that for a plurality of galvanic plating systems a substrate holder carrying a substrate to be treated, such as a wafer, has to be somehow properly and accurately moved in a vertical galvanic apparatus during such a vertical galvanic metal deposition process in order to ensure a thickness distribution of the deposited metal, preferably copper, as uniform as possible. Further, a proper and effective filling of vias or boreholes, if present, shall be achieved by such a movement of the substrate holder.

If such a movement of a substrate holder is not executed, it has been found in such vertical plating systems that the incoming flow of the electrolyte during the vertical galvanic metal, preferably copper, deposition does not arrive at the surface of the substrate to be treated in a uniform way. This would lead

subsequently to a non-uniform thickness distribution of the galvanic metal on the surface of the substrate to be treated.

Such a non-uniform distribution depends on the kind of device element, which is responsible for the incoming flow of the electrolyte, such as a carrier substrate having a plurality of through-going conduits, wherein the electrolyte would have been passing through these through-going conduits, so leading to different specific sites on the surface of the substrate to be treated from which the incoming flow would be distributed further, normally flowing to the outside areas. Without a movement of the substrate holder, the substrate to be treated would comprise a thickness distribution in analogy to the through-going conduit distribution of such a carrier substrate with areas of higher galvanic metal thickness, where the incoming flow have been directly arrived after passing through the through-going conduits; and neighbored areas with lower galvanic metal thickness, where the incoming flow have not been directly arrived after passing through the through-going conduits. For some alternative vertical plating systems, the thickness distribution on the surface of the substrate to be treated can be exactly opposite regarding the through-going conduit distribution of the carrier substrate in dependence of the electrolyte systems applied.

In order to fulfill this movement requirement for vertical galvanic metal deposition, the industry is generally making use of an approach as it is described in EP 2 176 450 B1 of the applicant. Herein, a method for the electrolytic treatment of a plate-shaped product is disclosed that comprises at least one substantially planar treatment surface, wherein the product is moved in method step c in two directions parallel to the treatment surface, wherein the two directions into which the product is moved are orthogonal to each other and wherein the product is moved in an oscillating manner. In a preferred embodiment of the method, the product can be moved on a circular path parallel to the treatment surface.

None of this literature, however, suggests the use of a device for moving

a substrate holder during a vertical galvanic metal deposition, which is able to freely modify in-situ the movement of the substrate holder comprising the substrate to be treated in dependence of the substrate to be treated or in dependence of the requirements of different incoming flows of the electrolyte, which shall be necessary for different technical purposes. Normally, just one defined oscillating movement can be installed, such as by a perforated disk, having a certainly fixed inner radius of the circular movement.

This typically will significantly limit the degree to which a movement of a substrate holder can be modified in a very strict manner; in particular, the known prior art devices often would not be capable of modifying or varying the movement process at all, let alone in dependence of the structure of the substrate to be treated, which could differ over the total surface area.

Objective of the present Invention

In view of the prior art, it was thus an object of the present invention to provide a device for moving a substrate holder during a vertical galvanic metal deposition, which shall not exhibit the aforementioned shortcomings of the known prior art devices.

What is needed therefore is a device suitable to move the substrate holder during the vertical galvanic metal deposition process in such a way that the deposited galvanic metal thickness distribution over the total surface area of the substrate to be treated can be minimized.

Furthermore, it was an object to provide a device for moving, which can freely modify in-situ the movement of the substrate holder in dependence of the substrate structure and/or in dependence of the incoming flow of the electrolyte.

Further, it was an object to provide an economic device, which shall comprise a minimum of required device elements, which shall be at the same time as cheap and as simply constructed as possible.

Summary of the Invention

These objects and also further objects which are not stated explicitly but are immediately derivable or discernible from the connections discussed herein by way of introduction are achieved by a device having all features of claim 1. Appropriate modifications to the inventive device are protected in dependent claims 2 to 12. Further, claim 13 comprises a method for vertical galvanic metal, preferably copper, deposition on a substrate using such a device.

The present invention accordingly provides a device for moving a substrate holder, which comprises at least a substrate to be treated, during a vertical galvanic metal, preferably copper, deposition on such a substrate to be treated characterized in that the device comprises at least a first driving means, at least a second driving means, at least a first adjusting means and at least a second adjusting means; wherein the first driving means is in operative connection to the first adjusting means to generate a first axial deflection and the second driving means is in operative connection to the second adjusting means to generate a second axial deflection of the substrate holder; wherein said first axial deflection and said second axial deflection are continuously adjustable and/or controllable.

It is thus possible in an unforeseeable manner to provide a device for moving a substrate holder during a vertical galvanic metal deposition, which does not exhibit the aforementioned shortcomings of the known prior art processes.

In addition thereto, the device is suitable to move the substrate holder during the vertical galvanic metal deposition process in such a way that the deposited galvanic metal thickness distribution over the total surface area of the substrate to be treated can be minimized.

Furthermore, the device for moving can freely modify in-situ the movement of the substrate holder in dependence of the substrate structure and/or in dependence of the incoming flow of the electrolyte.

Further, the device comprises a minimum of required device elements, which are relatively cheap and simply constructed.

Additionally, the device enables the adjusting of the movement of the substrate holder in-situ if the incoming flow has been changed or modified for different technical purposes.

Brief Description of the Figures

For a more complete understanding of the present invention, reference is made to the following Detailed Description of the Invention considered in conjunction with the accompanying figures, in which:

Fig. 1 shows a front view of a device for moving a substrate holder in accordance with a preferred embodiment of the present invention;

Fig. 2 shows another front view of the same device for moving a substrate holder as shown in Fig. 1;

Fig. 3 shows another front view of the same device for moving a substrate holder as shown in Fig. 1;

Fig. 4 shows another front view of the same device for moving a substrate holder as shown in Fig. 1; and

Fig. 5 shows a back view of the same device for moving a substrate holder as shown in Fig. 1.

Detailed Description of the Invention

As used herein, the term "device for moving a substrate holder" in ac-

cordance with the present invention, refers to any kind of device which is suitable to offer a possibility to move a substrate holder, either directly due to a direct operative connection between the device for moving and the substrate holder, or indirectly due to an indirect operative connection by an interconnecting device and/or device element, such as a holding device, as long as the movement is continuously adjustable and/or controllable.

Such a holding device itself can be an internal part of an apparatus for vertical galvanic metal deposition or such a holding device can be an additional "external" device, preferably in operative connection with said apparatus for vertical galvanic metal deposition.

As used herein, the term "substrate holder" in accordance with the present invention, refers to any kind of substrate folder, such as wafer holder, suitable to comprise at least one substrate to be treated for a vertical galvanic metal deposition process.

As used herein, the term "galvanic metal", when applied to a vertical galvanic metal deposition on a substrate to be treated in accordance with the present invention, refers to metals which are known to be suitable for such a vertical deposition method. Such galvanic metals comprise gold, nickel, and copper, preferably copper.

As used herein, the term "substrate to be treated", when applied to a vertical galvanic metal deposition on such a substrate in accordance with the present invention, refers to substrates which are round, preferably circular, or angular, preferably polyangular, such as rectangular, quadratic or triangular, or a mixture of round and angular structure elements, such as semicircular.

Such substrates have a diameter ranging from 50 mm to 1000 mm, preferably from 100 mm to 700 mm, and more preferably from 120 mm to 500 mm, in case of a round structure; or a side length ranging from 10 mm to 1000 mm,

preferably from 25 mm to 700 mm, and more preferably from 50 mm to 500 mm, in case of an angular, preferably polyangular, structure.

Such substrates can be a printed circuit board, a printed circuit foil, a semiconductor wafer, a solar cell, a photoelectric cell or a monitor cell.

Both driving means has to be active in order to generate the claimed adjustable and/or controllable two-dimensional movement of the substrate holder.

If solely one of the two driving means works, it would lead to a linear (axial) movement, which is already known in the prior art. The sole exception, wherein such a combination of two active driving means would lead again to a one-dimensional deflection, takes place if both axial deflections are running exactly parallel. This shall not be part of the invention.

The frequency of the movement of the substrate holder can be regulated and/or controlled by the speed of the respective first and/or second driven means, which on their part again regulate and/or control the respective first and/or adjusting means of the device for moving a substrate holder.

In one embodiment, the first axial deflection and the second axial deflection are taking place at an angle of 90°, relative to one another.

In one embodiment, the device additionally comprises at least a first cross slide as central guide element for supporting the first and second axial deflection.

It has been found advantageous to make use of such a known device element to take away or to take over the weight-loading during the movement of the substrate holder from the adjusting means of the device.

In one embodiment, the device further comprises at least a first oblong hole and at least a second oblong hole, wherein the first oblong hole is in operative connection with the first adjusting means and the second oblong hole is in

operative connection with the second adjusting means, both serving as mechanical guide for the respective first and second axial deflection.

In a preferred embodiment, the first adjusting means comprises at least a first tenon running inside of the first oblong hole and the second adjusting means comprises at least a second tenon running inside of the second oblong hole in order to provide the respective operative connection between each oblong hole and its respective adjusting means.

In a more preferred embodiment, the at least first tenon and the at least second tenon possess an outer diameter, which is nearly identical to the distance between the side walls of the respective oblong hole, to provide a backlash-free operative connection between a tenon of an adjusting means and the respective oblong hole.

The backlash-free operative connection shall minimize possible force losses during the movement of the substrate holder. The cross slide will be carried by the first and second tenons of the first and second adjusting means.

In a preferred embodiment, if the first axial deflection and the second axial deflection are taking place at an angle of 90° , relative to one another, the cross slide will be moved by a right-angled force application of the respective first or second tenon of the first or second adjusting means on the corresponding side wall of the respective oblong hole of the first or second adjusting means.

In one embodiment, the at least first driving means and the at least second driving means are independently adjustable and/or controllable from each other.

In an alternative embodiment, the at least first driving means and the at least second driving means are adjustable and/or controllable as coupled operative unit.

Both alternatives, namely the coupled operative unit as well as the independent operation, offer the advantage of a maximum of flexibility for continuously adjusting and/or controlling the movement of the substrate holder, as long as both driven means are active.

In one embodiment, the at least first driving means and the at least second driving means comprise manually driven and/or automatically driven means, wherein a linear actuator and/or a rotary actuator can be comprised, such as a stepper motor, preferably a servomotor.

In one embodiment, the generated movement of the substrate holder comprises in dependence of the maximal first and second axial deflection of the at least first and second adjusting means any kind of two-dimensional movement, such as circular, elliptical and wavelike.

It has been found advantageous to limit the movement on a two dimensional movement, even when a three-dimensional movement could be build-up, but solely with severe disadvantages.

A defined two dimensional movement of the substrate holder has to be carried out in the sense of the present invention in such a way that the distance between the substrate to be treated, which is hold and fixed by the respective substrate holder, and the anode(s) of the vertical galvanic deposition apparatus is kept constant as much as possible to ensure a uniform thickness of the deposited galvanic metal on the substrate to be treated. Thus, the inclusion of a third dimension for the movement of the device for moving a substrate holder, which would be mechanically possible, would not make sense due to constantly changing distances between anode(s) and the substrate to be treated. Therefore, a three-dimensional movement shall not be part of the present invention.

In one embodiment, the at least first adjusting means and/or the at least second adjusting means perform a rotary movement to generate the first and/or second axial deflection of the substrate holder.

Such a rotary movement would offer the advantage of reduced construction space requirements, which makes the device cheaper. Further, a rotary movement does not have a stop due to a continuous circular movement of the respective adjusting means, whereby a blocking situation can be avoided, which makes the device more effective regarding maintenance and required service.

In one embodiment, the device further comprises a holding device for a substrate holder, which is directly or indirectly coupled with the device for moving the substrate holder.

Further, the object of the present invention is also solved by a method for vertical galvanic metal, preferably copper, deposition on a substrate using such a device for moving a substrate holder comprising the following method steps:

i) Providing such a device for moving a substrate holder, which comprises at least a substrate to be treated, comprising at least a first driving means, at least a second driving means, at least a first adjusting means and at least a second adjusting means.

ii) Inserting the substrate holder comprising at least a substrate to be treated in a vertical galvanic reaction tank.

iii) Generating a first axial deflection of the substrate holder by an operative connection of the first driving means and the first adjusting means and a second axial deflection of the substrate holder by an operative connection of the second driving means and the second adjusting means.

iv) Choosing a desired two-dimensional movement of the substrate holder by continuously adjusting and/or controlling the first and second axial deflections during the vertical galvanic metal, preferably copper, deposition.

v) After having finished the galvanic metal, preferably copper, deposition, the inventive device for moving the substrate holder terminates the 2-dimensional movement of the substrate holder.

vi) Removing the substrate holder comprising at least a substrate to be treated from the vertical galvanic reaction tank.

The present invention thus addresses the problem of improving known devices for generating an oscillating movement by the claimed invention herein, wherein any kind of two-dimensional movement, which is continuously adjustable and/or controllable, can be generated in dependence of the requirements of the respective substrate to be treated and/or in dependence of the respective galvanic process.

The following non-limiting examples are provided to illustrate an embodiment of the present invention and to facilitate understanding of the invention, but are not intended to limit the scope of the invention, which is defined by the claims appended hereto.

Turning now to the Figures, Figure 1 shows a front view of a device for moving a substrate holder in accordance with a preferred embodiment of the present invention. The device shown comprises a first device element 2, a second device element 3, a first oblong hole 4, a second oblong hole 5, a first adjusting means 6, a second adjusting means 7 and a first cross slide 8.

In the preferred embodiment shown in Figure 1 the first driving means 9 (not to see in the front view of the embodiment) is in operative connection to the first adjusting means 6 to generate a first axial deflection and the second driving means 10 (not to see in the front view of the embodiment) is in operative connection to the second adjusting means 7 to generate a second axial deflection of the second device element 3 (and whereby of a possibly directly or indirectly coupled substrate holder and/or holding device for a substrate holder); wherein said first axial deflection and said second axial deflection are continuously adjustable and/or controllable.

In this preferred embodiment, the first axial deflection and the second axial deflection are taking place at an angle of 90°, relative to one another, where-

in the first cross slide 8 serves as central guide element for supporting the first and second axial deflection; and wherein the first oblong hole 4 is in operative connection with the first adjusting means 6 and the second oblong hole 5 is in operative connection with the second adjusting means 7, both serving as mechanical guide for the respective first and second axial deflection.

The first adjusting means 6 comprises a first tenon running inside of the first oblong hole 4 and the second adjusting means 7 comprises a second tenon running inside of the second oblong hole 5 in order to provide the respective operative connection between each oblong hole 4, 5 and its respective adjusting means 6, 7. In order to minimize a possible loss of movement, the first tenon and the second tenon possess an outer diameter, which is nearly identical to the distance between the side walls of the respective oblong hole to provide a backlash-free operative connection between each tenon of an adjusting means 6, 7 and the respective oblong hole 4, 5. The first adjusting means 6 and the second adjusting means 7 both perform in this preferred embodiment a rotary movement to generate the first and second axial deflection (not good to see in Figure 1).

When comparing the following Figures 2 to 4 with Figure 1, it is decisive to focus on the position of the first and second tenon of the first and second adjusting means 6, 7 to observe the generated movement. In Figure 1 (now exemplary defined as starting point) both tenons of the respective first and second adjusting means 6, 7 are located more or less in the middle of the respective oblong hole 4, 5.

Figure 2 shows another front view of the same device for moving a substrate holder as shown in Figure 1.

In contrast to Figure 1, Figure 2 illustrates a second tenon of the second adjusting means 7, which is located no more in the middle, but at the right end

of the respective oblong hole 5. The first tenon of the first adjusting means 6 seems to be still in the middle position of the respective oblong hole 4.

However, if the relative position of the first device element 2 versus the second device element 3 is taken into account, it is clearly demonstrated that the second device element 3 has been shifted to the left compared to Figure 1. The second tenon of the second adjusting element 7 has been running inside of the second oblong hole 5 from the middle to the right during this movement of the second device element 3 to the left.

Such a movement has not been generated, if it could be assumed, by the operative connection between the second driving means (not to see in Figure 1) and the second adjusting means 7, but by a rotary movement of the first adjusting means 6 in operative connection with the first driving means (not to see in Figure 2), wherein the side flanks of the first tenon has been pressed against the left side wall of the first oblong hole 4 to cause a first axial deflection to the left during said rotary movement of the first adjusting means 6.

When regarding solely such a movement of a single adjusting means, like in this case of the first adjusting means 6, it would solely lead to a one-dimensional movement to the left of the second device element 3. A possible direct or indirect coupling of said device element 3 to a substrate holder and/or to a holding device for a substrate holder shall forward the generated movement to the substrate holder comprising at least a substrate to be treated.

In general, Figures 1 to 4 shall help to understand the mechanism of the inventive device by splitting a claimed two-dimensional movement generated by the operative connections between two adjusting means and two driving means, which is claimed by the appended set of claims, in several one-dimensional movement steps generated by the operative connection between one adjusting means and one driving means without limiting the scope of protection of said set of claims.

Figure 3 shows another front view of the same device for moving a substrate holder as shown in Figure 1.

In contrast to Figure 1, Figure 3 illustrates a first tenon of the first adjusting means 6, which is located no more in the middle, but at the upper end of the respective oblong hole 4. The second tenon of the second adjusting means 7 seems to be still in the middle position of the respective oblong hole 5.

However, if the relative position of the first device element 2 versus the second device element 3 is taken into account, it is clearly demonstrated that the second device element 3 has been shifted downwards compared to Figure 1. The first tenon of the first adjusting element 6 has been running inside of the first oblong hole 4 from the middle to the upper end during this movement of the second device element 3 downwards.

Such a movement has been generated by a rotary movement of the second adjusting means 7 in operative connection with the second driving means (not to see in Figure 3), wherein the side flanks of the second tenon has been pressed against the lower side wall of the second oblong hole 5 to cause a second axial deflection downwards during said rotary movement of the second adjusting means 7.

When regarding solely such a movement of a single adjusting means, like in this case of the second adjusting means 7, it would solely lead to a one-dimensional movement downwards of the second device element 3.

Figure 4 shows another front view of the same device for moving a substrate holder as shown in Figure 1.

In contrast to Figure 3, Figure 4 illustrates a second tenon of the second adjusting means 7, which is located no more in the middle, but at the left end of the respective oblong hole 5. The first tenon of the first adjusting means 6 seems to be still in the upper position of the respective oblong hole 4.

However, if the relative position of the first device element 2 versus the second device element 3 is taken into account, it is demonstrated (not perfectly to see) that the second device element 3 has been shifted to the right compared to Figure 3. The second tenon of the second adjusting element 7 has been running inside of the second oblong hole 5 from the middle to the left during this movement of the second device element 3 to the right.

Such a movement has been generated by a rotary movement of the first adjusting means 6 in operative connection with the first driving means (not to see in Figure 4), wherein the side flanks of the first tenon has been pressed against the right side wall of the first oblong hole 4 to cause a first axial deflection to the right during said rotary movement of the first adjusting means 6.

When regarding solely such a movement of a single adjusting means, like in this case of the first adjusting means 6, it would solely lead to a one-dimensional movement to the right of the second device element 3.

If Figure 4 is further compared to Figure 1, there is clearly demonstrated that the second device element 3 has been shifted downwards and to the right compared to Figure 1.

The first tenon of the first adjusting element 6 has been running inside of the first oblong hole 4 from the middle to the upper end during the movement of the second device element 3 downwards. The second tenon of the second adjusting element 7 has been running inside of the second oblong hole 5 from the middle to the left during the movement of the second device element 3 to the right.

Such two individual movements have been generated by two rotary movements of the first and second adjusting means 6, 7 in operative connection with the first and second driving means (not to see in Figure 4), wherein the side flanks of the first tenon has been pressed against the right side wall of the first oblong hole 4 to cause a first axial deflection to the right during a rotary

movement of the first adjusting means 6; whereas the side flanks of the second tenon has been pressed against the lower side wall of the second oblong hole 5 to cause a second axial deflection downwards during said rotary movement of the second adjusting means 7.

Figure 5 shows a back view of the same device for moving a substrate holder as shown in Figure 1. The back view of the device shown comprises a first device element 2, a second device element 3, a first driving means 9 and a second driving means 10; wherein such a first driving means 9 and such a second driving means 10 are adjustable and/or controllable as coupled operative unit or independently adjustable and/or controllable from each other.

Herein, the first driving means 9 and the second driving means 10 comprise manually driven and/or automatically driven means, wherein in Figure 5 two rotary actuators are comprised in form of servomotors, which are in operative connection to the respective first and second adjusting means 6, 7 for generating a first and/or second axial deflection of the second device element 3.

While the principles of the invention have been explained in relation to certain particular embodiments, and are provided for purposes of illustration, it is to be understood that various modifications thereof will become apparent to those skilled in the art upon reading the specification. Therefore, it is to be understood that the invention disclosed herein is intended to cover such modifications as fall within the scope of the appended claims. The scope of the invention is limited only by the scope of the appended claims.

Reference signs

1	Device for moving a substrate holder
2	First device element
3	Second device element
4	First oblong hole
5	Second oblong hole
6	First adjusting means
7	Second adjusting means
8	First cross slide
9	First driving means
10	Second driving means

CLAIMS

1. Device (1) for moving a substrate holder, which comprises at least a substrate to be treated, during a vertical galvanic metal, preferably copper, deposition on such a substrate to be treated characterized in that the device (1) comprises at least a first driving means (9), at least a second driving means (10), at least a first adjusting means (6) and at least a second adjusting means (7); wherein the first driving means (9) is in operative connection to the first adjusting means (6) to generate a first axial deflection and the second driving means (10) is in operative connection to the second adjusting means (7) to generate a second axial deflection of the substrate holder; wherein said first axial deflection and said second axial deflection are continuously adjustable and/or controllable.

2. Device according to claim 1 characterized in that the first axial deflection and the second axial deflection are taking place at an angle of 90°, relative to one another.

3. Device according to claim 2 characterized in that the device additionally comprises at least a first cross slide (8) as central guide element for supporting the first and second axial deflection.

4. Device according to one of the preceding claims characterized in that the device (1) further comprises at least a first oblong hole (4) and at least a second oblong hole (5), wherein the first oblong hole (4) is in operative connection with the first adjusting means (6) and the second oblong hole (5) is in operative connection with the second adjusting means (7), both serving as mechanical guide for the respective first and second axial deflection.

5. Device according to claim 4 characterized in that the first adjusting means (6) comprises at least a first tenon running inside of the first oblong hole (4) and the second adjusting means (7) comprises at least a second tenon running inside of the second oblong hole (5) in order to provide the respective op-

erative connection between each oblong hole (4, 5) and its respective adjusting means (6, 7).

6. Device according to claim 5 characterized in that the at least first tenon and the at least second tenon possess an outer diameter, which is nearly identical to the distance between the side walls of the respective oblong hole, to provide a backlash-free operative connection between a tenon of an adjusting means (6, 7) and the respective oblong hole (4, 5).

7. Device according to one of the preceding claims characterized in that the at least first driving means (9) and the at least second driving means (10) are independently adjustable and/or controllable from each other.

8. Device according to one of the preceding claims characterized in that the at least first driving means (9) and the at least second driving means (10) are adjustable and/or controllable as coupled operative unit.

9. Device according to one of the preceding claims characterized in that the at least first driving means (9) and the at least second driving means (10) comprise manually driven and/or automatically driven means, wherein a linear actuator and/or a rotary actuator can be comprised, such as a stepper motor, preferably a servomotor.

10. Device according to one of the preceding claims characterized in that the generated movement of the substrate holder comprises in dependence of the maximal first and second axial deflection of the at least first and second adjusting means (6, 7) any kind of two-dimensional movement, such as circular, elliptical and wavelike.

11. Device according to one of the preceding claims characterized in that the at least first adjusting means (6) and/or the at least second adjusting means (7) perform a rotary movement to generate the first and/or second axial deflection of the substrate holder.

12. Device according to one of the preceding claims characterized in that the device (1) further comprises a holding device for a substrate holder, which is directly or indirectly coupled with the device (1) for moving the substrate holder.

13. Method for vertical galvanic metal, preferably copper, deposition on a substrate using a device (1) according to one of the preceding claims characterized by the following method steps:

i) Providing a device (1) for moving a substrate holder, which comprises at least a substrate to be treated, according to one of the preceding claims comprising at least a first driving means (9), at least a second driving means (10), at least a first adjusting means (6) and at least a second adjusting means (7).

ii) Inserting the substrate holder comprising at least a substrate to be treated in a vertical galvanic reaction tank.

iii) Generating a first axial deflection of the substrate holder by an operative connection of the first driving means (9) and the first adjusting means (6) and a second axial deflection of the substrate holder by an operative connection of the second driving means (10) and the second adjusting means (7).

iv) Choosing a desired two-dimensional movement of the substrate holder by continuously adjusting and/or controlling the first and second axial deflections during the vertical galvanic metal, preferably copper, deposition.

v) After having finished the galvanic metal, preferably copper, deposition, the device (1) for moving the substrate holder according to one of the preceding claims terminates the 2-dimensional movement of the substrate holder.

vi) Removing the substrate holder comprising at least a substrate to be treated from the vertical galvanic reaction tank.

1/5

FIGURES

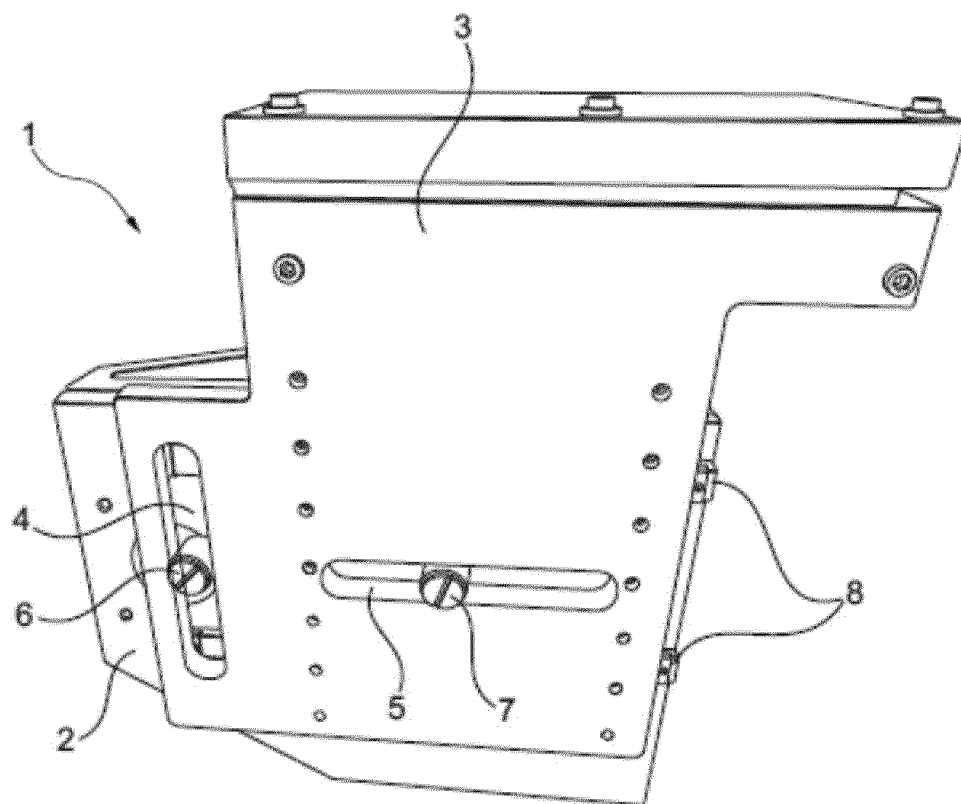


Figure 1

2/5

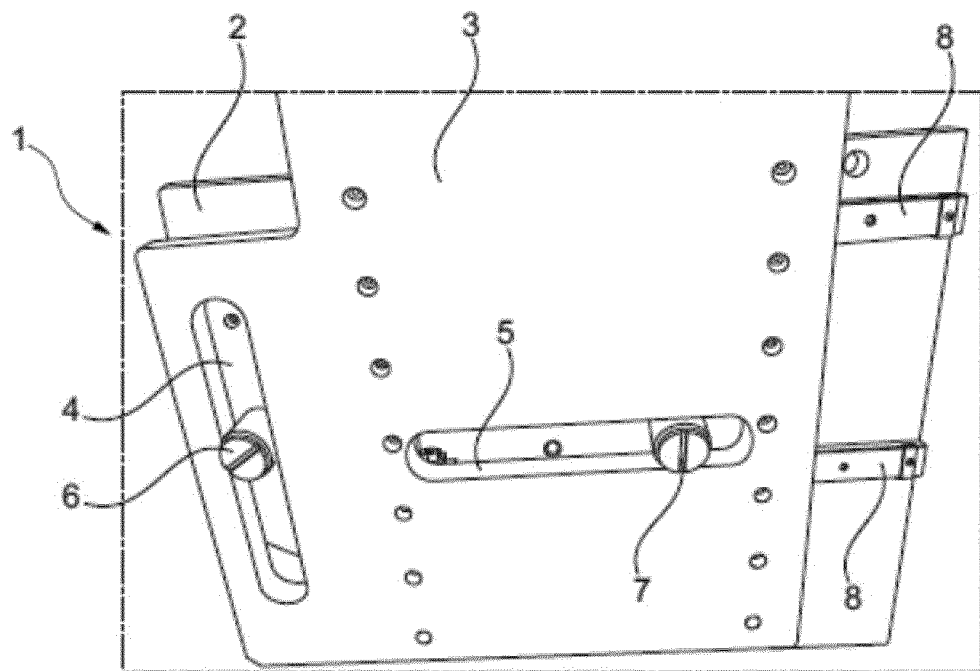


Figure 2

3/5

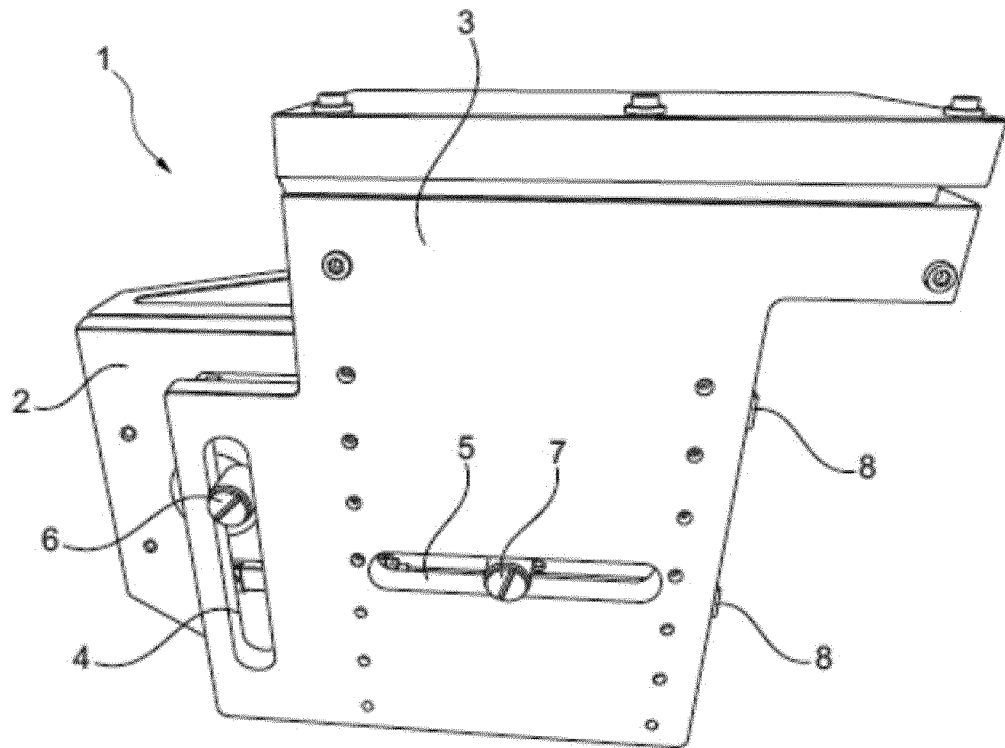


Figure 3

4/5

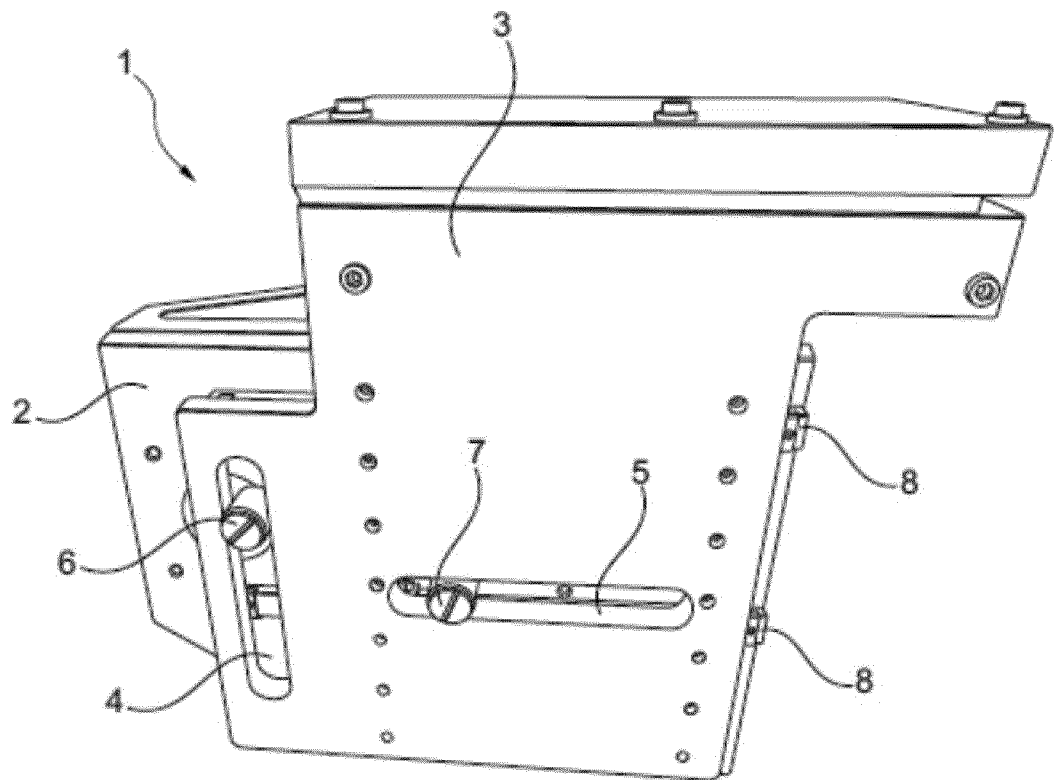


Figure 4

5/5

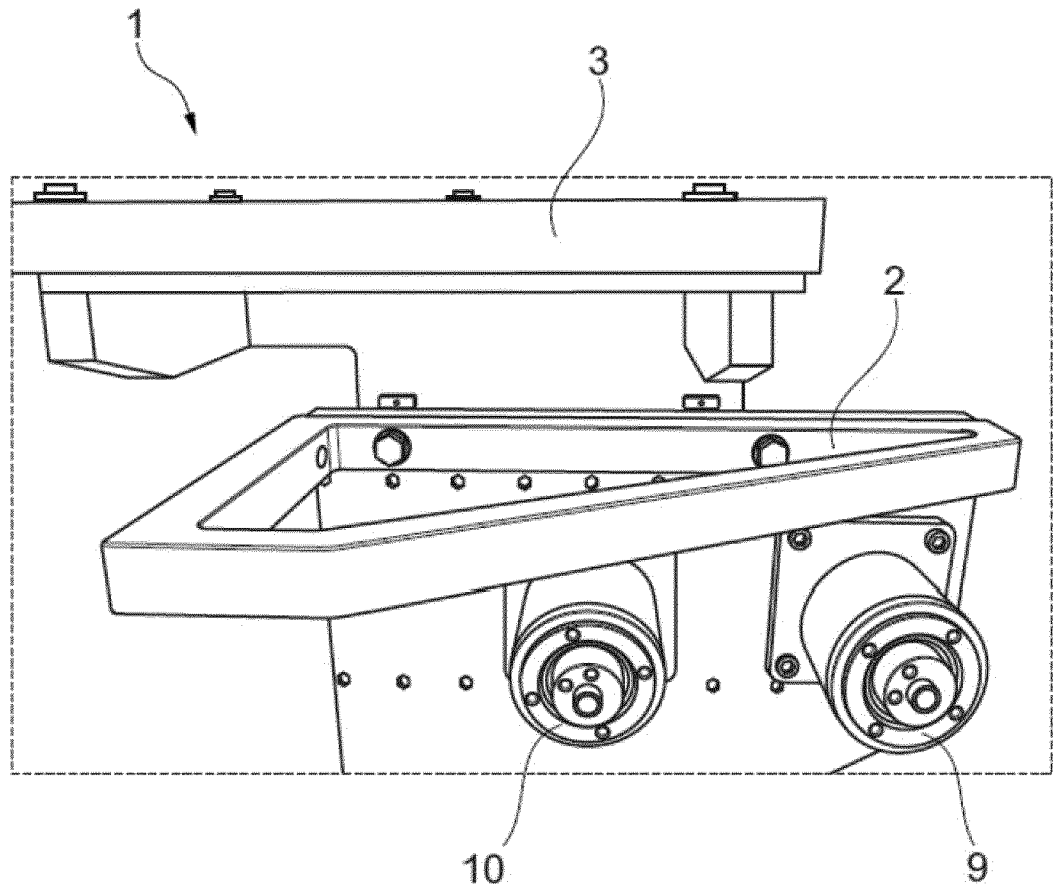


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/062031

A. CLASSIFICATION OF SUBJECT MATTER

INV. C25D5/04 C25D17/06 C25D21/10
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)
C25D

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 practicable, 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	DE 42 12 045 C1 (SCHERING AG [DE]) 2 December 1993 (1993-12-02) column 1, lines 3-8 column 3, lines 24-48 column 4, line 47 - column 5, line 32 column 6, line 27 - column 7, line 46; figures 1-3	1,2,4-13
X	DE 10 2005 024771 A1 (HANS GROHE AG [DE]) 23 November 2006 (2006-11-23) paragraphs [0001], [0002], [0518] - [0026]; figures 1-3	1,3,7-13
X	US 2002/071917 A1 (HEPTING EMIL [DE]) 13 June 2002 (2002-06-13) paragraphs [0020] - [0035]; figures 1-5	1,2,7-13
	-/--	



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 application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of 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

30 June 2014

Date of mailing of the international search report

07/07/2014

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

Authorized officer

Suárez Ramón, C

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/062031

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/037682 A1 (YOSHIOKA JUNICHIRO [JP] ET AL) 26 February 2004 (2004-02-26) paragraphs [0039] - [0074]; figures 2,3-5,9,10 -----	1-3,7,8, 10,12
X	GB 2 247 027 A (HENIG HANS HENIG HANS [DE]) 19 February 1992 (1992-02-19) page 9, line 5 - page 26, line 18; figures 1-8 -----	1,7-9, 11-13
X	EP 1 441 048 A2 (DAINIPPON SCREEN MFG [JP]) 28 July 2004 (2004-07-28) paragraphs [0198] - [0213]; figure 5 -----	1,3,7-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/062031

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4212045	C1	02-12-1993	NONE
DE 102005024771	A1	23-11-2006	NONE
US 2002071917	A1	13-06-2002	DE 10061226 A1 20-06-2002 EP 1213373 A2 12-06-2002 US 2002071917 A1 13-06-2002
US 2004037682	A1	26-02-2004	JP 3827627 B2 27-09-2006 JP 2004076072 A 11-03-2004 US 2004037682 A1 26-02-2004 US 2005092600 A1 05-05-2005 US 2010320090 A1 23-12-2010
GB 2247027	A	19-02-1992	CH 683007 A5 31-12-1993 FR 2665842 A1 21-02-1992 GB 2247027 A 19-02-1992 JP H04107297 A 08-04-1992 US 5167779 A 01-12-1992
EP 1441048	A2	28-07-2004	CN 1517453 A 04-08-2004 CN 101016645 A 15-08-2007 EP 1441048 A2 28-07-2004 JP 4303484 B2 29-07-2009 JP 2004225089 A 12-08-2004 KR 20040069174 A 04-08-2004 TW I237317 B 01-08-2005 US 2004140199 A1 22-07-2004 US 2007023277 A1 01-02-2007 US 2007080057 A1 12-04-2007