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R. SCHULTEN ET AL

3,679,517

APPARATUS FOR ETCHING SEMICONDUCTOR BODIES

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FIG. 1

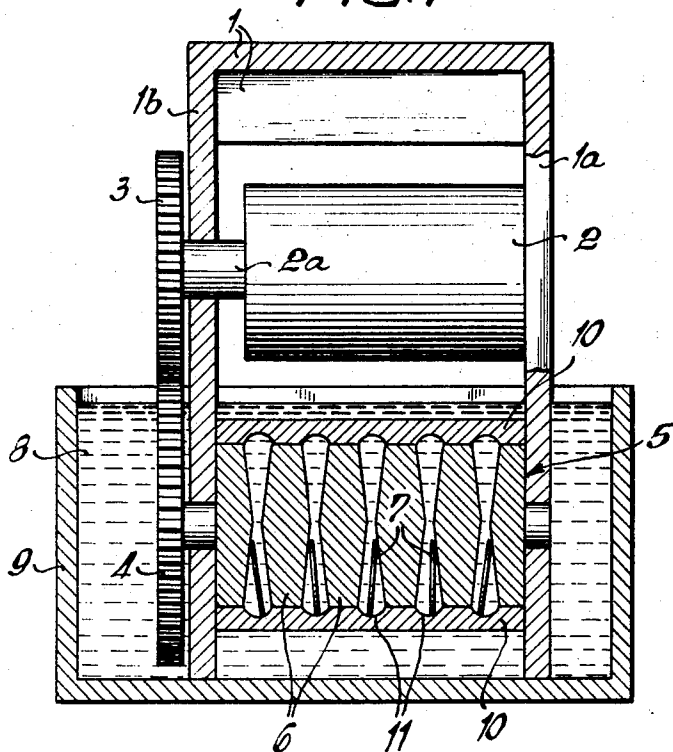


FIG. 2

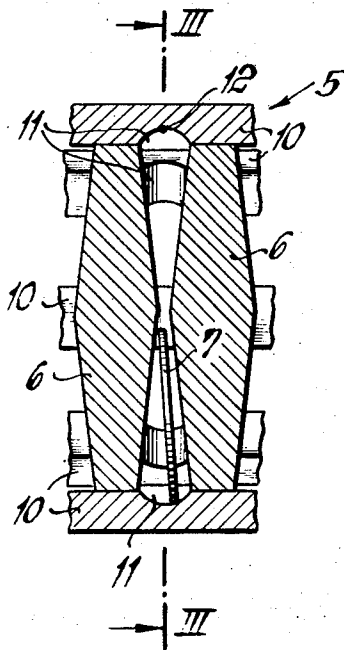


FIG. 3

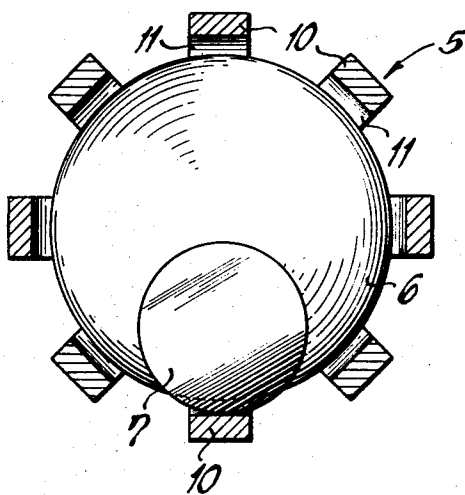
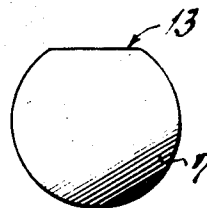


FIG. 4



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1

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APPARATUS FOR ETCHING SEMICONDUCTOR BODIES

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11 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for etching semiconductor bodies comprises a receptacle which accommodates a bath of etching fluid. A drum is mounted for rotation in the etching fluid about an at least substantially horizontal axis and is driven by drive means. Partitions separate the interior of the drum into a plurality of axially arrayed cells each of which extends transversely of the axis and has a cross-sectional area divergent from the region of the axis in radially outward direction, defining with the inner periphery of the drum a concavely curved guide path which annularly surrounds the axis and along which the semiconductor bodies to be etched travel in an orbit about the axis.

BACKGROUND OF THE INVENTION

The present invention relates generally to the production of semiconductor bodies, and more particularly to an apparatus for the etching of semiconductor bodies.

It is known to etch semiconductor bodies, particularly of disk-shaped configuration, by providing a so-called etching basket whose interior is separated into individual cells by planar plates of synthetic plastic material which are formed with apertures. The outer circumferential wall of the etching basket is defined by a hollow cylindrical wall means which also consists of synthetic plastic material and is provided with apertures. The apertures, of course, are to permit ingress and egress of etching fluid. With this known construction it has been found that during etching, accomplished by rotating the etching basket about a horizontal axis so that semiconductor bodies accommodated in the respective cells will perform an orbital movement about the axes of rotation, the semiconductor bodies do not achieve the desired degree of plano-parallelism. This is particularly noticeable when the thickness of layers to be removed exceeds a certain value, for instance if the material to be removed has a thickness which is greater than 20μ per side of the semiconductor body.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to overcome the aforementioned difficulties.

More particularly it is an object of the invention to provide an improved apparatus for etching semiconductor bodies which is not possessed of these drawbacks.

It is a further object of the invention to provide such an apparatus wherein it is possible to obtain very good plano-parallelism of semiconductor disks even if material to be removed from the various sides of the disk has a thickness on the order of between substantially 75 and 100μ per side.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides in an apparatus for etching semiconductor bodies which, briefly stated, comprises a receptacle accommodating a bath of etching fluid. A drum is mounted

2

for rotation in the etching fluid about an at least substantially horizontal axis. Drive means is provided for rotating the drum about the axis and partition means partitions the interior of the drum into a plurality of axially arrayed cells each extending transversely of the axis, with the partition means defining with the inner periphery of the drum within each of the cells a concavely curved guide path which annularly surrounds the axis of rotation.

This guide path serves for guidance of the semiconductor bodies in an orbital path about the axis in response to rotation of the drum, and the disk-shaped semiconductor bodies are so guided during such orbital movement that contact of the disk-shaped semiconductor bodies with one of their planar major surfaces to one of the two partitions respectively bounding each cell is prevented during the etching process.

It is advantageous, in accordance with a further feature of the invention, that the cross-sectional configuration of each cell converges in direction towards the axis, being so selected that the inner edge of the respective semiconductor bodies—that is the edge closest to the axis of rotation—has only small freedom of play between the opposite partitions bounding the respective cell so that during rotation of the drum and consequent orbital movement of the respective disk-shaped semiconductor bodies about the axis of rotation, the bodies will perform a wobbling movement during which the edge of each body which is closest to the axis of rotation will alternately move into contact with the opposite partitions bounding the respective cell. This causes a further improvement in the plano-parallelism attainable for such bodies.

It is possible, although not necessary, that the periphery of the drum is constituted by a plurality of circumferentially spaced parallel bars or rods which extend in parallelism with the axis of rotation of the drums. In that case, the inwardly directed surfaces of these bars will be formed with transverse grooves, and in each cell one groove of each bar will be circumferentially aligned with one groove in every other bar, so that they together constitute a guide track for a semiconductor body. This construction provides for particularly good liquid-exchange conditions. It is also advantageous for the distance between circumferentially successive bars to correspond to between 25 and 50% of the diameter of the usually disk-shaped semiconductor bodies.

Furthermore, to avoid etching of the semiconductor bodies in such manner that they are out-of-round, the spacing between successive bars is so selected that during each rotation of the semiconductor body different peripheral portions thereof will contact the bars. It is advisable to so construct the drum that the distance between its axis of rotation and that point of the respective grooves which is farthest spaced therefrom is equal to five quarters the diameter of the disk-shaped semiconductor bodies. The latter are especially advantageously provided with an orientation edge, for reasons which will be discussed subsequently.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic view, partially in axial section, illustrating an apparatus according to the present invention;

FIG. 2 is an enlarged fragmentary view illustrating a single cell of the embodiment shown in FIG. 1, in form of a sectional view taken on the axis of rotation of the drum of FIG. 1;

FIG. 3 is a section taken on the line III—III of FIG. 2; and

FIG. 4 is a plan view of a semiconductor body which in accordance with the present invention is provided with an orientation edge.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now firstly to FIG. 1, it will be seen that reference numeral 1 identifies a support which is substantially in form of an inverted U whose arms 1a and 1b are directed downwardly. Mounted on the right-hand arm 1a is a drive motor 2 whose horizontally oriented output shaft 2a passes through a suitable aperture in the arm 1b and carries exteriorly of the latter a gear 3 which is rigid with the output shaft 2a. The gear 3 meshes with a further gear 4 which is turnably mounted below the gear 3 and rotatable about an axis which is also horizontally oriented.

An etching drum or etching basket 5 is mounted for rotation coaxially with the axis of rotation of the gear 4, being located between the arms 1a and being of substantially rotation-symmetrical configuration with reference to its cross-section. The basket or drum 5 can thus be turned by the motor 2 via the meshing gears 3 and 4.

As FIGS. 1 and 2 clearly show, the interior of drum 5 is separated by axially arrayed partition walls 6 which are solid into individual discrete cells each of which accommodates a semiconductor disk 7. A receptacle 9 accommodates in its interior a bath 8 of etching fluid whose particular composition is of no importance for purposes of the present invention, and the drum 5 is immersed in the etching fluid 8.

As evident from FIG. 1 and particularly clearly from FIG. 2, the cross-sectional configuration of the partition wall 6 is such that the cross section of the respective cells diverges in direction radially outwardly from the axis of rotation of the basket 5. The periphery of the basket 5 is constituted by a plurality—in the illustrated embodiment 8—of bars or rods 10 which extend lengthwise of the drum 5 and are arranged in parallelism with the axis of rotation thereof. This is also evident from FIG. 3 and it is pointed out that the cross-section of the bars 10 is so selected that the spacing between circumferentially adjacent ones of the bars 10 corresponds to approximately 40% of the diameter of the semiconductor disks 7.

Furthermore, this spacing is so selected that during each rotation of the respective semiconductor body 7 different portions of the circumference of the semiconductor body come in contact with the bars 10. The inner surfaces or sides of the bars 10 which face the interior of the cells are provided with concavely curved—in cross-sectional view—grooves 11 extending transversely and defining, in conjunction with the inner sides of the partition walls 6 bounding the respective cells, guide paths for guidance of the semiconductor bodies 7 as the same orbit about the axis of rotation of the drum 5. It will be appreciated that one groove 11 on each of the bars 10 is circumferentially aligned in a common plane transversely to the axis of rotation, with one groove of each of the other bars 10, so that the thus-aligned grooves together constitute one of the guide paths. The distance between the axis of rotation and the point 12 of the respective guide grooves 11 which is farthest spaced from the axis of rotation, corresponds to four-fifths of the diameter of the semiconductor disks 7, that is it exceeds the diameter by one quarter of the dimension thereof.

It will be appreciated that when the drum 5 is rotated by the motor 2, the semiconductor disks 7 orbit about the axis of rotation by rolling from one to the other of the grooves 11 within the confines of their respective cell. Particularly if the rotational speed of the drum 5 is so

selected that the peripheral speed of the semiconductor bodies 7 is in the area of approximately 3 cm./sec., the resulting finished etched semiconductor disks are in plano-parallelism to $\pm 2\mu$ with the exception of a margin of 1.5 mm. which in any case is not usable in plano-parallelism constructions, and that they have a mirror-like surface if a suitable etching fluid is used. By increasing the circumferential speed it is possible to achieve that the margin after etching will increase with respect to the middle by between 10 and 20 μ over a width of approximately 3 mm., whereby the susceptibility of the finished semiconductor disks to breakage is substantially reduced. Under these latter circumstances a particularly blunt edge of the disks is obtained.

FIG. 4 shows that it is advantageous to provide the semiconductor disks 7 with an orientation edge 13 as illustrated, whereby the effectiveness of the present apparatus in obtaining excellent plano-parallelism of their major surfaces is further enhanced.

It will be appreciated, of course, that the apparatus can also be used not only for etching alone, but also for etching-polishing by utilizing suitable materials in conjunction with the bath 8.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus for etching semiconductor bodies, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. An apparatus for etching semiconductor bodies comprising a receptacle accommodating a bath of etching fluid; a drum mounted for rotation in said etching fluid about an at least substantially horizontal axis and having an inner periphery provided with a plurality of concave circumferential grooves, drive means for rotating said drum about said axis; and partition means partitioning the interior of said drum into a plurality of axially arrayed cells each extending transversely of said axis, said partition means defining with the inner periphery of said drum within each cell a concavely curved guide path annularly surrounding said axis.

2. An apparatus as defined in claim 1, wherein said semiconductor bodies are disk-shaped blanks which roll in said guide path.

3. An apparatus as defined in claim 2, said drum comprising an outer peripheral wall composed of a plurality of axially extending circumferentially spaced bars each having a side facing inwardly and provided with a plurality of axially spaced transverse grooves each of which constitutes a portion of the guide path of a respective cell.

4. An apparatus as defined in claim 2, said cross-sectional area being in the region in which the periphery of the respective disk-shaped blank is closest to said axis, of such value as to prevent in such region only limited axial play of the blank in the respective cell.

5. An apparatus as defined in claim 2, said drum comprising an outer peripheral wall composed of a plurality of circumferentially spaced bars extending in parallelism with said axis of said drum.

5

6. An apparatus as defined in claim 5, said disk-shaped blanks having a predetermined diameter, and said bars being spaced from one another circumferentially of said drum by a distance corresponding to between substantially 25% and 50% of said predetermined diameter.

7. An apparatus as defined in claim 5, said disk-shaped blanks rolling in said path and at the same time performing an axial tumbling movement in the respective cell; and wherein the circumferential distance between adjacent ones of said bars is so selected that in response to each revolution of a blank in the respective path different sections of the blank circumference contact the respective bars.

8. An apparatus as defined in claim 2, said semiconductor bodies being disk-shaped blanks having a predetermined diameter; and wherein the maximum distance between said axis and a region of the respective path which is farthest from said axis corresponds to four-fifths of said predetermined diameter.

9. An apparatus as defined in claim 8, said partition means comprising a plurality of solid partition walls.

6

10. An apparatus as defined in claim 2, said semiconductor bodies being disk-shaped blanks having an orientation edge at their respective periphery for effecting predetermined orientation of said blanks during rotation of said drum.

11. An apparatus as defined in claim 1, said apparatus also being adapted for accommodating polishing material so as to effect polish-etching of said semiconductor bodies in response to rotation of said drum.

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15 JACOB H. STEINBERG, Primary Examiner

U.S. Cl. X.R.

51—7, 164; 134—159