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BASKET FOR POLISHED WAFERS

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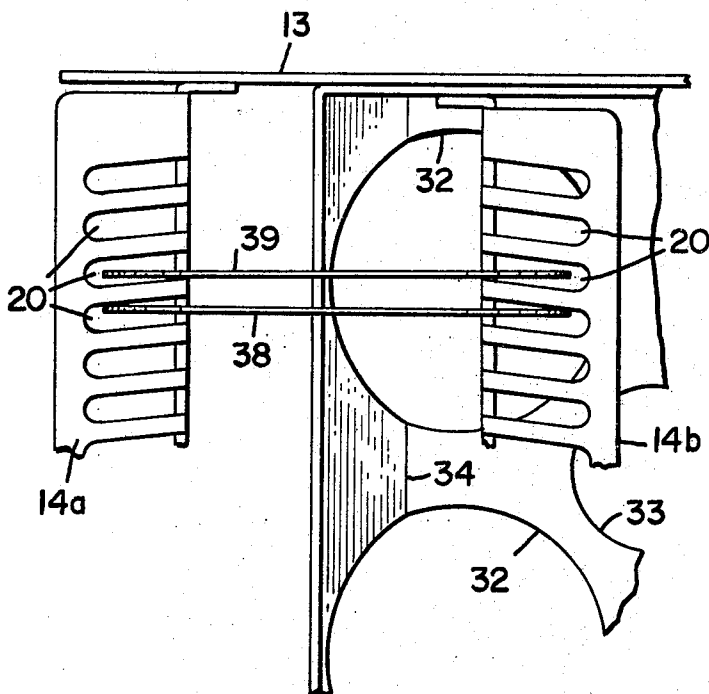
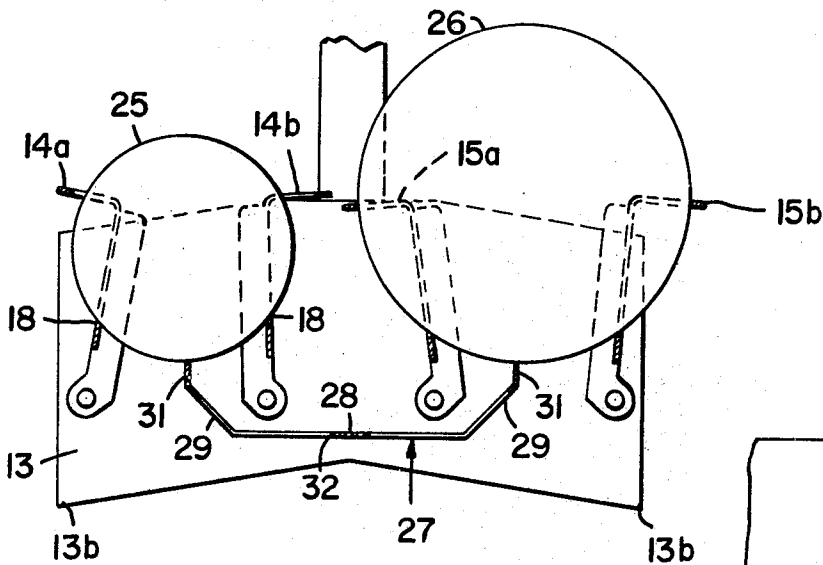
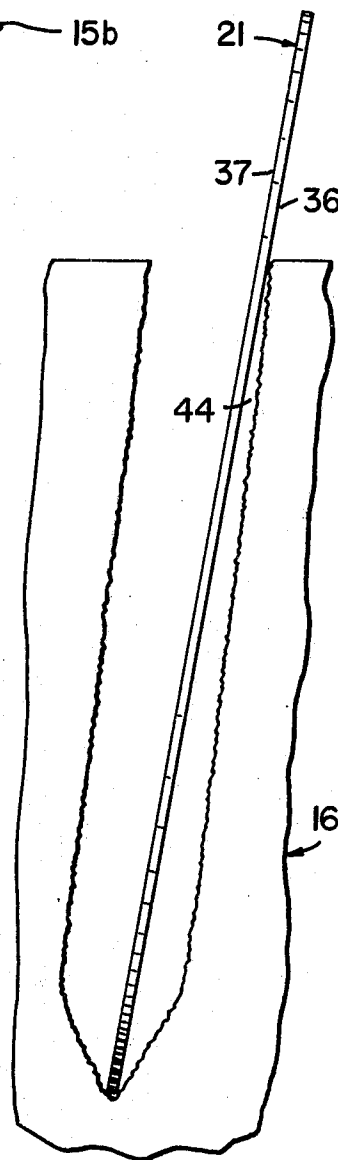


FIG. 5



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BASKET FOR POLISHED WAFERS

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16 Claims

ABSTRACT OF THE DISCLOSURE

A stainless steel basket holds several semiconductive wafers for immersing them in a cleaning liquid. Slanted parallel support fingers or slots cause the unpolished side of the wafers to recline against the support fingers. Folded top portions of the fingers are canted so that when a wafer is removed, only the edge and not the polished surface will contact the next adjacent finger pair. The wafers are also supported at substantially their bottom-most portions by a longitudinal support member. All surfaces, including the fingers and support member, are roughened by sandblasting or acid etching to promote the runoff of liquid.

Background of the invention

This invention is directed generally to a device for holding a plurality of articles to facilitate cleaning or processing in solutions and more specifically to a basket which may be immersed in a liquid and when removed therefrom, the liquid will easily run off from the basket and the articles therein.

In the washing, cleaning or other treatment of articles as part of the process of manufacture, it is customary to arrange them in trays, baskets, or other devices in a manner such that they receive maximum exposure to the liquid in which they are immersed. Furthermore, since these type of process operations are usually assisted by auxiliary means, such as mechanical agitation or ultrasonic vibration, it is desired that the device holding the articles not interfere with these auxiliary means.

One of the disadvantages of present devices for holding articles is that the material of which the device or basket is constructed is generally a plastic or molded resin. Such baskets, while resistant to the chemical agents used in the cleaning solution, absorb such things as the ultrasonic vibrations, reducing the efficiency of the process. Also, the combination of the shape of the holding device and the material used, which is necessary in construction, serves as a partial screen of the articles from the sources; for example, ultrasonic vibrations, further reducing the effectiveness of the process.

Another serious disadvantage of present devices is that with the present material and shapes utilized, liquid is retained in the holding device after its removal from the liquid bath either as a result of entrapment, adhering droplets, or as a film. This results in excessive carry over into the next cleaning solution of the process and causes early contamination and a resultant need for renewal of the solution or bath. The above problems are especially critical in the cleaning of semiconductor wafers where contamination and staining of the wafers must be clearly avoided. Moreover, since semiconductor wafers are highly polished on at least one surface their wettability is reduced, thus encouraging the undesirable formation of liquid droplets.

Thus far, present baskets for semiconductive wafers have tended to contaminate subsequent cleaning solutions and have not prevented stains on the surfaces of the semiconductive metal wafers.

Summary of the invention and objects

It is, therefore, a general object of the invention to provide an improved device for holding several articles in a manner which facilitates cleaning, washing, or other treatments, particularly where several successive cleaning solutions are involved.

It is another object of the invention to provide a device as above which promotes efficient drainage of the liquid from the holding device in order to reduce contamination of succeeding solutions in the process.

It is a further object of the invention to provide an improved holding device which prevents stains or the accumulation of residues on the article being cleaned.

It is another object of the invention to provide a device, as above, which holds articles therein in a manner to reduce the possibility of mechanical damage to finished surfaces.

It is another object of the invention to provide a device, as above, which holds articles therein in a manner which provides maximum exposure to the treatment bath and to auxiliary forces, such as ultrasonic vibrations.

It is another object of the invention to provide a holding device which facilitates the insertion and withdrawal of articles therein to minimize the danger of damage to treated surfaces.

It is another object of the invention to provide a holding device which provides maximum resistance to chemicals employed in the cleaning process while at the same time not interfering with the action of auxiliary forces, such as ultrasonic vibrations in the cleaning process.

It is another object of the invention to provide a holding device for articles as above which has adequate mechanical strength, structural strength, and at the same time provides for minimum interference or baffling action to cleaning forces.

Another object of the invention is to provide an improved holding device of the above character which prevents staining of semiconductor wafers or other parts being cleaned.

In accordance with the above objects, there is provided a device for holding a plurality of articles for immersing such articles in a liquid. The device includes means for supporting the articles in spaced relationship with surfaces of the device being roughened to provide for maximum runoff of the liquid after withdrawal of the device from the liquid.

Brief description of the drawing

FIGURE 1 is a perspective view of a device embodying the present invention;

FIGURE 2 is an enlarged side view of a portion of the device showing comb-like slots or fingers used to support the articles being processed;

FIGURE 3 is a cross-sectional view taken along the line 3—3 of FIGURE 1 which shows the device as it would appear if adjusted to accommodate different sized articles or semiconductive wafers;

FIGURE 4 is an enlarged partial top view of the device showing a semiconductive wafer both at rest and in the insertion and removal position; and

FIGURE 5 is a greatly enlarged view of a single slotted support element showing the preferred angle of the slot in relation to a wafer at rest.

Description of the preferred embodiment

Referring now to FIGURE 1, the holding device or basket of the present invention includes a handle 10 with a slightly curved carrying portion 11 attached to side supports or end plates 12 and 13. Each plate has two bottom support points, 12a, 12b, and 13a, 13b, respectively, which are rounded at the tips for better liquid

runoff. The points can also be characterized as drip points since the liquid tends to collect at these points and drip back into the cleaning solution after removal of the basket from the solution.

Rigidly fastened between end plates 12 and 13 is a box-like bottom structure 27 (FIGURE 3) including a bite portion 28 and leg portions including sloping segment 29 and vertical segments 21. The bottom structure 27 may also be rectangular in cross section as well as the configuration shown in FIGURE 3.

The function of bottom structure 27 is to provide a rigid support member for the entire system and by means of the thin knife longitudinal edge at the ends of vertical support segment 31, to provide a bottom support for the semiconductor wafers 25 and 26 contained in the holding device. Such support, which is substantially at the bottommost edge of the semiconductor wafers, provides an efficient drainage path for liquid draining off the article being processed. The provision of a knife edge support causes any liquid which has been accumulated by gravity or capillary action at this point to be drawn on to the vertical segments 31 of the support structure 27.

Bottom structure 27 also contains cutout areas or drain openings 32 and 33 in the bite portion 28. As best shown in FIGURE 4, the drain opening 32 also extends into sloping segments 29 to provide a minimum amount of intermediate or "ligament" material between the holes, as indicated at 34. This further promotes the drainage of fluids. Moreover, the proportion of cutout areas to overall areas is maximized to promote drainage of fluids while maintaining a reasonable mechanical strength.

Pivotaly attached between end plates 12 and 13 are comb-like supports or finger pairs 14a, 14b, and 15a, 15b (FIGURE 1). These fingers support wafers or other articles being processed. The fingers include individual elements 16 (FIGURE 2) arranged in a row. A pair of opposed elements provide support for a semiconductor wafer or article. Each of the elements 16 include a slanted lower portion 17 (FIGURE 2) terminating in an apex 18 with a next adjacent element and an upper portion 19 folded at right angles to lower portion 17. Portions 19 are canted in opposed senses in each of the finger pairs. In other words, portions 17 are slanted with reference to a vertical plane and portions 19 are canted in opposed senses to the same plane. A typical wafer 21 (FIGURE 1) is shown as supported between the comb-like finger pairs.

Due to the shape of the comb-like support fingers with the folded upper portion 19, a predetermined longitudinal stiffness is provided. Moreover, because of the pivotal mounting of the support fingers, they can be adjusted to accommodate different diameter articles as shown in FIGURE 3.

Longitudinal rigidity may also be obtained by bending the bottom portion of the support fingers.

In the preferred embodiment illustrated, the support fingers 14a, 14b, and 15a, 15b are formed from flat, stainless steel plates and the slots are punched out and the fingers bent as shown. The bottom of the fingers are formed in a V as shown at 22 and terminate at drip points 23 (FIGURE 2) and 24 (FIGURE 1) to promote the run-off of liquid.

The present invention is not specifically limited to the design of the support fingers as shown since other materials which are also resistant to chemical action may be utilized and other configurations which provide sufficient structural rigidity.

The multiple slots and fingers of support fingers 14 and 15 are slanted at an angle to the vertical as best illustrated in FIGURE 5. The wafers preferentially lie at the angle shown resulting in no contact with the highly polished finished surface 37 of wafer 21. Furthermore, only the unpolished backsides 36 of the wafer makes point contact with support element 16. Moreover, as best shown in FIGURE 4, any force such as a flowing current of

fluid or mechanical tilting while removing the basket from the fluid only results in contact with the edge or periphery of the wafer without contacting or damaging its finished surface. This is achieved as best shown in FIGURE 4 by the particular canting of the top folded portion 20 of the support fingers in opposed senses so that while being removed or inserted the front polished surface 37 of the wafer only contacts the edge of the wafer as best shown at 38. Wafer 39 is shown in its normal reclining position against its unpolished backside.

All of the surfaces of the basket or holding device of the present invention are processed by either sandblasting, acid etching, or other treatment methods to produce a surface which promotes the runoff of the liquid. From one aspect it is believed that the roughening, for example by sandblasting, forms a network of capillary channels whereby any liquid remaining after withdrawal of the basket is formed into a relatively thin film and conducted by capillary action to the bottom edge of the finger pairs. Then, by gravity, the droplets run to the several drip points on both the end plates and structural number 27. In addition, as shown in FIGURE 5, the roughness of the support fingers causes them to act like a blotter to cause any of the water droplets to be drawn off of the wafer.

As shown in FIGURE 5, another critical point where liquid may tend to collect is the wedge-shaped portion 44 between the finger element 16 and the wafer itself. Here again, the roughness of the surface serves as a blotter to drain water from this area. Finally, as shown in FIGURE 3, the box-like or U-shaped support section 27 having vertical segment 31 located at substantially the bottommost portion of the wafer is similarly roughened to drain off droplets which have collected at this bottommost portion of the wafer. As mentioned above, the knife edge vertical support element 31 promotes this drainage.

Untreated metallic surfaces of the tray, basket or other holding device, as previously described, tend to retain droplets both on the surfaces and in corners or at points of contact between parts. Also, a substantial film of the cleaning fluid remains on both the holding device and the article being cleaned. By treatment and roughening of the surface by acid etching or sandblasting this holding tendency to retain droplets on surfaces, crevices and at points of contact between parts of the device is greatly reduced. Not only does the surface treatment reduce the retention of droplets but it also assists in the rapid drainage of the surface film itself. The treated surfaces appear to act like a blotter sucking all retained film off the surfaces of the articles being cleaned and facilitating the flow of fluid to the various drip points divided in the holding device. This phenomenon is particularly noticed at points where the article being cleaned contacts the framework of the device itself.

The beneficial surface treatment or roughening consists of developing a minute granular surface on the parts of the device which it is believed creates a capillary force or action which simulates the action of a blotter. This type of surface can be developed mechanically by sandblasting or chemically as by etching. A typical successful sandblasting method which has produced good results in commercial application is the use of 100 mesh Monterey-type sharp sand using a one-half inch nozzle with air at a pressure of 100 pounds per square inch, applied for 30 seconds. Alternatively, acid etching may be used with a mixture of nitric and fluoric acid. However, depending on the specific material utilized, other materials might require a slightly different chemical treatment with the objective of producing a surface having the desired capillary action.

It also should be emphasized that the present holding device or basket provides a continuous path of fluid drainage from the articles being processed to predetermined drip points. This is accomplished both by gravity

and capillary drainage. More specifically, capillary action or blotting action occurs at the knife edge support points provided by both the bottom support structures 31, V-shaped points or apexes 18 of the support fingers, and the point contact support at the wafer backside 36 as shown in FIGURE 5. Liquid thus is drained from the individual articles and proceeds by gravity and by capillary action over the surfaces and edges of the basket support structure itself to the several drip points. In addition, liquid on the surface of the basket proceeds by capillary action to edges and thus by gravity to the drip points. Therefore, continuous paths are provided for drainage.

Thus, the present invention as disclosed, provides a simple and inexpensive holding device or basket for cleaning articles such as semiconductive wafers, and other articles of this type which have low surface wettability. In addition, contamination of subsequent cleaning solution is avoided by the proper drainage of the liquid from the holding device itself.

I claim:

1. A device for holding a plurality of articles for immersing such articles in a liquid comprising means for supporting said articles in spaced relationship, said means having roughened surfaces, at least a portion of the remainder of said device also having roughened surfaces, said surfaces providing for maximum runoff of said liquid after withdrawal of said device from said liquid said surfaces being substantially non-absorbent to said liquid.

2. A device as in claim 1 where said roughened surfaces form a random network of capillary channels whereby any of said liquid remaining in contact with said device surfaces after withdrawal of said device from said liquid is in the form of a thin film which flows to the bottommost portion of the device under the influence of gravity.

3. A device as in claim 1 where said roughened surfaces are sandblasted surfaces.

4. A device as in claim 1 where said roughened surfaces are acid-etched surfaces having exposed grain boundaries whereby drainage of said liquid from said surfaces is promoted.

5. A device as in claim 1 where said device has spaced finger means for supporting said articles in parallel spaced relationship.

6. A device as in claim 5 where said finger means are adjustable to accommodate articles of different sizes.

7. A device as in claim 5 where said finger means are arranged in pairs for holding a single article, the lower portions of a finger pair being slanted in a common direction with reference to a vertical plane and having folded top portions which are canted in opposed senses with reference to said vertical plane.

8. A device as in claim 7 in which said articles are wafers and where said finger pairs are arranged in a row and a wafer normally reclines against and is sup-

ported on one side by a first finger pair, the next adjacent finger pair in proximity to the other side of said wafer being spaced from said first finger pair and having top portions canted at such an angle for allowing only the edge of said wafer to contact said second finger pair during removal of said wafer from said basket.

9. A device as in claim 1 including roughened means for contacting each of said articles at substantially their bottommost portion.

10. A device as in claim 9 in which said roughened means is a knife edge at the contact point with said bottommost portion of said article.

11. A device as in claim 9 where said support means is a U-shaped elongated structural member of said basket having a plurality of drain openings in the bite portion of the member and where the legs of the U-shaped member support said articles.

12. A device as in claim 11 where the bite of said U-shaped member is normally horizontally oriented and each of said legs has a sloping segment terminating in vertical segments, at least a portion of said drain openings extending from said bite portion into said sloping segments.

13. A device as in claim 1 together with bottom drainage edges which are sloped to provide drip points to dispose of accumulated liquid.

14. A device as in claim 1 in which said holding device provides for continuous paths of fluid drainage from the articles held therein to predetermined drip points.

15. A device as in claim 14 where said continuous paths include roughened surfaces which provide capillary drainage and sloping edges and surfaces which provide drainage by gravity.

16. A device as in claim 1 together with means providing for maximum exposure to cleaning solutions and to the action of ultrasonic vibration said means including a structural support member having apertures therein to provide minimum interference with cleaning.

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