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[54]. TOOL ALIGNMENT APPARATUS AND METHOD
15 Claims, 7 Drawing Figs.

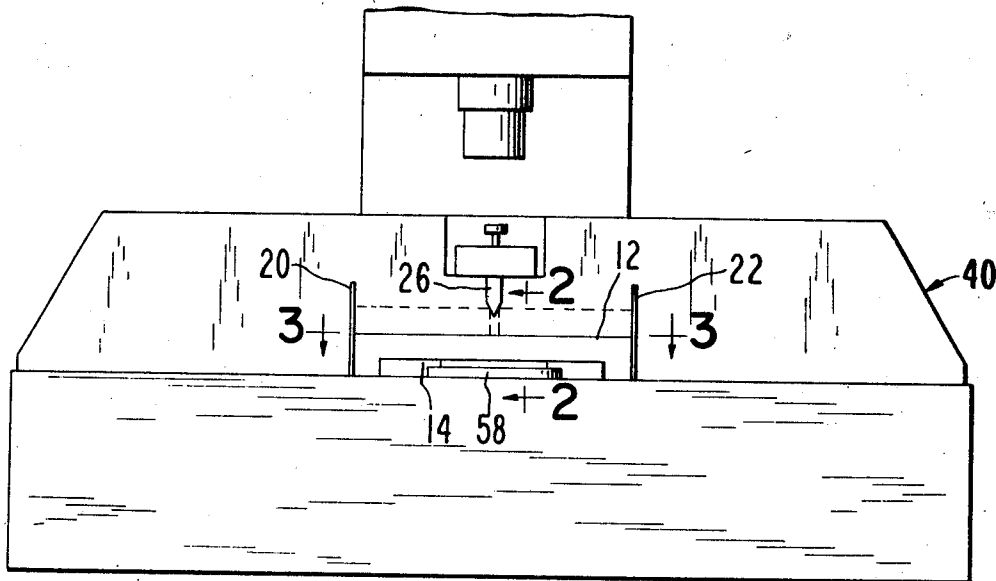
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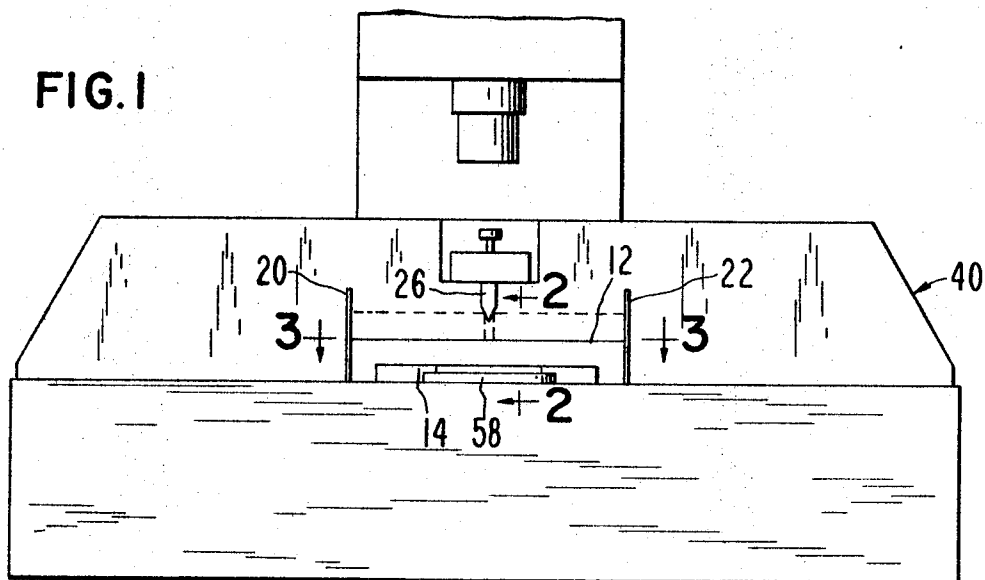
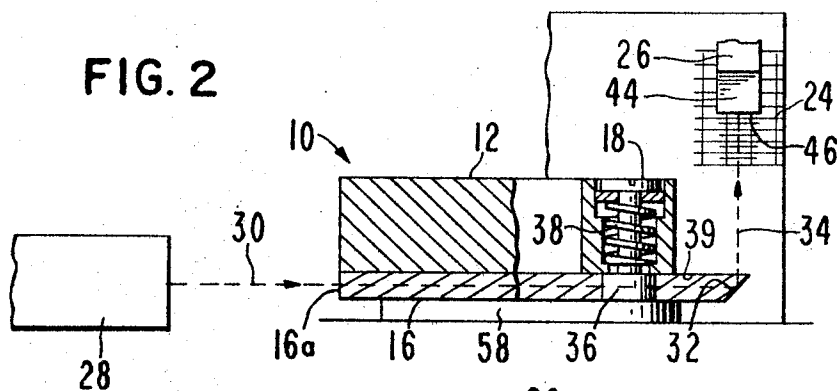
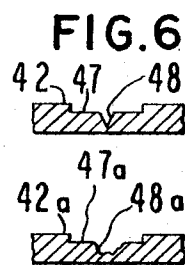
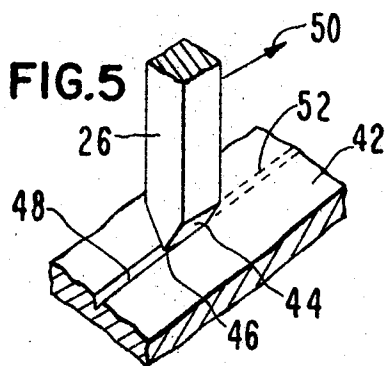
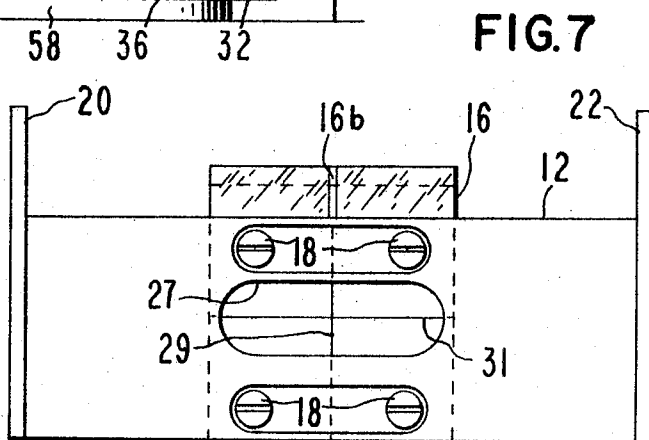
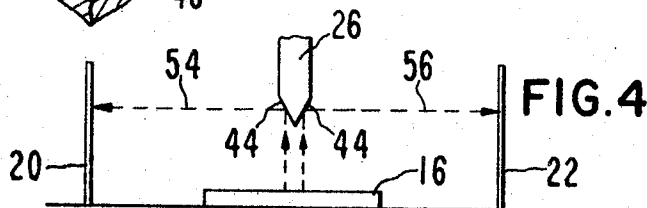
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153, 154, 172, 164; 73/104; 33/18 A

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ABSTRACT:- Apparatus and a method for use in aligning a cutting edge of a cutting tool wherein the tool is of the type having a pair of opposed, relatively convergent faces defining the cutting edge. The tool is aligned by directing a beam of radiation toward and against the tool faces for reflection therefrom onto respective surfaces intersecting the path of the reflected radiation. The locations of the reflected radiation on these surfaces provide an indication of the orientation of the cutting edge of the tool with respect to a predetermined reference, such as the direction of movement of the tool relative to a support.





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TOOL ALIGNMENT APPARATUS AND METHOD

This invention relates to improvements in the alignment of tools for automatic machine operations and, more particularly, to apparatus and a method for aligning a cutting edge of a cutting tool.

In the production of semiconductor dice of the type forming diodes, transistors, integrated circuits and the like, the dice are made in an integral fashion in large numbers and collectively form a wafer of frangible material. The wafer is generally in the form of a disc whose diameter is about 2 inches. The dice are usually square, rectangular or triangular in shape and have dimensions on the side ranging from 0.010 to 0.400 inches. The dice are separated from each other by scribe paths that are about 0.002 inches wide and the scribe paths form a grid on the surface of the wafer.

The material of the wafer is monocrystalline and, as such, it is usually scribed and broken along certain crystal planes. Channels are etched between the rows and columns of dice to form the scribe paths.

To separate the dice from each other, it is first necessary to scribe the wafer along these scribe paths with a scribing tool. The purpose of this is to weaken the wafer material sufficiently to permit the wafer to be later fractured when additional stresses are exerted on the lines scribed by the tool. The scribing operation, therefore, causes a high-stress concentration to be applied in the scribe paths; thus, after the wafer has been scribed, it is broken into the pieces, i.e., the dice are separated from each other by using any one of a number of known techniques, such as by laying the wafer on a resilient surface with the scribed side down and moving a cylindrical roller across the back of the wafer. The contact line of the roller will be held parallel to the scribed lines so as to apply maximum stress thereto as the roller passes over the same.

To scribe a wafer along the scribe path thereof, a wafer scribing machine is employed, the machine utilizing a scribing tool of the type having a cutting edge defined by a pair of opposed, convergent faces which terminate at the cutting edge itself. To scribe a wafer, the tool moves along one surface of the wafer in a slightly tilted condition so that one end portion of the cutting edge will perform the scribing action, i.e., will create the very high concentrated stress condition in the wafer as described above to form a scribe line in a scribe path thereof as the tool moves relative to the wafer. After being separated from each other, the dice are then handled individually and placed on suitable mounts so that electrical connections can be made to the dice to place them in condition for use as electronic circuit components.

Scribing a semiconductor wafer requires a machine capable of precisely orienting the wafer and moving a scribe tool over the scribe path of the wafer. Since the scribe paths are usually only 0.002 inches wide and the width of the scribe line formed by a scribing tool is approximately 0.0005 inches wide, it is extremely important to maintain the scribe tool within the width limits of a scribe path from one extremity of the wafer to the opposite extremity thereof to prevent damaging the dice adjacent to the channel. It is also extremely important to maintain parallelism between the tool-cutting edge and its direction of travel relative to the wafer. Failure to do this will cause the scribe tool to apply damaging lateral stresses to the wafer so that, when the latter is broken to separate the dice thereof, breaks will occur in the direction of these lateral stresses and not be confined to the scribe lines only. This will cause some of the dice to fracture and chip and thereby be unusable. Thus, the yield of dice from a particular wafer will be relatively low when damaging stresses are set in the wafer by the scribing tool.

To avoid the wafer alignment problem the machine must be capable of orienting the scribe paths of the wafer and the tool travel perfectly parallel so that the angle between them is zero. The angular accuracy of the orientation must be precise enough to allow the scribe tool to travel the maximum transverse dimension of the wafer, without drifting out of a scribe path. A mathematical expression of the angle of drift of the tool which can be tolerated is as follows:

$$\text{arc tan } \Delta\phi = \frac{W_p - W_t}{L}$$

where

W_p = width of scribe path $\approx .002"$

W_t = width of scribe line $\approx .0005"$

L = length of scribe path $\approx 2.000"$

Using the parameters mentioned above, the angle is approximately plus or minus 2.5 minutes of arc. This mathematical expression does not account for lateral misalignment of the scribe line but assumes that all error of alignment is the result of angular misalignment.

The machine generally will have means for aligning the wafer scribe paths relative to the direction of travel of the tool. In this connection, the machine can have an alignment microscope with an eyepiece provided with a reticle line which will previously have been oriented parallel to the path of tool travel and, with the use of this reticle line, the wafer scribe paths will be oriented parallel to the tool travel itself.

Other wafer alignment systems are sometimes employed which utilize variations of the methods described above. Some examples are: (1) The scribe channel is observed in two separate places simultaneously by two microscope objectives. The images from the microscope objectives are combined to present a split image to an eyepiece, one-half of the image from one objective and the other half of the image from the other objective. The alignment procedure is the same as above but accuracy of angular alignment is greater. (2) The microscope or the wafer is moved to allow scanning of the channel by the microscope.

A scribing tool is usually formed from diamond and is provided with at least one pair of convergent faces which terminate at the cutting edge of the tool. To avoid the damaging lateral stresses which can be caused by the scribe tool, the tool is placed in the scribing machine so that the cutting edge is as closely as possible parallel to the direction of tool travel. Unless the edge is perfectly parallel to such direction, the tool will create a "tiller effect" which will cause the tool to want to deviate from the direction of tool travel. However, the scribing machine will force the scribe tool to follow the direction of travel. When this occurs, the cutting edge "plows" into the wafer material instead of scribing the same. The tiller effect, therefore, creates the damaging stresses in the wafer so as to limit its yield when the wafer is broken up into the dice.

The angular alignment accuracy of the scribe tool cutting edge relative to direction of the tool travel should be equal to that of the accuracy of the scribe tool drift relative to the scribe paths of the wafer. As shown above mathematically, this accuracy is plus or minus 2.5 minutes of arc. Most scribing machine alignment systems approach this accuracy in locating the scribing tool but none provide for orientation of the cutting edge of the tool to this accuracy. Moreover, since the scribing tool is relatively small in physical size, mechanical orientation of the tool with any accuracy is substantially precluded.

The present invention provides apparatus and a method for avoiding the problem of tool alignment in its mounting in the scribing machine by providing a system of alignment which utilizes the converging faces of the tool which form its cutting edge to orient the cutting edge with respect to the direction of travel of the tool itself. These tool faces are generally ground and polished to provide good light reflection therefrom. Thus, if a beam of coherent or collimated light or other radiation is directed head-on at the cutting edge, the beam will be split into two beams with each split beam being reflected from a corresponding face of the tool. By using the original beam as reference, the cutting edge can be oriented to the beam by observing the location of the split beams reflected from the tool faces. The tool can then be manually manipulated in its mount until the intersections of the reflected split beams on surfaces on opposite sides of the tool are correspondingly the same.

The actual procedure for aligning a scribing tool includes a number of steps. These steps are the alignment of the system for directing the beam toward the tool, the alignment of the

beam with respect to the beam direction system, and the alignment of the tool with respect to the beam. The beam direction system includes a reticle defining means adapted to be positioned on the wafer support of a scribing machine. The reticle means has a reticle line which is oriented with the direction of travel of the cutting tool in the same manner as the scribe paths of a wafer when the latter is on the wafer support. Means is provided on the wafer support for fixedly holding wafer thereon and such means can be utilized to maintain the reticle means in a fixed position.

After the reticle means has been oriented parallel to the direction of tool travel, a beam of coherent or collimated light or other radiation can be directed along a predetermined path relative to the reticle of the reticle means so that the beam will move perpendicular to the direction of tool travel and toward and impinge on the cutting edge and the faces of the tool. Thus, the radiation will be reflected from the tool faces onto the radiation intercepting surfaces spaced at equal distances on opposite sides of the tool.

After the beam has been precisely aligned with the direction of tool travel, the alignment of the tool-cutting edge can be accomplished. This can be done by observing the locations of the light on the light-intercepting surfaces and, if the locations are not in correspondence with each other, the tool is then manually manipulated until the locations do correspond. When correspondence is achieved, the cutting edge will then be oriented precisely parallel with the direction of tool movement, whereupon the beam alignment system can be removed from the machine and a wafer placed on the wafer support, following which a scribing operation can commence. The tool will then perfectly scribe a wafer in a manner such that the angular deviation of the tool over the maximum length of travel of the wafer will be equal to or less than 3 minutes of arc. Thus, the cutting edge of the tool will remain in the scribe path of the wafer as it moves from one extremity of the wafer to the opposite extremity thereof. In this way, there will be no damaging stresses created in the wafer and the latter will be properly broken into the dice following the scribing operation so as to provide a maximum yield of dice from the wafer.

The primary object of this invention is, therefore, to provide apparatus and a method for aligning an adjustable tool of the type having a pair of opposed, generally convergent faces wherein a beam of radiation is directed toward the faces and allowed to be reflected therefrom onto light-intercepting means so that the positions of the radiation on the intercepting means will provide information about the orientation of the tool relative to a predetermined reference to thereby indicate whether or not the tool position needs to be adjusted to permit it to perform a specific function.

Another object of this invention is to provide a method and apparatus of the type described which can be used to monitor or check the alignment of the cutting edge of a wafer-scribing tool with reference to the path of movement of the tool relative to a wafer during a wafer-scribing operation, so that, if misalignment is indicated, the tool can be adjustably positioned until the alignment is correct before the wafer-scribing operation commences to thereby assure the scribing tool will move relative to the wafer within the scribe paths formed in the wafer during its manufacture without "plowing" or causing damaging lateral stresses.

Still another object of this invention is to provide a method and apparatus of the type described wherein a beam of coherent or collimated light is utilized for impingement onto a pair of opposed, relatively convergent faces of the wafer-scribing tool which define the cutting edge thereof whereby the tool faces will reflect the light beam onto light-intercepting surfaces which can be visually observed to determine the need for adjustment of the tool to bring its cutting edge into parallelism with the direction of movement of the tool.

Other objects of this invention will become apparent as the following specification progresses, reference being had to the accompanying drawing for an illustration of an embodiment of the apparatus.

In the drawings:

FIG. 1 is a front elevational view of a wafer-scribing machine showing the tool alignment apparatus of this invention mounted thereon;

FIG. 2 is an enlarged, side elevational view, partly in section, of the apparatus adjacent to the scribing tool of the scribing machine;

FIG. 3 is a top plan view of the reticle plate of the apparatus for directing a light beam from a light source to the tool and the light-intercepted surfaces for intercepting light reflected from the tool;

FIG. 4 is a schematic view of the apparatus and the tool showing the paths of the light beam before and after it is reflected from opposed faces of the tool;

FIG. 5 is an enlarged, fragmentary perspective view of the tool as it scribes a wafer;

FIG. 6 is a fragmentary cross-sectional view of the wafer showing a desired configuration of a scribe line therein; and,

FIG. 7 is a view similar to FIG. 6 but showing a scribe line which can result when the tool is improperly aligned.

The apparatus of this invention will be described with respect to aligning a scribing tool of a wafer-scribing machine. The invention is broadly denoted by the numeral 10 and includes an assembly comprised of a baseplate 12 having a recess 14 in the bottom thereof for receiving a reticle-prism plate 16, plate 16 being secured to baseplate 12 by a number of fasteners 18. A pair of sideplates 20 and 22 are secured in any suitable manner to opposed sides of baseplate 12 (FIG. 1) in alignment with each other. For purposes of illustration only, each sideplate has a scale 24 thereon which provides a radiation-intercepting surface to intercept light reflected from one of a pair of faces of a wafer-scribing tool 26 in a manner to be described. Tool 26 can be movable relative to a wafer mounted on a fixed support or, in the alternative, the tool can be fixed and the wafer mounted on a support movable relative to the tool. For purposes of illustration only, the tool will hereinafter be described as being movable relative to a wafer and its support.

Baseplate 12 has an opening 27 therethrough by means of which the user of apparatus 10 can view a pair of mutually perpendicular reticle lines 29 and 31 on the upper surface of plate 16. At least one of these reticle lines is used to align plate 16 in parallelism with the direction of movement of tool 26 as described hereinafter.

Included in apparatus 10 is a radiation source 28 for directing a beam 30 of radiation through prism plate 16, the latter having an end face 16a for receiving beam 30 and an internal reflecting surface 32 for directing the beam along a path 34 substantially perpendicular to the upper surface of plate 16 and extending toward tool 26. Source 28 can be a source of coherent light, such as a laser source, or can be a radiation source, such as a source of visible light whose light is collimated to provide a beam whose beam width is substantially uniform throughout the distances which the beam must traverse in carrying out the teachings of this invention. Means (not shown) is provided for mounting the source in any suitable manner with respect to baseplate 12. For purposes of illustration, source 28 will be considered a laser source.

Each fastener 18 is threadably coupled to an insert 36 provided in a suitable opening in prism plate 16. A coil spring 38 surrounds each fastener 18 and biases plate 16 in firm engagement with the underside of baseplate 12.

Apparatus 10 is adapted to be used with a wafer-scribing machine 40 (FIG. 1) of which tool 26 forms an integral part. Tool 26 is of the type shown in FIG. 5 for scribing a wafer 42 of frangible material which is adapted to be scribed and broken into small pieces or dice to form semiconductor components, such as diodes, transistors, integrated circuit chips and the like. Tool 26 has a pair of opposed faces 44 which converge toward each other to define a cutting edge 46. The tool is usually slightly tilted during a wafer-scribing operation and can have a positive rake angle as shown in FIG. 5, the inclination of the tool being exaggerated in the figure to illustrate the portion of cutting edge which forms the scribe line as

the tool moves relative to and along the wafer. As shown in FIG. 5, the portion near the leading end of the edge 46 is used to form the scribe line, assuming that the tool is travelling in the direction of arrow 50 (FIG. 5). Dashed line 52 indicates the path along which the tool will traverse as it moves in the direction of arrow 50. If desired, the tool could have a negative rake angle, i.e., the tool being tilted in the opposite sense from FIG. 5 so that the trailing end of cutting edge 46 forms the scribe line.

FIG. 6 illustrates a cross-sectional view of wafer 42 having a transversely V-shaped scribe line 48 in a scribe path 47 formed in the wafer surface. Scribe line 48 is formed when the tool is properly aligned, i.e., when cutting edge 46 is substantially in the plane of movement of tool 26. The tool will also be properly aligned if its cutting edge 46 is parallel to the direction of tool travel. In such a case, the tool will be tilted to the side and the resulting scribe line will have sloping, inwardly directed sides which will be at different angles of inclination. One side will have a shallow angle and the other side will have a steep angle. Nonetheless the scribe line will be sufficient to avoid the creation of stresses in the wafer.

The effect of misalignment of the tool is that it is rotated along its longitudinal axis so that cutting edge 46 will be askew relative to the plane of movement of the tool. When this condition exists, the tool will "plow" a scribe line in the wafer due to the "tiller effect" of the tool so as to cause stresses to be developed in the wafer at various locations along the scribe line. FIG. 7 illustrates the scribe line 48a of a scribe path 47a in a wafer 42a which results when the cutting edge 46 of tool 26 is not in the same plane as or parallel with the direction of movement of the tool. In such a case, the stresses in the wafer will cause the wafer thereof to fracture along lines extending into adjacent dice when the wafer is broken to form the dice. Thus, the fractured dice must be discarded as they are not usable as semiconductor components.

When apparatus 10 is used, it provides an indication of the orientation of the tool-cutting edge with respect to the direction of movement of the tool. Thus, if the alignment is not correct, as indicated by light impinging on sideplates 20 and 22, the tool can be manually manipulated in its mount until the proper orientation is achieved. To check the orientation, apparatus 10 directs the laser beam toward edge 46 and onto faces 44 of tool 26 whereupon the beam is divided and reflected from these faces toward and onto respective sideplates 20 and 22. The locations of the light spots on scales 24 of the sideplates are determined by the position of cutting edge 26 with respect to the path of movement of the tool.

In FIG. 4, the paths of the reflected light from faces 44 of tool 26 are shown as they impinge on sideplates 20 and 22. When the tool is properly aligned and the tool-cutting edge is in the plane of movement of the tool, light paths 54 and 56 are substantially coextensive with each other, and they form light spots at scale locations which have substantially the same horizontal and vertical coordinates. If the tool-cutting edge is parallel to the plane of movement of the tool, but the tool is slightly tilted to the side, the cutting edge is still properly aligned to form scribe lines in a wafer. In this case, light paths 54 will still be coextensive with each other, but they will be tilted, one path being tilted upwardly and the other path being tilted downwardly. The horizontal coordinates of the light spots on scales 24 will be the same but the vertical coordinates will differ from each other. When the tool is not properly aligned, the scale locations for the reflected light beams will differ in at least the horizontal coordinates. It will then be known that tool 26 will have to be manipulated, i.e., rotated in its mount, about its longitudinal axis, until faces 44 are positioned such that the light spots on the scales are made to have substantially the same horizontal coordinates. These latter conditions, when satisfied, will assure proper alignment of tool 26. It is to be noted that sideplates will be equidistant from the tool and in planes parallel to the plane of tool travel, the greater the distance between the tool and the sideplates, the better the angular resolution of the light spots on the

sideplates. Corresponding horizontal and vertical scale lines of sideplates 20 and 22 are substantially coplanar with each other, and the planes in which such lines are disposed are substantially perpendicular to the plane of movement of tool 26. Also, the planes of the horizontal lines are parallel to the upper surface of plate 16.

In carrying out the method of the invention, the first step is to align the beam direction system, i.e., reticle plate 16, with respect to the direction of travel of tool 26. The scribing machine will generally have a microscope with an eyepiece with a reticle line which will have previously been aligned in parallelism with the path of travel of the tool. Using this eyepiece or some equivalent means, plate 16 will be positioned on a wafer mount 58 of machine 40. The mount will generally have some type of holding means, such as a vacuum device for causing a wafer to adhere thereto. Such holding means can be used to keep the reticle plate in place on mount 58. Also, machine 40 will be provided with adjustment means (not shown) for translating mount 58 from one side to the other and also for rotating the mount. By using the adjustment means, the reticle line 29 of plate 16 can be made coincident with the reticle line of the eyepiece of the machine. Thus, reticle line 29 will then be in parallelism with the direction of travel of the tool.

The next step is the alignment of the radiation beam with respect to plate 16. In carrying out this step, source 28 is positioned on its supporting means so that beam 30 will enter plate 16 at face 16a thereof. By the use of simple collimation techniques, beam 30 can be adjusted so that it strikes surface 32 at a location in alignment with a slit 16b in the upper surface of plate 16 so that the beam reflected from surface 32 will pass out of plate 16 through slit 16b perfectly perpendicular ($< 0^{\circ}1'$ error) to the surface of reticle plate 16. The reflecting surface is made at an angle of approximately 45° so that the beam 34 issuing from the plate will be substantially perpendicular to beam 30 entering the plate. A visible light spot will be observed at slit 16b since the surface on opposite sides of the slit will be coated with a reflecting material to prevent the light from passing upwardly and outwardly from the plate 16 except through slit 16b. When this alignment step has been completed, the final step of aligning the tool can now commence.

The final step is the alignment of the scribing tool wherein source 28 is energized and light therefrom is directed through plate 16 and out of the same onto faces 44 of tool 26. The light is divided into two beams and reflected from faces 44 in opposite directions for impingement on the surfaces defined by the inner faces of sideplates 20 and 22. By observing the locations of the light spots on the side plates, it is possible to determine whether or not the cutting edge of tool 26 is in the same plane as or parallel with the direction of tool movement.

If the light spots on scales 24 have essentially the same horizontal and vertical coordinates with respect to fixed references on the scales, such as the center lines thereof, the cutting edge is in the same plane as the direction of movement of the tool; hence, the tool is properly aligned and no adjustment of the tool is necessary. If the scale reading on sideplates 20 and 22 have different vertical coordinates but the same horizontal coordinates, the cutting edge is parallel to the direction of tool movement and is properly aligned to form scribe lines in a wafer. Again, no adjustment of the tool is necessary. Finally, if the horizontal coordinates of the light spots are different from each other, regardless of whether the vertical coordinates are the same as or different from each other, the tool requires adjustment, i.e., the cutting edge is not in the same plane or in parallelism with the direction of tool travel. Thus, the mount for the tool must be manipulated to allow for adjustment of the tool, specifically, to allow for rotation of the tool about its longitudinal axis so as to bring the cutting edge either into the plane of the tool movement or in parallelism therewith. The progress of this adjustment can be visually observed by noting the positions of the light spots on sideplates 20 and 22. As soon as the horizontal coordinates of

the light spots become essentially the same, the tool is then locked in its mount since it will be then properly aligned to form scribe lines in a wafer.

Following the alignment of the tool, the baseplate, the reticle plate and the sideplates are then removed from the wafer mount and a wafer placed thereon to be scribed in the conventional manner. The orientation of the cutting edge can be checked periodically if desired using apparatus 10 and by carrying out the steps of the method of this invention.

While a laser source or a source of collimated visible light has been described as usable with apparatus 10, it is clear that other radiation sources can be used if deemed desirable or practical. Also, it is not necessary that the radiation spots on the sideplates be visually observable although such is desired to minimize the time required to align the tool-cutting edge.

The teachings of this invention have been described hereinabove with respect to the alignment of a scribing tool when the latter is mounted in a scribing machine. It is also possible to carry out the teachings of the invention with the tool out of its mount on the scribing machine. To this end, the mount may be held in any suitable manner, such as by a chuck or the like, and the method of the invention can be practiced to align the tool according to a predetermined reference. After the alignment is complete, an index can be applied to the tool which will correspond to an index on the tool mount of the machine. Thus, when the tool is inserted in its mount in the machine, the index on the tool will be brought into registry or correspondence with the index on the mount to assure proper positioning of the tool in the mount. With the tool properly mounted, the machine can then be operated to scribe a wafer.

The index on the tool can be a mark which is to be placed in alignment with a corresponding mark on the tool mount of the machine. Also, the index can be a flat surfaced portion on the tool which can be engaged by, for instance, a setscrew or can be inserted into a keyway in the mount.

Still another aspect of the invention is to provide a portion on the tool for holding a mirror, which portion will be machined in the tool after the tool has been aligned in accordance with the present invention. With the mirror on the tool when the latter is in the tool mount of the machine, the orientation of the mount can be accomplished by collimating on the mirror secured to the tool. In this way, the tool need not be aligned while it is in the mount but can be aligned elsewhere and then placed in the mount. Also, in lieu of a mirror, the tool can be machined to form a flattened surface which can then be silvered to provide a mirror for reflecting a collimating beam.

What I claim is:

1. Apparatus for use in aligning a tool having a pair of opposed, relatively convergent, faces comprising: a support; a source of radiation, mounted on said support in a position to direct a beam of radiation therefrom along a first path toward the faces of said tool for impingement thereon when the latter is disposed in the first path, whereby the radiation impinging on the faces will be reflected therefrom along respective second paths extending away from the tool; and means in each second path, respectively, for intercepting the radiation reflected from the corresponding tool faces and for indicating the presence of the radiation to thereby provide an indication of the relative positions of the tool faces with respect to said first path.

2. Apparatus as set forth in claim 1, wherein said radiation source comprises a laser source.

3. Apparatus as set forth in claim 1, wherein said radiation source includes a radiation-transmitting device to receive an incoming radiation beam directed along a second path and having an internal reflecting surface for reflecting a radiation beam along said first path disposed at an angle relative to the second path, said device having a reticle line for aligning the same with a predetermined reference.

4. Apparatus as set forth in claim 1, wherein said source includes a radiation-transmitting plate having a beam exit sur-

face alignable with the tool, said intercepting means including structure coupled with said plate and defining a surface across the path of radiation reflected from each face of the tool, respectively.

5. Apparatus as set forth in claim 4, wherein the radiation-transmitting plate has a face from which the beam exits therefrom, said face being coated with a radiation-reflecting material, there being a slit formed in the coating to permit the beam to exit from the radiation-transmitting plate only through the slit.

6. Apparatus for aligning a scribing tool of a wafer-scribing machine movable relative to a wafer support below the tool with the tool having a cutting edge and a pair of opposed faces converging to said cutting edge comprising: means to be mounted on the wafer support of the machine for directing a beam of radiation upwardly toward and against the opposed faces of the scribing tool, whereby the beam will be divided by the faces and reflected transversely therefrom; and means to be disposed adjacent to each side of the tool, respectively, for receiving the reflected radiation from the corresponding tool face and for indicating the relative position of the tool face and thereby the orientation of said cutting edge with respect to the path of movement of said tool relative to said wafer support.

7. Apparatus as set forth in claim 6, wherein said directing means includes a radiation-transmitting device having an internal reflecting surface permitting said beam to be directed substantially horizontally to said reflecting surface and then substantially vertically to said tool faces, and wherein is included a source of radiation disposed in alignment with said device for directing a beam of coherent radiation toward and into the same along a generally horizontal path.

8. Apparatus as set forth in claim 6, wherein said receiving and indicating means includes a structure defining a surface on which the reflected radiation from a corresponding tool face impinges.

9. In combination: a scribing tool having a cutting edge and a pair of opposed faces converging to said edge; means coupled with the scribing tool for mounting the same above a support for an article to be scribed with the tool being movable relative to said article support; a source of radiation disposed to direct a radiation beam along a path adjacent to the wafer support and substantially parallel to the direction of movement of the tool; means in the path of the beam for directing the same upwardly from the article support and toward and against the faces of the tool whereby the beam impinging on the tool faces will be divided and reflected therefrom away from the tool; and a pair of radiation receiving devices on opposite sides of the tool, said devices being disposed to intercept the beams reflected from respective faces of the tool to provide indications of the locations of respective tool faces and thereby the orientation of said cutting edge with respect to said direction of movement of the tool relative to said support.

10. A method of aligning a tool having a pair of opposed, relatively convergent faces with respect to a predetermined reference direction comprising: directing a beam of radiation having a known spatial relationship to said reference direction toward and against the opposed faces of the tool to cause the beam to be divided by the tool and to be reflected from the tool faces in directions extending away from the tool; and intercepting the radiation reflected from the tool faces to provide observable indications of the positions of the tool faces relative to said predetermined reference direction.

11. A method as set forth in claim 10, wherein is included the step of adjusting the position of the tool until a predetermined spatial coordinate of one of the indications is substantially the same as the corresponding coordinate of the other indication.

12. A method of aligning a scribing tool movable relative to a support with the tool having a pair of opposed faces which converge toward a cutting edge comprising: providing a beam of radiation; aligning said beam so that it is perpendicular to

the direction of movement of the tool relative to the support; directing the beam toward the cutting edge of the tool to cause the beam to impinge on and to be divided by said tool faces, whereby the divided beams will be reflected from said tool faces along respective paths extending away from the tool; and intercepting the radiation reflected from said tool faces to provide indications of the orientation of said tool faces and thereby said cutting edge with respect to said direction of movement of the tool relative to the support, whereby any difference between said indications will provide a determination of the need to adjust the location of the tool to move said cutting edge into a new position relative to said direction of tool movement.

13. A method as set forth in claim 12, wherein said beam

directing step includes directing the beam along a first path substantially parallel to said direction of tool movement and then directing the beam along a second path substantially perpendicular to said first path.

14. A method as set forth in claim 12, wherein said providing step includes providing a source of coherent radiation.

15. A method as set forth in claim 12, wherein is included the step of adjusting the tool relative to its path of movement when said indications differ in a predetermined spatial coordinate from each other, whereby the tool can be moved into a position at which the spatial coordinates of the indications are the same.

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