

PLATING RACK

5 This application claims the benefit of Taiwan Patent Application
Serial No. 103116854, filed May 13, 2014, the subject matter of which is
incorporated herein by reference.

BACKGROUND OF INVENTION

1. FIELD OF THE INVENTION

10 [0001] The invention relates to a plating rack, and more
particularly to the plating rack that is applied to a plating process of a
substrate for the printed circuit board (PCB).

2. DESCRIPTION OF THE PRIOR ART

15 [0002] The PCB is a circuit product that is manufactured by
printing. To meet the trend of minimizing the line width of the PCB,
the conventional printing process for forming the circuit lines is no more
satisfied. Alternatively, a new dry-film exposure and development
manufacturing process is the mainstream for manufacturing the PCBs.
20 According to the flexibility, there are a group of rigid PCBs and a group
of flexible PCBs. Following is a typical process for manufacturing a
multi-layer rigid PCB.

[0003] A. Prepare a substrate and form an internal layout;

[0004] B. Form necessary circuits by performing pasting the photo
resist, exposing, developing, etching and then removing the photo resist;

25 [0005] C. Make coarse the copper surface so as to enhance the
adherence with the insulating resin, laminate a prepreg, and form the
vias by machine or laser drilling;

[0006] D. Form the conductive layout on the substrate by plating

so as to generate the final circuit layer of the PCB; and

5 [0007] E. Perform the soldermask coating and the anti-oxidation treatment so as to avoid possible short circuiting from overflowing of the solder for mounting the electronic elements and also thereby to isolate the substrate from the moisture and the oxygen in the atmosphere, in which the surface anti-oxidation treatment is carried out for enhancing the surface anti-oxidation ability per customer's demand after the coating of the soldermask over the PCB.

10 [0008] Referring now to FIG.1A and FIG.1B, a schematic front view and a corresponding side view of a conventional plating rack 1 for a PCB substrate plating process are shown, respectively. The plating rack 1 includes a substrate loading area 2 for resting at least one PCB substrate, a linking-up frame 10 and support frames 15, in which the linking-up frame 10 and support frames 15 are both coupled to an external driving device (not shown in the figures). The linking-up frame 10 and the support frames 15 are located to opposing sides of the plating rack 1, and both of which are extended along a first axial direction of the PCB substrate. One end of the linking-up frame 10 is coupled to a first hanging frame 110 of the plating rack 1, while one end of each the support frame 15 is coupled to a second hanging frame 111 opposing and parallel substantially to the first hanging frame 110.

25 [0009] As shown, the first hanging frame 110 and the second hanging frame 111 extending along a second axial direction of the PCB substrate but parallel to each other are solidly spaced at both ends by two parallel extendable frames 12. Specifically, the first hanging frame 110, the second hanging frame 111, and the two parallel extendable frames 12 are connected to form a rectangular structure having the substrate loading area as its central area.

30 [0010] The length of the extendable frame 12 can be adjusted according the PCB substrate to be loaded. A plurality of first clamp members 13 are constructed to both the first hanging frame 110 and the second hanging frame 111 in a discrete but orderly manner along the second axial direction. Each of the first clamp members 13 has two

holder ends P for holding or clamping the PCB substrate across its thickness (i.e., along the third axial direction in FIG.1B).

5 [0011] Nevertheless, due to the area around each contact point of the holder end P and the PCB substrate shall be dipped in the plating solvent during the whole plating process, an uneven metal layer would be coated to this particular area. Typically, the metal layer in the area around the contact point would be thicker and contain copper slag, which will lead to the manufacturing difficulty, yield drop and cost hike in the following processes.

10 SUMMARY OF THE INVENTION

[0012] Accordingly, it is the primary object of the present invention to provide a plating rack having a linking-up frame, a support frame, a pair of parallel extendable frames and a plurality of first clamp members.

[0013] The linking-up frame coupled to an external driving device has one end thereof to couple a first hanging frame.

20 [0014] The support frame located oppositely to the linking-up frame with respect to a first axial direction has one end thereof to couple a second hanging frame.

[0015] The extendable frame extending along the first axial direction has two opposing ends to couple the first hanging frame and the second hanging frame, respectively.

25 [0016] A plurality of the first clamp members is constructed to both the first hanging frame and the second hanging frame in a discrete but orderly manner in a second axial direction. Along a third axial direction, each of the first clamp members provides a pair of lever arms to clamp fixedly a substrate. Each of the lever arm has a first liquid stopper to encircle the holder in an annular-setting manner, such that an enclosed region can be formed between the holder and the first liquid stopper.

30 In the present invention, the holder and the first liquid stopper

are to completely contact at the substrate to be held, and the first liquid stopper is a soft seal ring made of a material selected from the group of an NBR synthetic rubber, an EPDM synthetic rubber, a VITON rubber, a silicon, a Teflon, an IIR rubber, and a CR rubber.

5 [0017] By providing the liquid stopper to the plating rack of the present invention so as to utilize the soft compressible and seal ring to prevent the solvent from entering the neighboring areas of the clamping points, additional metal layers won't be formed to these specific areas adjacent to the sides of the substrate. Upon such an arrangement, the
10 metal layer in these specific areas around the clamping points wouldn't be thicker or contain metal slag so that no further machining thereupon should be required, and thus the yield of plating can be increased without a sacrifice of cost hike.

15 [0018] All these objects are achieved by the plating rack described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The present invention will now be specified with reference to its preferred embodiment illustrated in the drawings, in which:

20 [0020] FIG.1A is a schematic front view of a conventional plating rack;

[0021] FIG.1B is a schematic side view of FIG.1A;

[0022] FIG.2A is a schematic front view of an embodiment of the plating rack in accordance with the present invention;

25 [0023] FIG.2B is a schematic enlarged view of a first clamp member of FIG.2A;

[0024] FIG.2C is a schematic side view of FIG.2B;

[0025] FIG.3A is a schematic front view of another embodiment of the plating rack in accordance with the present invention;

[0026] FIG.3B is a schematic enlarged view of a second holding device of FIG.2A;

[0027] FIG.3C is a schematic side view of FIG.3B;

5 [0028] FIG.4A is a schematic front view of a further embodiment of the plating rack in accordance with the present invention;

[0029] FIG.4B is a schematic enlarged view of a third holding device of FIG.4A; and

[0030] FIG.4C is a schematic side view of FIG.4B.

10 **DESCRIPTION OF THE PREFERRED EMBODIMENT**

[0031] The invention disclosed herein is directed to a plating rack. In the following description, numerous details are set forth in order to provide a thorough understanding of the present invention. It will be appreciated by one skilled in the art that variations of these specific details are possible while still achieving the results of the present invention. In other instance, well-known components are not described in detail in order not to unnecessarily obscure the present invention.

20 [0032] Referring now to FIG.2A, the plating rack 3 of the present invention includes a linking-up frame 30 coupled with an external driving device (not shown in the figure) and a support frame 35, in which the linking-up frame 30 and the support frame 35 are located in an opposing way with respect to a first axial direction of a substrate loading area 2. One end (the lower end shown in FIG.2A) of the linking-up frame 30 is engaged with a first hanging frame 310, and one end (the upper end shown in FIG.2A) of each the support frame 35 is engaged with a second hanging frame 311. As shown, the first hanging frame 310 and the second hanging frame 311 are parallel and extended along the second axial direction, while ends of two parallel extendable frames 32 extending along the first axial direction are introduced to engage
30 respective ends of the first hanging frame 310 and the second hanging frame 311, such that first hanging frame 310, the second hanging frame

311 and the pair of the parallel extendable frames 32 are formed as a rectangular frame structure having the substrate loading area 2 encircled thereinside. In particular, each of the extendable frames 32 can be extended or shortened along the first axial direction. A plurality of first clamp members 33 are discretely and evenly located at the first hanging frame 310 and the second hanging frame 311, i.e. along the second axial direction. Each of the first clamp members 33 is formed as a clamp structure to hold the substrate loading area 2 in a cross-thickness direction, i.e. the third axial direction. Further, at each clamp end of the first clamp member 33, at least one holder P is included to contact fixedly the substrate in the substrate loading area 2. Preferably, the holders P of different first clamp members 33 are aligned linearly, and the required number of the holders P for each first clamp member 33 is per the practical needs.

[0033] Referring also to FIG.2B and FIG.2C, the plating rack 3 of the present invention is characterized on that each of the first clamp members 33 has a pair of lever arms 330 to form a clamp mechanism for holding the substrate in between and the clamp end of each lever arms 330 is further constructed to include a liquid stopper 34 for surrounding the corresponding holders P thereof in an annular-setting manner. Further, the two first liquid stoppers 34 located inside to the pair of the lever arms 330 are aligned along a third axial direction, i.e. the direction penetrating the thickness of the substrate to be held.

[0034] Specifically, to ensure in application that the substrate in the substrate loading area 2 can be properly held by the first clamp members 33 for a plating purpose, the involved liquid stoppers 34 shall be located completely and firmly on the substrate so that the plating solvent can be prohibited from the enclosed area A within each the liquid stopper 34. With the help of the extendable frames 32, such a purpose can prevail also to different specs of substrates, while it is understood that, under a situation of plating a small-size substrate, only the middle first clamp members 33 as well as the corresponding liquid stoppers 34 are involved in clamping the substrate.

[0035] Namely, in the case that a substrate with a predetermined size is loaded in the substrate loading area 2 of the plating rack 3, the pair of the extendable frames 32 are adjusted to have at least a portion (usually the middle portion) of the first clamp members 33 to clamp at the respective sides of the substrate, and more specifically each of the liquid stoppers 34 of said portion of the first clamp members 33 contacts completely on the substrate, such that the respective enclosed area A can be a sealed space from the solvent on the substrate. On the other hand, to those first clamp members 33 that are not adopted to hold the substrate, the respective liquid stoppers 34 as well as the corresponding holders P are totally free from the substrate.

[0036] Referring now to FIG.3A, another embodiment of the plating rack 4 in accordance with the present invention is shown in a schematic front view. In the following description upon this embodiment, only the difference thereof to the aforesaid embodiment of FIG.2A is described.

[0037] As shown, the plating rack 4 includes the linking-up frame 30, the support frame 35, the first hanging frame 310 and the second hanging frame 311. However, the plating rack 4 does not include the extendable frames 32 and the first clamp members 34, and one of the first hanging frame 310 and the second hanging frame 311 is restructured to be an adjustable hanging frame that can displace freely along the first axial direction.

[0038] Referring also to FIG.3B and FIG.3C, the plating rack 4 of the present invention is characterized to have a plurality of second clamp members 43 and a plurality of corresponding second liquid stoppers 44 (two shown in the figure).

[0039] The second clamp members 43 are individually extended along the first axial direction, and distributed in a discrete but orderly manner to couple either the first hanging frame 310 or the second hanging frame 311. Namely, a plurality of the second clamp members 43 are distributed to two groups, one upper group close to the first hanging frame 310 and another lower group close to the second hanging

frame 311. Each of the second clamp members 43 includes a pair of first lever arms 430 extended inward (with respect to the substrate to be held) along the first axial direction. In the present invention, spacing between pairs of the first lever arms may be fixed or various. Inward ends (with respect to the substrate to be held) of the first lever arms 430 of the upper group are connected with a same first clamp head 431, while inward ends (with respect to the substrate to be held) of the first lever arms 430 of the lower group are connected with another same first clamp head 431. As shown, at least one first holder P1 for contacting the substrate to be held is located at each cross section of the first clamp head 431 and the first lever arm 430. The first holders P1 belong to the same group of the second clamp members 43 are aligned along the same line, preferably parallel to the second direction. Further, the first lever arm 430 can be perpendicular or oblique to the first clamp head 431, per practical requirements.

[0040] The second liquid stopper 44 is mounted to the first clamp head 431 at the side facing the substrate to be held and extended along the second axial direction to both remote sides of the first clamp head 431. The second liquid stopper 44 is to encircle all the first holders P1 belong to the same group in an annular-setting manner, such that a connected first enclosed region A1 is formed between the first holders P1 of the same group and the second liquid stopper 44.

[0041] In this embodiment, to ensure in application that the substrate in the substrate loading area 2 can be properly held by the second clamp members 43 for a plating purpose, each of the two parallel second liquid stoppers 44 shall be located completely and firmly on the substrate so that the plating solvent can be prohibited from the first enclosed area A1 within each the second liquid stopper 44.

[0042] Referring now to FIG.4A, a further embodiment of the plating rack 5 in accordance with the present invention is shown in a schematic front view. In the following description upon this embodiment, only the difference thereof to the aforesaid two embodiments of FIG.2A and FIG.3A is described.

5 [0043] As shown, the plating rack 5 includes the linking-up frame 30, the support frame 35, the first hanging frame 310, the second hanging frame 311, the second clamp members 43, the first holders P1 and the second liquid stoppers 44. The plating rack 5 of the present invention is characterized on that the two lateral sides of the plating rack 5, in the second axial direction, further includes a first hanging frame 510 and a second hanging frame 511, respectively, both of which are extended along the first axial direction. Opposing ends, upper and lower, of either the first hanging frame 510 or the second hanging frame 10 511 are connected to the first hanging frame 310 and the second hanging frame 311, respectively. Each of the first hanging frame 510 and the second hanging frame 511 provides a plurality of third clamp members 53 extending toward the substrate loading area 2 for clamping a substrate to be held.

15 [0044] Referring also to FIG.4B and FIG.4C, a plurality of the third clamp members 53 having individual pairs of second lever arms 530 are extended along the second axial direction and arranged in a discrete order with or without identical spacing.

20 [0045] The third clamp members 53 are individually extended along the second axial direction, and distributed in a discrete but orderly manner to couple either the first hanging frame 510 or the second hanging frame 511. Namely, a plurality of the third clamp members 53 are distributed to two groups, one left-hand-side group close to the first hanging frame 510 and another right-hand-side group close to the 25 second hanging frame 511. Each of the third clamp members 53 includes a pair of second lever arms 530 extended inward (with respect to the substrate to be held) along the second axial direction. In the present invention, spacing between pairs of the second lever arms 530 may be fixed or various. Inward ends (with respect to the substrate to be held) of the second lever arms 530 of the left-hand-side group are connected with a same second clamp head 531, while inward ends (with respect to the substrate to be held) of the second lever arms 530 of the 30 right-hand-side group are connected with another same second clamp head 531. As shown, at least one second holder P2 for contacting the

substrate to be held is located at each cross section of the second clamp head 531 and the second lever arm 530. The second holders P2 belong to the same group of the third clamp members 53 are aligned along the same line, preferably parallel to the first direction. Further, the second lever arm 530 can be perpendicular or oblique to the second clamp head 531, per practical requirements.

[0046] The third liquid stopper 54 is mounted to the second clamp head 531 at the side facing the substrate to be held and extended along the first axial direction to both remote sides of the second clamp head 531. The second liquid stopper 54 is to encircle all the second holders P2 belong to the same group in an annular-setting manner, such that a connected second enclosed region A2 is formed between the second holders P2 of the same group and the third liquid stopper 54.

[0047] In this embodiment, to ensure in application that the substrate in the substrate loading area 2 can be properly held by the third clamp members 53 for a plating purpose, each of the two parallel third liquid stoppers 54 shall be located completely and firmly on the substrate so that the plating solvent can be prohibited from the second enclosed area A2 within each the third liquid stopper 44.

[0048] In all the aforesaid three embodiments, each of the first liquid stopper 34, the second liquid stopper 44 and the third liquid stopper 54 can be a soft seal ring made of a material selected from the group of an NBR synthetic rubber, an EPDM synthetic rubber, a VITON rubber, a silicon, a Teflon, an IIR rubber, and a CR rubber.

[0049] By providing the liquid stopper (34/44/54) to the plating rack of the present invention so as to utilize the soft compressible and seal ring to prevent the solvent from entering the neighboring areas of the clamping points, additional metal layers won't be formed to these specific areas adjacent to the sides of the substrate. Upon such an arrangement, the metal layer in these specific areas around the clamping points wouldn't be thicker or contain metal slag so that no further machining thereupon should be required, and thus the yield of plating can be increased without a sacrifice of cost hike.

[0050] While the present invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be without departing from the spirit and scope of the present invention.

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What is claimed is:

1. A plating rack, comprising:

a linking-up frame, coupled with an external driving device, having one end thereof to couple a first hanging frame;

5 a support frame, located oppositely to the linking-up frame with respect to a first axial direction, having one end thereof to couple a second hanging frame; the second hanging frame located oppositely to the first hanging frame with respect to the first axial direction;

10 a parallel extendable frames, extending along the first axial direction so as to bridge ends of the first hanging frame and the second hanging frame; and

15 a plurality of first clamp members is constructed to both the first hanging frame and the second hanging frame in a discrete but orderly manner along a second axial direction, at least one holder for contacting the substrate to be held, disposed at both ends of the first clamp members corresponding to a third axial direction, the third axial direction is perpendicular to the surface defined by the first axial direction and the second axial direction, and

20 a substrate loading area, enclosed by the first hanging frame, the second hanging frame and the pairs of the parallel extendable frames are formed as an area for the first clamp members to contact or support the substrate;

25 wherein a first liquid stopper is constructed at the lever arm to encircle the at least one holder in an annular-setting manner, such that an enclosed region is formed between the at least one holder and the first liquid stopper.

30 **2. The plating rack of claim 1, wherein the first liquid stopper is a soft seal ring made of a material selected from the group of an NBR synthetic rubber, an EPDM synthetic rubber, a VITON (trademark) rubber, a silicon, a Teflon (trademark) .**

3. The plating rack of claim 1, wherein the holder is to completely contact at the substrate to be held.

4. The plating rack of claim 1, wherein the holders are arranged linearly.

5 5. The plating rack of claim 1, wherein the extendable frame is extended or shortened along the first axial direction.

6. A plating rack, comprising:

a linking-up frame, having one end thereof coupled with an external driving device;

10 a support frame, located oppositely to the linking-up frame with respect to a first axial direction, having one end thereof to couple a second hanging frame, the second hanging frame located oppositely to the first hanging frame with respect to the first axial direction;

15 a first hanging frame, having one lateral side coupled with the linking-up frame;

a second hanging frame, having one end thereof to couple the support frame;

20 a plurality of second clamp members, extended individually along the first axial direction, couple the first hanging frame and the second hanging frame, the second clamp members including a pair of first lever arms extended inward along the first axial direction with respect to a substrate to be held, each of the first lever arms being connected with a first clamp head having at least one first holder for contacting the substrate to be held;

25 a substrate loading area, can be properly held by the second clamp members for plating purpose; and

30 a second liquid stopper, mounted to the first clamp head at a side facing the substrate to be held and extended along the second axial direction to both remote sides of the first clamp head, the second liquid stopper circling the corresponding first holders in an annular-setting

manner, such that a connected first enclosed region is formed between the encircled first holders and the second liquid stopper.

5 7. The plating rack of claim 6, wherein the second liquid stopper is a soft seal ring made of a material selected from the group of an NBR synthetic rubber, an EPDM synthetic rubber, a VITON (trademark) rubber, a silicon, a Teflon (trademark) .

8. The plating rack of claim 6, wherein the first holders and the second liquid stoppers are to completely contact at the substrate to be held.

10 9. The plating rack of claim 6, wherein the first holders are arranged linearly.

15 10. The plating rack of claim 6, wherein one of the first hanging frame and the second hanging frame is structured to be an adjustable hanging frame that is able to displace freely along the first axial direction.

11. The plating rack of claim 6, further including:

another first hanging frame, having opposite ends thereof to connect one-side ends of the first hanging frame and the second hanging frame; and

20 another second hanging frame, located opposing to the another first hanging frame with respect to the second axial direction, having opposite ends thereof to connect another-side ends of the first hanging frame and the second hanging frame, each of the another first hanging frame and the another second hanging frame providing a plurality of
25 third clamp members for clamping the substrate to be held;

wherein each of the third clamp members has a pair of lever arms , each of the lever arms connects a second clamp head having at least one second holder.

30 12. The plating rack of claim 11, wherein the second holder for contacting the substrate to be held, and a third liquid stopper is mounted

to the second clamp head at a side facing the substrate to be held and extended along the first axial direction to both remote sides of the second clamp head, the third liquid stopper encircles the corresponding second holders in an annular-setting manner, such that a connected
5 second enclosed region is formed between the encircled second holders and the third liquid stopper.

13. The plating rack of claim 12, wherein the third liquid stopper is a soft seal ring made of a material selected from the group of an NBR synthetic rubber, an EPDM synthetic rubber, a VITON (trademark)
10 rubber, a silicon, a Teflon (trademark) .

14. The plating rack of claim 12, wherein the second holders are arranged linearly, and the third liquid stoppers are to completely contact at the substrate to be held.