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[54] **PHOTOGRAPHIC PRODUCTION OF SEMICONDUCTOR MICROSTRUCTURES**
 20 Claims, 6 Drawing Figs.

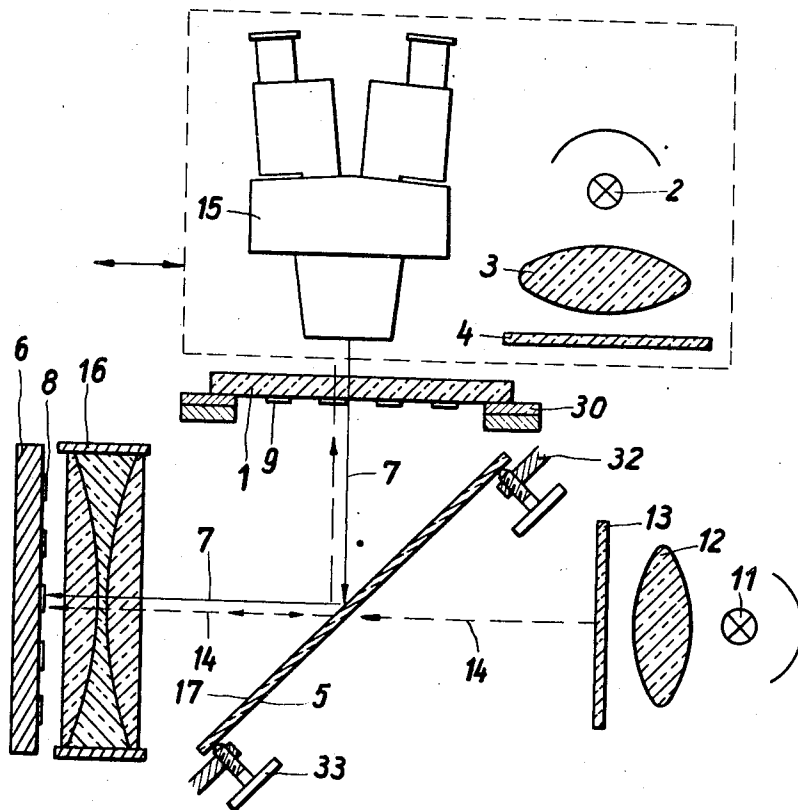
[52] U.S. Cl. 355/46;
 356/171, 356/172
 [51] Int. Cl. **G01b 11/26**
 [50] Field of Search. 356/165,
 166, 171, 172; 355/46

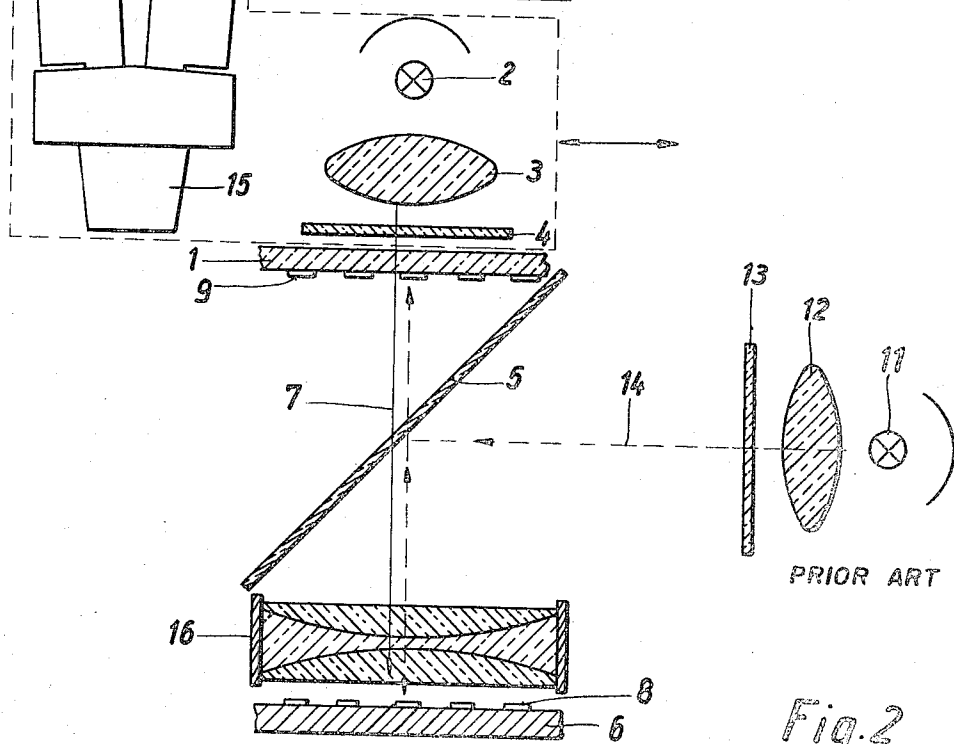
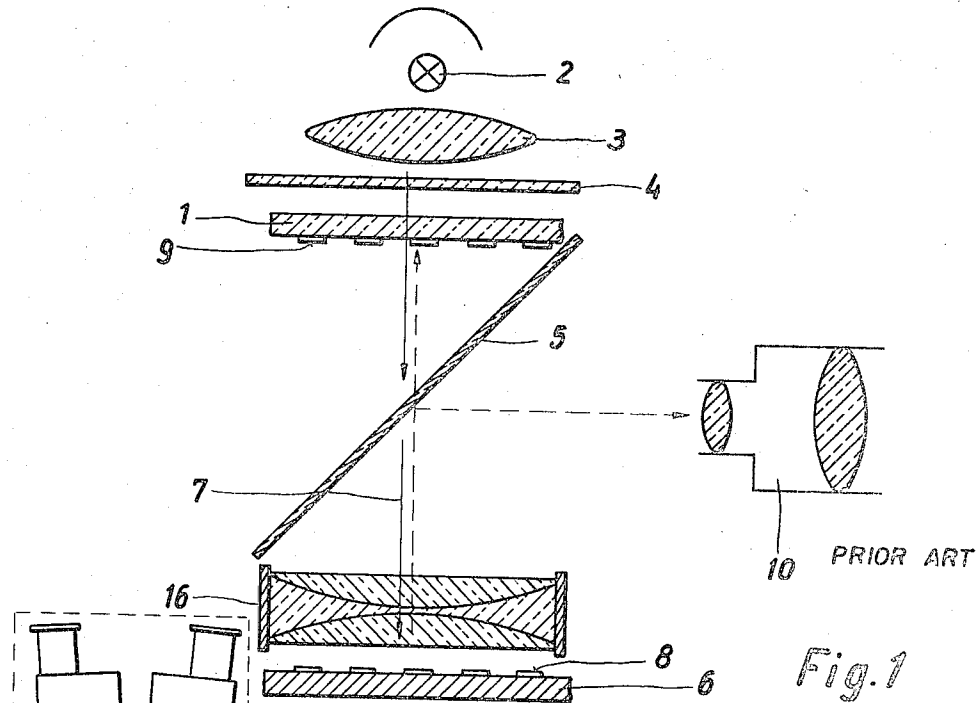
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ABSTRACT: An arrangement for producing microstructures on a substrate surface by forming an image of a mask containing a microstructure pattern on a photosensitive layer provided on such surface, the system including a semireflecting mirror oriented to reflect light passing through the mask toward the layer and to reflect light from the layer toward the mask, and an objective lens arranged for forming an image of the mask on the layer, the lens being optimally corrected to have the same longitudinal and lateral aberration with respect to two different light wavelengths, light having one of these wavelengths being used for forming an image of the mask on the layer and light of the other of these wavelengths being reflected from the layer for permitting an alignment to be effected between the mask and the layer.





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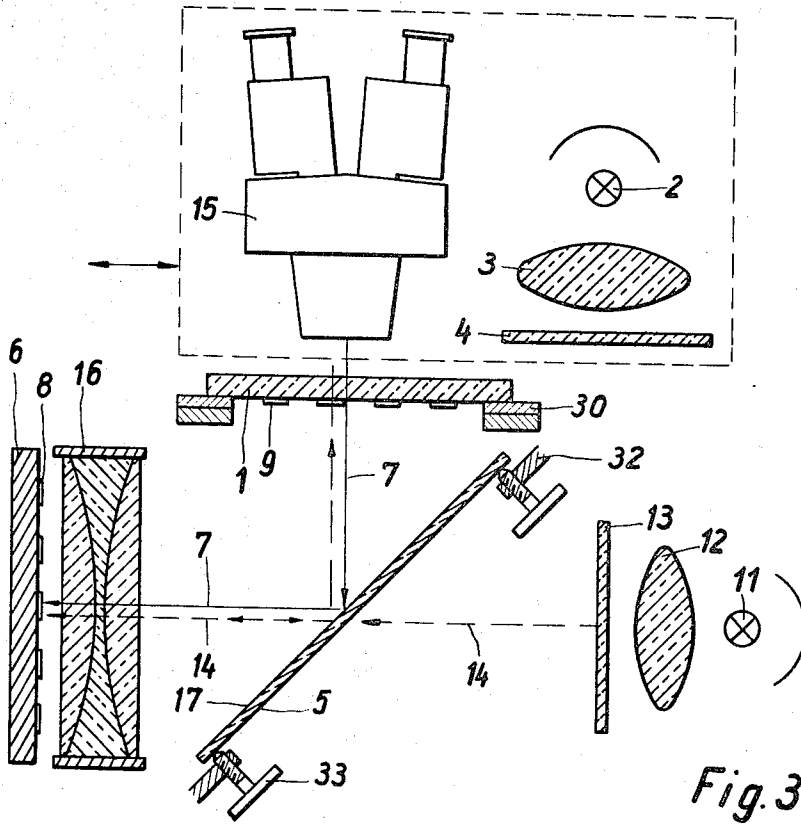


Fig. 3

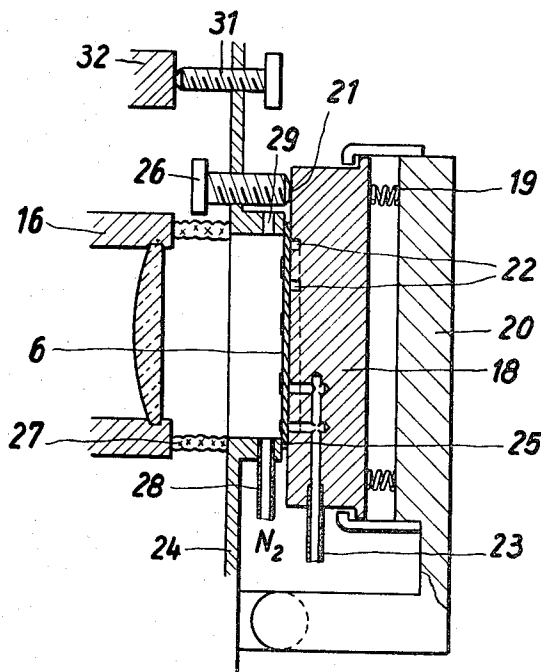


Fig. 5

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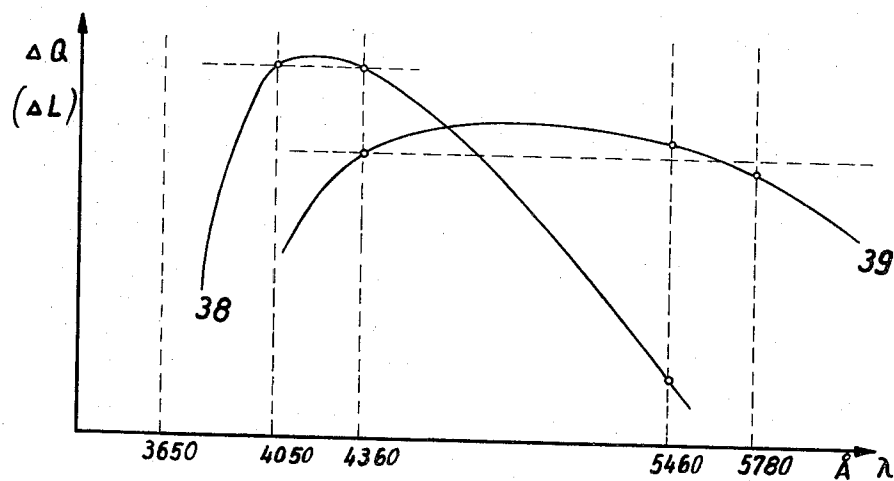


Fig. 4

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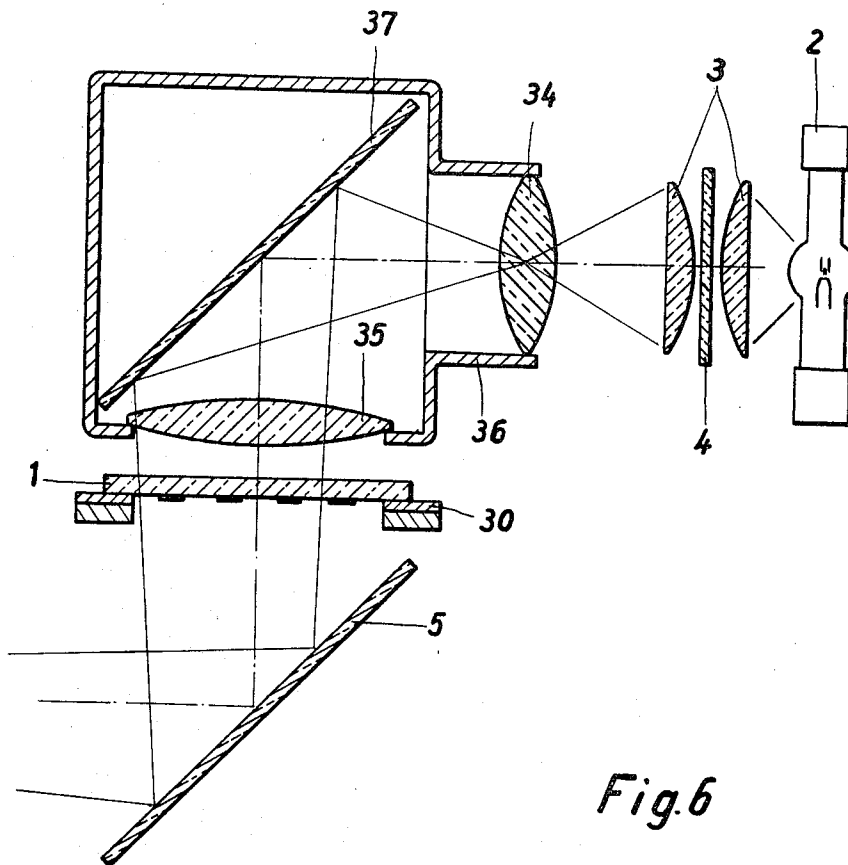


Fig. 6

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PHOTOGRAPHIC PRODUCTION OF SEMICONDUCTOR MICROSTRUCTURES

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for producing microstructures on a substrate, and particularly to an apparatus for focusing, by means of a lens, an image on the substrate of the structures formed on a mask, the substrate being covered with a light-sensitive layer.

Two basic arrangements have already been proposed for producing a mask on a semiconductor wafer by projecting the image of a masking pattern onto the semiconductor substrate. These arrangements will be briefly described below with the aid of FIGS. 1 and 2.

In the known arrangement shown in FIG. 1, the image of the structure patterns 9 of a transparent mask 1 is reproduced on the substrate 6, which is covered with a light-sensitive layer, by projection through an objective lens 16. For this purpose, a light source 2 is disposed above the mask 1, and a condenser lens 3 and a filter 4 are placed in the path of the beam between the light source and the mask 1. Condenser 3 acts to form the light from source 2 into a beam of converging rays, i.e., to focus the beam at the lens 16. Between the mask whose patterns are to be projected and the substrate 6, a semireflecting mirror 5 having flat parallel surfaces is inclined at an angle of 45° with respect to the image projection direction. This mirror 5 is traversed by the projection light beam 7. The light beam 7 is then reflected by the substrate surface and a portion of the beam is subsequently reflected by mirror 5, the reflected beam forming an angle of 90° with the incident beam. This reflected light beam, which is used for purposes of observation and for mutually aligning the mask patterns 9 with the previously formed substrate structures 8, is received by a microscope 10.

In FIG. 2, the arrangement of the mask 1, the mirror 5, the objective 16 and the substrate 6 corresponds to that of FIG. 1. The light source 2 disposed above the mask, however, here furnishes only the projection light beam 7 which traverses the semireflecting mirror 5 and which forms an image of the mask pattern 9 on the semiconductor substrate 6, whereas a further light source 11 is provided for observation purposes and for mutually aligning the mask pattern with the substrate pattern. This light source 11 furnishes a light beam 14 which is projected via a condenser 12, which is similar to condenser 3, and a filter 13 in a direction perpendicular to the projection direction, is reflected at right angles to the projection direction by the mirror 5 and is then reflected by the substrate surface.

The reflected observation light beam traverses the mirror 5 in a direction opposite to the projection direction of beam 7 and thus forms an image of the substrate structure 8 in the plane of the mask structure 9. In this manner the mask structure can be lined up with, and made parallel with, the substrate structure, if the light source 2, condenser 3 and filter 4 are preferably replaced by a split field observation microscope 15.

In the two reproduction arrangements described above, the image of the mask structure 9 formed on the substrate structure 8 is preferably of same or smaller size than the structure 9. To achieve this an appropriate objective 16 is used and is inserted into the projection and observation beam paths between mirror 5 and substrate 6.

Whereas both arrangements are identical with respect to their projection beam path, they differ with regard to their observation beam path, which permits a pattern 8 already disposed on the substrate 6 to be lined up with respect to the pattern 9 of the mask 1, or vice versa. In both arrangements the projection beam 7 traverses the semireflecting mirror 5, while in the arrangement according to FIG. 2 this mirror is also traversed by the observation beam 14. The arrangement of FIG. 2 thus has the drawback that the projection of the mask pattern 9 onto the substrate, or semiconductor wafer 6, as well as the projection of the reciprocal image of the sub-

strate pattern 8 in the plane of mask pattern 9, is impaired by the slanted, semireflecting flat plate 5 which leads to considerable astigmatism and to a great loss in brightness. Image errors are caused in these cases even by a mirror having perfectly parallel and planar surfaces. Any errors in the parallelism or in the planarity of the plate surfaces results in further image errors.

The same drawbacks apply to the arrangement shown in FIG. 1 with regard to the image projecting portion 7 of the beam path. Moreover, two additional drawbacks are present. During observation of the mutual alinement of the mask structure 9 and the semiconductor wafer structure 8 in the arrangement according to FIG. 1, it is the image of the mask projected onto the semiconductor surface that is observed. A heavy loss of contrast occurs due to the high reflectivity of the surface of the substrate 6, which loss is augmented by the fact that interference phenomena occur in the oxide and lacquer layers disposed on the semiconductor surface. Moreover, the beam reproducing the mask pattern must pass twice through the objective 16 for observation, so that the objective errors are incorporated twice into the image being observed.

Since the photographic quality of the image formed on the substrate is of primary importance in the projection masking operations employed in the production of semiconductor arrangements, it would be highly advantageous if this quality could be improved.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to overcome the aforementioned drawbacks and difficulties.

A more specific object of the invention is to substantially improve the photographic quality achieved by such projection masking operations.

Another object of the invention is to substantially reduce the source of distortions in such operations.

Yet another object of the invention is to permit the layer on which the mask image is formed to be inspected and compared with the mask in a simple and highly accurate manner.

Yet another object of the invention is to reduce the differences between the optical influences experienced by a projection light beam and an inspection light beam in such devices.

These and other objects according to the invention are achieved in a system for producing microstructures on a substrate surface by forming an image of a mask containing a microstructure pattern on a photosensitive layer provided on such surface, the system including a first source of light whose wavelength lies in a first range and a second source of light whose wavelength lies in a second range, the first source being arranged for directing light through the mask and the second source being arranged to direct light toward the layer over a path which avoids the mask. The improvement according to the invention includes a semireflecting mirror having its reflecting surface oriented symmetrically with respect to the mask and the layer for reflecting light passing through the mask toward the layer and for reflecting light from the layer toward the mask. The improvement according to the invention further includes objective lens means disposed between the layer and the mirror in the path of the light reflected from the mirror to the layer for forming an image of the pattern contained by the mask on the layer, the lens being optimally corrected to have disappearing longitudinal and lateral aberration with respect to the light wavelengths from both the first source and the second source.

In the system according to the invention, the light from the first source serves to project the image of the mask pattern onto the layer and the light from the second source is reflected from the layer for causing an image of the layer to be formed in the plane of the mask to permit the mask to be aligned with the layer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of one projection masking arrangement according to the prior art, which arrangement has already been described in detail.

FIG. 2 is a view similar to that of FIG. 1 showing another prior art projection masking arrangement which has also already been described in detail.

FIG. 3 is a view similar to that of FIG. 1 showing one embodiment of the present invention.

FIG. 4 is a chart presenting curves used in explaining one of the principles of the present invention.

FIG. 5 is a cross-sectional view of a preferred embodiment of one portion of the apparatus according to the present invention.

FIG. 6 is a cross-sectional view of a modified form of construction of a portion of the apparatus according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus according to the invention will now be explained in detail with the aid of the arrangement shown in FIG. 3.

From a light source 2, which is disposed above a mask 1 and which is interchangeable with a split field microscope 15, a projection light beam 7 is directed to the mask 1 through the condenser 3 and the filter 4, and focuses the mask structure 9 on the surface of the semiconductor wafer 6. The projection beam path 7 here passes through the mask 1 and is deflected at the surface side of the mirror 5 which faces the objective 16, which plate is here partially silvered at 17. The beam 7 then impinges on the surface of the semiconductor substrate 6 after having passed through objective 16.

Since the light reflected by surface 17 is preferably at an angle of 90° to the light incident thereon, the optical axis of the objective 16 is perpendicular to the plane of the mask 1. A further light source 11 is provided which furnishes a light beam 14 travelling through the condenser 12 and the filter 13 in a direction parallel to the optical axis of the objective 16, beam 14 then passing through the mirror 5 without being reflected and being used to observe, and to mutually align, the substrate structure 8 and the mask structure 9. The reflected beam, which is again reflected by 90° at the mirror surface 17, forms an image of the substrate structure 8 in the plane of the mask so that the structures can be observed and aligned with each other with the aid of the microscope 15. The alignment of the patterns with each other is effected, for example, by means of the rotatable support 30 on which the mask is mounted.

This beam path arrangement has the advantage that no element which can impair the image is disposed either along the projection beam path 7 between the mask 1 and the substrate 6 or along the portion of the observation beam path 14 extending from the substrate 6 to the mask 1, since the above-mentioned beam paths do not pass through the semireflecting mirror 5 but are rather reflected at an angle of 90° at its silvered surface 17. Only a light path portion not critical for the image quality passes through the mirror 5 to illuminate the semiconductor surface. The image errors occurring in arrangements according to the present invention are extremely small, since the surface 17 of the plate 5 can be given an extremely accurate planarity, having deviations of the order of no more than $\lambda/20$, where λ is the wavelength of the light used. Since the reflectivity of the mirror can furthermore be selected to be up to 90 percent, the intensity loss is also negligible in the image.

The beam path no longer traverses any glass boundaries not required for the optical image as this was still the case in the arrangements of FIGS. 1 and 2 due to the two surfaces of the flat plate 5. Thus the scattering of the beam portion traversing the objective is also reduced. The scattering coefficient of the objective is kept at a minimum by means of antireflection coatings appropriately selected for the particular wavelength

employed and can be further reduced for the observation beam path by means of an aperture associated with the condenser lens 12 for illuminating only the points actually being observed. It should also be noted that between the mask 1 and the substrate 6 no optical means need be disposed other than the objective 16 and the semireflecting mirror 5.

The above-described apparatus is preferably used for the production of semiconductor arrangements such as diodes, transistors and integrated semiconductor circuits. These are structural components which are produced essentially by diffusion, epitaxial, or vapor-deposition processes. To carry out these processes, it is generally required that a layer on the semiconductor surface, which layer consists of an insulating material, a semiconductor oxide or a metal, be given a particular structure, or pattern. For this purpose, the layer on the semiconductor wafer surface is covered with a photolacquer upon which a mask structure, or pattern, is photographed with the aid of the above-described method. Subsequent developing of the lacquer and etching out of the structures will result in the desired pattern on the semiconductor surface.

The image-forming objective 16 must meet several further requirements in addition to the requirement of presenting the best possible resolution, or of having a favorable modulation transfer function. For observation of the alignment process a long wavelength must be used to which the photolacquer is no longer sensitive, whereas the projection procedure requires a wavelength which produces a rather intensive photographic reaction in the photolacquer and which leads to short exposure times.

Most of the photolacquers which might be used have a spectral sensitivity distribution which extends from short wavelengths of about 2,000 Å. to about 4,500 Å., and in one case up to 5,300 Å. Consequently, the projection wavelength must be shorter than 4,500 Å. and the observation wavelength longer than 5,300 Å., which latter fortunately coincides with the sensitivity of the human eye.

Due to the required maximum resolution and the unavoidable chromatic aberration of the lens, it is necessary to operate over very small wavelength ranges in which the chromatic aberration is negligible with respect to the resolution. For this reason, the projection light sources primarily used are high-pressure mercury vapor lamps which produce narrow and intensive spectral lines lying in the wavelength ranges in question, these lines being filterable by interference filters, for example. For the projection of the mask image spectral lines at wavelength of 3,650 Å., 4,050 Å. and 4,360 Å. are particularly well suited and for observation those at 5,460 and 5,780 Å. prove to be satisfactory.

By way of comparison, when, as was previously the practice, the mask pattern is reproduced on the semiconductor wafer with the aid of a contact mask, the entire spectrum of the mercury vapor lamp is utilized, from the 3,000 Å. short-wave permeability limit of the glass constituting the mask up to the 4,500 Å. or 5,300 Å. longwave sensitivity limit of the photolacquer, and thus exposure times of several seconds resulted. In order to arrive at the same order of magnitude for the exposure time when employing the recently suggested projection masking techniques, it has been proposed to use a projection lens having an achromatic correction for the two wavelengths of 4,050 Å. and 4,360 Å. so that at least two wavelengths and the spectrum extending therebetween can be utilized for the projection of the mask image onto the semiconductor surface. The longitudinal ($\Delta\epsilon$) and lateral ($\Delta\Phi$) aberrations of an objective corrected in such a manner, as a function of light wavelength, is shown in FIG. 4 and indicated with the numeral 38. The newly proposed objective has substantial advantages when compared with the previously used objectives.

However, it is additionally necessary, for accurate observation, that the longitudinal and lateral chromatic aberrations also disappear for the observation wavelength, i.e. for the wavelength of 5,460 Å. or 5,700 Å. Successful projection masking is, in fact, possible only when the observation

image of a pattern produced by light at the observation wavelength coincides with the original pattern projected by light at the projection wavelength. A maximum error of only about $1\ \mu$ is permissible for each point of the image field.

For this reason, the correction curve 39 of FIG. 4 is used in arrangements according to the present invention. It represents the correction curve for the chromatic aberration of an objective whose longitudinal and lateral aberration correction with respect to the projection wavelength of 4,360 Å. is the same as that at about the observation wavelength of 5,600 Å. Thus a subsequent focusing for the observation wavelength with respect to the focus effected for the projection wavelength is no longer necessary.

It has been found to be particularly advantageous if the point of disappearing lateral and longitudinal aberration with respect to the projection wavelength (4,500 Å. or 4,360 Å.) falls between the wavelengths of 5,460 Å. and 5,780 Å. selected for observation and alinement. This is due to the fact that the structure of the semiconductor wafer with which the mask is to be alined generally consists of an oxide layer which when subjected to the type of illumination used here appears only as an interference phenomenon.

Interference phenomena show a greater contrast as the illumination band is narrowed. This is favorable from the point of view of the objective characteristics. However, the interference phenomenon depends very definitely on the thickness of the oxide layer and/or the dimensions of the different oxide regions and the lacquer layer still present on the oxide-layer. There are, therefore, many wafers whose structure becomes undetectable at the particular observation wavelength employed due to unsuitable layer thickness, or exhibits only a very low contrast.

It has been found in practice that wafers which have little contrast at 5,460 Å. will just begin to show a high contrast at 5,780 Å., and vice versa. This is due to the oxide and lacquer layer thicknesses used during the semiconductor production, which thicknesses result in a change in the order of interference from one-quarter to one-half.

If then, according to the present invention, the point of disappearing longitudinal and lateral aberration is placed between the two observation wavelengths of 5,460 Å. and 5,780 Å., only very small longitudinal and lateral aberrations will result at these two observation wavelengths, corresponding to the shallow path of the correction curve 39 of FIG. 4 in that region. The longitudinal aberrations of the two mercury vapor spectral lines of 5,460 Å. and 5,780 Å. with respect to the projection wavelength are approximately $10\ \mu$ and are negligible with respect to the depth of focus. The lateral aberration for both spectral lines is only about $1\ \mu$ in respectively opposite directions. Thus it is possible to adjust the observation wavelength to the oxide-lacquer structure employed simply by an exchange of filters so that the best contrast is always achieved for all wafers.

The filters used for observation and alinement can be interference line filters having a bandwidth of about 100 to 150 Å., or interference filters having a bandwidth of about 200 to 300 Å., the former providing the better contrast. Interference line filters, or interference band filters, or low-pass filters can also be used for the image projection beam (4,050 or 4,360 Å.). A low-pass filter would permit all frequencies below the band edge of the low-pass filter to penetrate down to the respective sensitivity limit of the photolacquer (e.g. 4,250 to 4,500 Å.).

By means of an appropriately applied multilayer coating, a reduction in reflectivity can be achieved at the lens surfaces for the desired wavelengths. A further possibility to reduce the amount of scattered light during observation consists in that, through the use of an aperture, or diaphragm, inserted into the condenser 12 (FIG. 3) and imaged onto the semiconductor wafer, only those portions of the semiconductor wafer which are to be actually observed through microscope 15 are illuminated.

When a split field microscope is used, its two objectives are arranged to be displaceable in such a manner that all points of the image lying on one diameter of the image field or of the semiconductor wafer can be observed. Accordingly, it is advisable to form the above-mentioned aperture as a slitted aperture which just illuminates this diameter of the field to a sufficient width to form an image field diameter of the microscope objective. If the slit area is 10 percent of the entire image field of the projection lens, the scattered light intensity is also reduced to about 10 percent without there being an accompanying decrease in the image-transferring luminance in the split field microscope.

It can furthermore be advisable to dispose a field lens between the mask 1 and the microscope 15 for directing all the light coming from objective 16 into the microscope. This added lens can, with a suitable arrangement of the illumination apparatus for the projection, simultaneously serve as the condenser lens. On the other hand it can be advantageous to add another lens that acts as an image correcting means between mask 1 and mirror 5 or with other words to place the first optical member of the projection objective lens just below the mask 1.

Since in the production of a semiconductor arrangement it is necessary to perform three to seven projections of different mask structures onto one substrate surface, it must be possible, in order to facilitate manufacturing procedures, to produce different structures of the semiconductor arrangement with different projection devices, i.e. with different lenses. This means that the projected and reimaged pattern of not only one lens, but of all lenses within a series of projection devices, must coincide. The prerequisite for this is, first of all, that the focus and reproduction scale of all projection devices be preset to a fixed value and that the mechanical structures be so sturdy that a change of this setting is impossible. During the manufacture of the lenses, however, there occur unavoidable aberrations of which the different distortion factor for each lens is particularly critical. This has the result that alinement errors can occur in the image field to a magnitude of approximately $10\ \mu$.

In order to avoid such alinement errors, an advantageous further modification of the present invention involves the setting of the reproduction scale to a predetermined nominal value taking into consideration the distortion in a median image field diameter (e.g., one-half or two-thirds of the total image field) by providing two calibration marks, one in the mask and the other on the substrate, which are simultaneously focused and imaged with the aid of the observation beam path to be superimposed exactly on one another. The one calibration mark on the semiconductor wafer constituting the substrate has a length L_1 and is preferably disposed on a diameter of the semiconductor wafer symmetrically to its center, which is placed in the optical axis of the system. The calibration mark in the mask then has a length $L_2 = \frac{L_1}{\beta}$, where β is the ratio of the image size to the mask pattern size, or the reproduction size coefficient.

The two calibration marks are alined with each other by varying the image, adjusting the lateral position of the mask and/or the substrate, the mask and the substrate being immovable in the direction of the optical axis, whereas focus and size coefficient are adjusted by moving the objective and the mirror in the dissection of the lens axis. The mask then follows the movement of the mirror in its plane by means of the mounting 30. The calibration marks in the mask and on the substrate advantageously have lengths of $\frac{1}{2}$ to $\frac{3}{4}$ of the maximum image field diameter.

Before the focus and size coefficient of the device are adjusted, the image plane and the objective lens plane must first be set to be optically normal to the optical axis of the lens, or parallel to the screw-on plane of the lens mount. This is done, with the aid of an autocollimation telescope, by tilting the wafer support surface 24 shown in FIG. 5 by means of the screws 31 for adjusting the plane of the image, and by tilting the mirror 5 (FIG. 3) with the aid of screws 33 for adjusting

the plane of the lens, in both cases with respect to the common housing 32 (FIG. 3). It is advantageous to adjust and fix the focus and the size coefficient during installation of the projection device. During operation of the apparatus for producing semiconductor devices these values then remain unchanged.

The size coefficient must be given for the selection of the lens and is advisably chosen to be between $\beta = 0.5$ and $\beta = 1$ so that the mask structure is reproduced on the semiconductor wafer to the same size or to a reduced size.

FIG. 5 shows a section of a very advantageous mounting for the substrate, or the semiconductor wafer, in which the advantages of the method according to the present invention are fully utilized and which prevents a canted or uneven position of the substrate which would lead to image errors.

A mounting plate 18 provided for holding the semiconductor wafer is held against springs, or rubber feet, 19 to be movable in a guide 20. The polished surface 21 of the mounting plate 18, onto which the semiconductor wafer 6 is to be fastened, is provided with channels 22 which are connected to a vacuum pump (not shown), via a connecting member 23, to suck the semiconductor wafer 6 against the mounting plate. The channels 22 are preferably of annular form and are disposed one inside the other.

Associated with the focusing plane of the objective lens is a reference ring 24 against which the semiconductor wafer fastened to the above-described mounting mechanism is pressed, the springs 19 assuring that the semiconductor wafer is evenly and positively pressed against the reference ring.

If the semiconductor wafer should become bent during the oxidation, diffusion or epitaxial processes, the above-described mounting will cause it to be brought into the focusing plane, which coincides with the frontal surface 25 of the reference ring 24. This will be accomplished even when the semiconductor wafer has a deep surface flaw. It is only necessary that the rear surface of the semiconductor wafer be originally as flat as the frontal surface which is to be masked. With this mounting even broken wafers can be used if the spacing screws 26 in the reference ring are set to the previously determined thickness of the broken semiconductor wafers.

Since there are a number of photolacquers which are sensitive to oxygen and which upon exposure to light in air require a substantially longer exposure time, it is advantageous to seal the space between the image end of the objective 16 and the reference ring 24, for example by a rubber seal 27. Through an inlet opening 28, this area can be filled with nitrogen (N_2), for example, which can then be exhausted through the outlet opening 29.

FIG. 6 shows another advantageous arrangement for the projection illumination apparatus which permits a better illumination than the simpler arrangements of FIGS. 1 to 3 and which it is not necessary to move the mercury vapor lamp aside in order to position the split field microscope for observation. At the same time the arrangement shown in FIG. 6 permits an intermediate image of the light source 2 to be formed by the condenser 3 in the field lens 34 and from there to be projected via the mirror 37 and the condensing lens 35 into the entrance pupil of the projection objective. The field lens 34 images the aperture of condenser 3 on the mask 1. In this way a perfectly uniform illumination of the mask 1 and of the objective entrance pupil is achieved. The filter 4 is here disposed between the two components of the condenser 3 so as to be in an almost parallel beam path. To use the microscope it is now only necessary to swing away the housing 36 together with the condensing lens 35, field lens 34 and mirror 37, whereas the positions of the mercury vapor lamp 2, the condenser 3 and the filter 4 remain unchanged and it is even possible by placing a further mirror at the position of the light source 11 (FIG. 5) to use the mercury vapor lamp 2 for both the illumination and the projection ray path.

The apparatus according to the present invention makes possible the formation of extremely accurate and reliable images of a mask structure on the light-sensitive layer of a

semiconductor wafer. By reflecting the projection and the observation light beams at a partially transparent mirror, sources of substantial errors present in the previously known reproduction systems are eliminated.

The use of calibration marks on the mask and on the semiconductor substrate to set the reproduction size scale makes it possible to work on the semiconductor wafer, in the course of the various required masking processes, with different projection devices without the occurrence of errors even when the devices do not have exactly identical lenses. The above-described mounting device for the semiconductor wafer assures that the surface of the semiconductor wafer is always as flat as possible and coincides with the focusing plane of the objective.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. In a system for producing microstructures on a substrate surface by forming an image of a mask containing a microstructure pattern on a photosensitive layer provided on such surface, the system including a first source of light whose wavelength lies in a first range and a second source of light whose wavelength lies in a second range, the first source being arranged for directing light through the mask and the second source being arranged to direct light toward the layer over a path which avoids the mask, the improvement comprising:

a semireflecting mirror having its reflecting surface oriented symmetrically with respect to said mask and said layer for reflecting light passing through said mask toward said layer and for reflecting light from said layer toward said mask;

objective lens means disposed between said layer and said mirror in the path of the light reflected from said mirror to said layer for forming an image of the pattern contained by said mask on said layer, said lens being optically corrected to have the disappearing longitudinal and lateral aberration with respect to the light wavelengths from both said first source and said second source; and

wherein the light from said first source serves to project the image of said mask pattern onto said layer and the light from said second source is reflected from said layer for causing an image of said layer to be formed in the plane of said mask to permit said mask to be aligned with said layer.

2. An arrangement as defined in claim 1 wherein said mirror is oriented to reflect light from said mask or from said layer through an angle of 90° .

3. An arrangement as defined in claim 1 wherein said second source is arranged so that the light which it directs toward said layer passes through said mirror, and said mirror and lens means being arranged for causing the light striking said layer from said second source to produce an image of said layer in the plane of said mask so that the image of said layer can be inspected together with said mask by microscopic means.

4. An arrangement as defined in claim 1 wherein said mask and said substrate are immovable in the direction of the light path striking them and said objective and said mirror are movable for focusing the mask image and for adjusting the ratio between the size of the image formed on said layer and the size of the pattern contained by said mask.

5. An arrangement as defined in claim 4 wherein said mask is provided with a calibration line and said substrate is provided with a corresponding calibration line for permitting the focusing and the image to mask pattern size ratio to be adjusted by causing the calibration mark on said substrate to be superimposed on the calibration mark on said mask by the light produced by said second source.

6. An arrangement as defined in claim 5 wherein the size ratio is between 0.5 and 1.

7. An arrangement as defined in claim 5 wherein the length of each calibration mark is approximately one-half to two-thirds of the diameter of the image field formed on said layer.

8. An arrangement as defined in claim 1 wherein the optical axis of said lens means is parallel to the plane of said mask.

9. An arrangement as defined in claim 1 wherein said mirror is constituted by a flat glass plate provided with a partly reflecting coating on that surface of said plate which faces said lens means and said mask.

10. An arrangement as defined in claim 1 wherein the light from first source is defined by that mercury spectral line having a wavelength of 3,650, 4,050 or 4,360 Å.

11. An arrangement as defined in claim 1 wherein the light from said second source is defined by at least one of the mercury spectral lines having wavelengths of 5,460 and 5,780 Å.

12. An arrangement as defined in claim 11 wherein said lens means is corrected so that its longitudinal and lateral aberration disappear for the light wavelength from said first source and for a light wavelength lying between 5,460 and 5,780 Å.

13. An arrangement as defined in claim 1 further comprising an interference line filter disposed between said mask and said first source.

14. An arrangement as defined in claim 1 further comprising an interference band filter disposed between said mask and said first source.

15. An arrangement as defined in claim 1 further comprising a low-pass light filter disposed between said mask and said first source.

16. An arrangement as defined in claim 1 further comprising an interference filter disposed between said second source and said substrate for permitting the passage of light having a

wavelength which will cause the image of said substrate formed on said mask to have a high contrast for a given substrate arrangement.

17. An arrangement as defined in claim 1 further comprising a mounting device for said substrate, said mounting device including a mounting plate having a flat surface on which said substrate bears, said plate being provided with channels extending to its flat surface, said channels being connectable to a vacuum pump for creating a low pressure which causes said substrate to be drawn against the flat surface of said plate.

18. An arrangement as defined in claim 17 wherein said channels have an annular form and are disposed one within the other, said mounting device further comprising: a guide surrounding said mounting plate; compression spring means disposed between said guide and said plate and pressing against that surface of said plate which is opposite its said flat surface; and a reference ring mounted to have a bearing surface lying in the plane in which the image of said mask is formed, said substrate being disposed so that the surface thereof carrying said layer bears against said reference ring bearing surface, said substrate being urged against said bearing surface by the action of said spring means against said plate.

19. An arrangement as defined in claim 18 further comprising hermetic sealing means disposed to create a seal between said objective lens means and said reference ring, and means for filling the space enclosed by said sealing means with a protective gas.

20. An arrangement as defined in claim 1 wherein said substrate is constituted by a semiconductor wafer and said photosensitive layer is made of a photolacquer deposited on an oxide layer.

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