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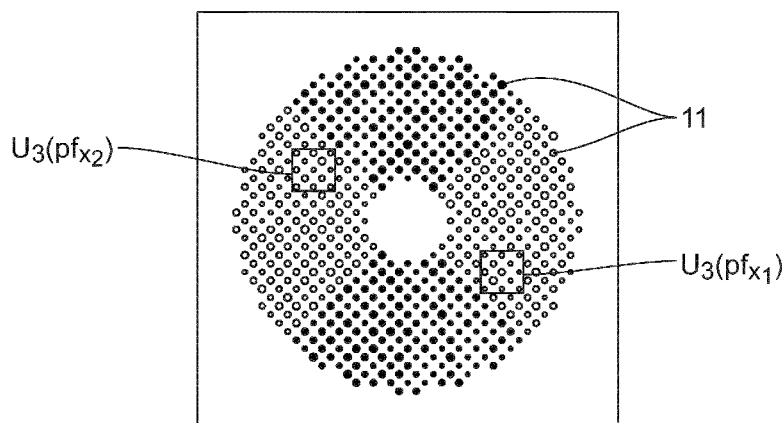


Fig. 6c

(57) Abstract: Method for designing an allocation of pupil facets (11) to field facets (7) of an illumination optics (23) for an EUV-projection exposure system (1) taking into account variations of the corresponding intensity distribution in an imaging pupil at different length scales.



Method for designing an illumination optics and illumination optics

The invention relates to a method for designing an illumination optics for an EUV-projection exposure system. The invention further relates to such
5 an illumination optics, an illumination system and an EUV-projection exposure system with such an illumination optics. Finally, the invention relates to a method for producing structured components and a structured component produced by a method of this type.

10 An illumination optics for an EUV-projection exposure system is disclosed in WO 2009/132 756 A1 and WO 2010/037 453 A1.

It is an object of the present invention to provide a method for designing an illumination optics with improved optical properties.
15

This object is achieved according to the invention by a method for designing an illumination optics according to claim 1.

One step in the process of designing such an illumination optics is the allocation of the pupil facets of a pupil facet mirror to the field facets of a field
20 facet mirror.

According to the invention, it was recognized that the allocation of the pupil facets to the field facets has an important influence on the optical properties of the illumination optics. Usually, this allocation is designed taking
25 into account a finite number of known structures to be used with the projection exposure system. However, it was recognized that such an allocation does not necessarily lead to sufficiently good imaging results for additional, in particular novel structures. According to the invention an im-

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- proved method for allocating pupil facets to field facets is provided. According to an aspect of the invention this improvement is achieved by taking into account a weighted sum of terms corresponding to intensity contributions to the illumination of the object field from at least two surroundings of different length-scales of each pupil facet. By taking into account contributions from areas of different length-scales both global properties such as telecentricity and ellipticity, and local properties of the imaging pupil are optimized.
- 5
- 10 It was recognized that due to an always existent field dependency of each field facet the design of the pupil will always have local variations, in particular local deviations from a theoretically optimal design. For example, it is for practical purposes not possible to design an imaging pupil of an illumination system to be exactly point symmetrical. However, it was recognized that it is advantageous for the optical quality of the illumination optics, to optimize the design of the pupil not only locally but taking into account local properties as well as more global properties. To give a descriptive explanation, the design is such that a locally too high intensity in the pupil is at least partly compensated by a lower intensity of the pupil in the
- 15
- 20 local surroundings. A residual error associated with a surrounding of a given length-scale is herein at least partly compensated by the next larger surrounding.

The merit-function comprises a weighted sum of terms corresponding to a total intensity of illumination radiation guided to the object field from all pupil facets within at least two, in particular at least three, in particular at least four, in particular at least five different surroundings of each pupil facet. Taking into account a larger number of surroundings leads to larger

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improvements. Taking into account a smaller number of surroundings leads to an easier optimization method.

5 The surroundings are defined as local surroundings. The smallest surrounding of each pupil facet can comprise only the pupil facet itself. Larger surroundings comprise successively larger numbers of pupil facets.

According to an aspect of the invention the surroundings of each pupil facet are defined to comprise a predefined number of pupil facets, which
10 are n nearest neighbors for the respective pupil facet.

Alternative definitions of the surroundings, in particular by way of a geometric, Euclidean distance, is also possible. In this case the surroundings can be circular.
15

According to an aspect of the invention, the merit-function takes into account properties of the imaging pupil. The merit-function can in particular take into account deviations of the imaging pupil from predefined symmetry properties. By this, the so-called overlay for a given defocus is reduced.
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According to an aspect of the invention the merit-function takes into account deviations of the imaging pupil from a flat top pupil.

According to another aspect of the invention the merit-function takes into
25 account variations of the imaging pupil due to differences between different light sources. By this the illumination optics can be optimized to be relatively independent from the light source and its properties. This makes the illumination optics more universally usable. It improves in particular

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the tolerance of the illumination optics against variations of the light source.

According to an aspect of the invention weights for the terms corresponding to contributions from different surroundings to the merit-function are
5 determined as a function of the number of pupil facets in these surroundings. By this the relative importance of local and global properties of the imaging pupil can be adjusted.

10 The weights of the merit-function can in particular be determined such, that terms corresponding to larger surroundings have allocated larger weights than those allocated to smaller surroundings. Alternatively, it is possible to weight larger surroundings successively less. The merit function can quantify an absolute deviation between the imaging pupil in a surrounding from
15 some desired imaging properties, or it can quantify a relative deviation. If an absolute deviation is employed, larger surroundings have a larger weight already intrinsically.

According to an aspect of the invention the weights for the terms corresponding to contributions from different surroundings to the merit-function
20 are determined in dependence of a given allocation of the pupil facets to the field facets. In particular, a first allocation of the pupil facets to the field facets can be chosen and weights for the terms corresponding to contributions from different surroundings to the merit-functions are determined as an inverse of an unweighted contribution of each of these terms,
25 respectively. By this differences in the variability of the intensity distribution in the pupil on different length-scales can be accounted for.

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Another object of the invention is to improve an illumination optics for an EUV-projection exposure system.

This object is achieved according to the invention by an illumination optics
5 having the features disclosed in claim 9.

The illumination optics can in particular be designed according to a method having the features described above. It has the corresponding advantages.

10 The advantages of an illumination system according to claim 10, an EUV-projection exposure system according to claim 11, a method for producing a structured component according to claim 12 and a component produced in this way according to claim 13 correspond to those described above with reference to the illumination optics and the method for designing it. The
15 light source may be an EUV light source with a wavelength of the generated radiation in the range between 5 nm and 30 nm. The projection exposure system is used for the lithographic production of a microstructured or nanostructured component.

20 Embodiments of the invention will be described in more detail below with the aid of the drawings, in which:

Fig. 1 shows a projection exposure system for microlithography, schematically and in relation to an illumination
25 optical system in meridional section;

Fig. 2 shows a plan view of a facet arrangement of a field facet mirror of the illumination optics of the projection exposure system according to Fig. 1;

- Fig. 3 shows a plan view of a facet arrangement of a pupil facet mirror of the illumination optics of the projection exposure system according to Fig. 1;
- 5 Fig. 4 shows in a view similar to Fig. 2, a facet arrangement of a further configuration of a field facet mirror;
- 10 Fig. 5 shows a schematic representation of an intensity distribution of the illumination pupil of an illumination optics, wherein to each field facet two pupil facets are allocated;
- 15 Figs. 6a to 6e show schematic representations of the imaging pupil similar to Fig. 5 with different surroundings of two point-symmetrically located pupil facets;
- 20 Figs. 7a to 7c show schematic representations of three of the surroundings depicted in Figs. 6a to 6e;
- Figs. 8a to 8c show a view similar to Figs. 7a to 7c to represent the case, wherein surroundings of four different pupil facets are taken into account for the merit-function;
- 25 Figs. 9a to 9c show exemplary diagrams to show the effect of the allocation according to the invention on the overlay as a function of defocus; and

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Figs. 10a and 10b show diagrams providing an exemplary representation of the difference of the critical dimension associated with the use of two different radiation sources depending on field points and pitch.

5

A projection exposure system 1 for microlithography is used to produce a microstructured or nanostructured electronic semiconductor structural element. A light source 2 emits EUV radiation used for illumination in the wavelength range, for example between 5 nm and 30 nm. The light source
10 2 may be a GDPP source (gas discharge produced plasma) or an LPP source (laser produced plasma). A radiation source, based on a synchrotron, can also be used for the light source 2. A person skilled in the art will, for example, find information on a light source of this type in US Patent No. 6 859 515 B2. EUV illumination light or illumination radiation 3 is
15 used for illumination and imaging within the projection exposure system 1. The EUV illumination light 3, after the light source 2, firstly runs through a collector 4, which is, for example, a nested collector with a multishell structure known from the prior art or, alternatively, an ellipsoidally formed collector. A corresponding collector is known from EP 1 225 481 A. After
20 the collector 4, the EUV illumination light 3 firstly runs through an intermediate focus plane 5, which can be used to separate the EUV illumination light 3 from undesired radiation or particle fractions. After running through the intermediate focus plane, the EUV illumination light 3 firstly impinges on a field facet mirror 6.

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To facilitate the description of positional relationships, a Cartesian global xyz-coordinates system is firstly drawn in the drawing in each case. The x-axis in Fig. 1 runs perpendicular to the drawing plane and out of it. The y-axis in Fig. 1 runs to the right. The z-axis runs upwardly in Fig. 1.

To facilitate the description of positional relationships in individual optical components of the projection exposure system 1, a Cartesian local xyz- or xy-coordinates system is also used in each case in the following Figs. The
5 respective local xy-coordinates, where nothing else is described, span a respective main arrangement plane of the optical component, for example a reflection plane. The x-axes of the global xyz-coordinates system and the local xyz- or xy-coordinates systems run parallel to one another. The re-
10 spective y-axes of the local xyz- or xy-coordinates systems have an angle to the y-axis of the global xyz-coordinates system, which corresponds to a tilt angle of the respective optical component about the x-axis.

Fig. 2 shows, by way of example, a facet arrangement of field facets 7 of the field facet mirror 6. The field facets 7 are rectangular and in each case
15 have the same x/y-aspect ratio. The x/y-aspect ratio may, for example, be 12/5, 25/4 or 104/8.

The field facets 7 specify a reflection face of the field facet mirror 6 and are grouped in four columns each with six to eight field facet groups 8a,
20 8b. The field facet groups 8a in each case have seven field facets 7. The two additional edge-side field facet groups 8b of the two central field facet columns in each case have four field facets 7. Between the two central facet columns and between the third and fourth facet rows, the facet arrangement of the field facet mirror 6 has intermediate spaces 9, in which
25 the field facet mirror 6 is shaded by holding spokes of the collector 4.

After reflection on the field facet mirror 6, the EUV illumination light 3 divided into beam pencils or part bundles, which are assigned to the individual field facets 7, impinges on a pupil facet mirror 10.

Fig. 3 shows an exemplary facet arrangement of round pupil facets 11 of the pupil facet mirror 10. The pupil facets 11 are arranged around a centre in facet rings lying within one another. At least one pupil facet 11 is assigned to each part bundle of the EUV illumination light 3 reflected by one of the field facets 7 in such a way that, in each case, one facet pair that is impinged on with one of the field facets 7 and one of the pupil facets 11 specifies an object field illumination channel for the associated part bundle of the EUV illumination light 3. The channel-wise assignment of the pupil facets 11 to the field facets 7 takes place depending on a desired illumination by the projection exposure system 1.

The field facets 7 are imaged in an object plane 16 of the projection exposure system 1 via the pupil facet mirror 10 (cf Fig. 1) and a following transmission optical system 15 consisting of three EUV mirrors 12, 13, 14. The EUV mirror 14 is configured as a grazing incidence mirror. Arranged in the object plane 16 is a reticle 17, by which an illumination region in the form of an illumination field is illuminated with the EUV illumination light 3, the illumination field coinciding with an object field 18 of a downstream projection optical system 19 of the projection exposure system 1. The object field illumination channels are overlaid in the object field 18. The EUV illumination light 3 is reflected by the reticle 17.

The projection optical system 19 images the object field 18 in the object plane 16 in an image field 20 in an image plane 21. Arranged in this image plane 21 is a wafer 22, which carries a light-sensitive layer, which is exposed during the projection exposure with the projection exposure system 1. During the projection exposure, both the reticle 17 and the wafer 22 are scanned in a synchronized manner in the y-direction. The projection expo-

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sure system 1 is configured as a scanner. The scanning direction is also called the object displacement direction below.

For the projection exposure the reticle 17 and the wafer 22, which carries a
5 coating that is light-sensitive to the EUV illumination light 3, is provided.
At least one portion of the reticle 17 is then projected onto the wafer 22
with the aid of the projection exposure system 1. Finally, the light-sensitive
layer exposed with the EUV illumination light 3 is developed on the wafer
22. In this manner, a microstructured or nanostructured component, for
10 example a semiconductor chip, is produced.

The field facet mirror 6, the pupil facet mirror 10 and the mirrors 12 to 14
of the transmission optical system 15 are components of an illumination
optical system 23 of the projection exposure system 1. Together with the
15 light source 2, the illumination optical system 23 forms an illumination
system of the projection exposure system 1.

The field facet mirror 6 is a first facet mirror of the illumination optical
system 23. The field facets 7 are first facets of the illumination optical sys-
20 tem 23.

The pupil facet mirror 10 is a second facet mirror of the illumination opti-
cal system 23. The pupil facets 11 are second facets of the illumination op-
tical system 23.

25

Fig. 4 shows a further configuration of a field facet mirror 6. Components
which correspond to those which were described above with reference to
the field facet mirror 6 according to Fig. 2, have the same reference numer-
als and will only be described inasmuch as they differ from the components

of the field facet mirror 6 according to Fig. 2. The field facet mirror 6 according to Fig. 4 has a field facet arrangement with curved field facets 7. These field facets 7 are arranged in a total of five columns each with a plurality of field facet groups 8. The field facet arrangement is written into a
5 circular limitation of a carrier plate 24 of the field facet mirror.

The field facets 7 of the embodiment according to Fig. 4 all have the same area and the same ratio of width in the x-direction and height in the y-direction, which corresponds to the x/y aspect ratio of the field facets 7 of
10 the configuration according to Fig. 2.

Precisely two of the pupil facets 11 of the pupil facet mirror 10 are assigned to each of the field facets 7 of the respective configuration of the field facet mirror 6 by way of an object field illumination channel, in each
15 case. The pupil facet mirror 10 thus has twice as many pupil facets 11 as the field facet mirror 6 has field facets 7.

Depending on the configuration of a mechanical tilting ability of the field facets 7, more than two of the pupil facets 11 of the pupil facet mirror 10
20 may be assigned to one of the field facets 7 by way of respective object field illumination channels. The field facets 7 can then be displaced into a corresponding number of illumination tilting positions.

In the following a method for designing the illumination optical system 23,
25 which is also called an illumination optics, is described. The main step for designing the illumination optics 23 is the choosing of an allocation of the pupil facets 11 to the field facets 7 to form a plurality of illumination channels for illumination of the object field 18. The allocation is such, that at least one of the pupil facets 11 is allocated to each of the field facets 7. In

case of tiltable field facets 7 there may be two or more pupil facets 11 allocated to each of the field facets 7. In particular, the number of pupil facets 11 allocated to each of the field facets 7 corresponds to the number of tilt positions of the field facets 7.

5

Each illumination channel leads to a certain intensity contribution of the illumination of the object field 18. For illustrative purposes the intensity contribution of the illumination channels associated with the different pupil facets 11 is schematically shown in Fig. 5. Here, the differences in intensity in an imaging pupil are schematically represented by different sizes of the symbols. The location of the symbols represents the location of the pupil facets 11. Furthermore, the open symbols correspond to an allocation of a first subset of the pupil facets 11 to the field facets 7 in a first tilting position, whereas the filled symbols correspond to an allocation of a second subset of the pupil facets 11 to the field facets 7 in a second tilting position.

15

The method according to the invention is similarly applicable to illumination optical systems 23 with field facets 7, which are not tiltable or which have more than two tilting positions.

20

As represented schematically in Fig. 5 each field facet 7 leads to a illumination channel with a certain intensity contribution of the illumination of the object field 18. The different illumination channels can in particular have different intensity contributions, in particular different intensity distributions of the illumination of the object field 18.

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According to the invention a merit-function is defined to assign an assessment value to the chosen allocation of the pupil facets 11 to the field facets 7. Details of the merit-function will be described below.

Furthermore, a target for a value of the merit-function is defined.

For each pupil facet (pf) 11 a number l of at least two surroundings $U_l(pf)$ are defined. An exemplary representation of different surroundings $U_l(pf)$, $1 \leq l \leq 5$ is depicted in Figs. 6a to 6e. In Figs. 6a to 6e the surroundings U of a first pupil facet at a first location x_1 , pf_{x1} , and a second pupil facet pf_{x2} located at a second location x_2 point-symmetrically to the first location x_1 of the first pupil facet pf_{x1} are shown.

10

The surroundings $U_l(pf_i)$ of each pupil facet 11 are defined to comprise a predefined number $n(l)$ of pupil facets 11, which are n nearest neighbors for the respective pupil facet 11.

15 Alternatively, the surrounding can be defined geometrically, in particular to include all pupil facets 11 within a predefined Euclidean distance of a certain pupil facet 11.

20 The surroundings can comprise pupil facets 11 which correspond to different tilting positions of the field facets 7. This allows to find an allocation that will yield good performance of the illumination system for all possible tilting positions of the field facets 7.

25 Defining the surroundings U by way of the n nearest neighbors leads to more or less square surroundings corresponding to the arrangement of the pupil facets 11 in a square grid on the pupil facet mirror 10.

Defining the surroundings U by geometric, Euclidean distances will lead to round, in particular circular surroundings.

The assessment of the allocation of the pupil facets 11 to the field facets 7 is done with help of a merit-function, which comprises a weighted sum of terms corresponding to a total intensity $I_l^{pf}(x)$ of illumination radiation 3 guided to the object field 18 from all pupil facets 11 within surroundings $U_l(pf)$ of different length-scale l of each pupil facet 11. Herein $I_l^{pf}(x)$ denotes the scan-integrated total intensity of the illumination radiation 3 from all illumination channels associated with pupil facets (pf) 11 within the surrounding $U_l(pf)$ at the field point x in the object field 18.

10

The merit-function can be written as

$$\int \sum_{l=1}^M g_l \sum_{pf=1}^N f[\{I_l^{(pf)}(x)\}] dx$$

Here, the criterion f can take different functional shapes, as outlined below. Thus, according to the invention, the merit-function assesses the criterion f for different length-scales, which are denoted by the parameter l . In addition, the assessment takes into account each pupil facet 11 and each field point x similarly.

20

The terms corresponding to contributions from different surroundings U to the merit-function are weighted by weights g_l . These weights are determined as function of the number of pupil facets 11 in the respective surroundings U_l . In particular, the weights g_l of the merit-function are determined such, that term corresponding to larger surroundings U_{l2} have allocated larger weights than those allocated to smaller surroundings U_{l1} .

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Possible values for the weights g_l can be determined as follows: Given a first allocation of the pupil facets 11 to the field facets 7 for each length-scale l a value of the merit-function is determined, including summation over the different pupil facets pf and integration over the object field, i.e. x ,
 5 the weight g_l is then determined as the inverse value of this.

It is also possible to start with a random allocation of pupil facets 11 to the field facets 7, determine a first, preliminary value for the weights g_l as described above, perform a first optimization of the allocation and determine
 10 the value of the weights g_l after such an optimization as above. Thus, the weights g_l can be determined by an iterative process. This can in principle be repeated several times.

For the criterion f in the merit-function different functional forms are possible. The explicit functional form of the criterion f depends on the choice,
 15 which parameters of the imaging pupil are to be taken into account by the merit-function.

The merit-function can take into account deviations of the imaging pupil
 20 from predefined symmetry properties. In this case, the criterion f can have the following functional form:

$$f(pf, l, x) = \left\| \frac{I_l^{(pf)}(x) - I_l^{q[pf]}(x)}{I_l^{(pf)}(x) + I_l^{q[pf]}(x)} \right\|^4$$

25 In this formula $q[pf]$ denotes the pupil facet 11, which is located point-symmetrically to the pupil facet pf (see Figs. 6a to 6e and Figs. 7a to 7c). Herein, the bars $\| \cdot \|$ can denote the absolute value of the term in between.

Instead of the exponent 4, the exponent 2 or other even exponents can be used. With such a definition of the merit-function different allocations of the pupil facets 11 to the field facets 7 will have assigned different assessment values. According to the invention the allocation of the pupil facets 11 to the field facets 7 is optimized, until the value of the merit-function falls within a predefined target. For the optimization of the allocation different algorithms may be used. In particular, the allocation of the pupil facets 11 to the field facets 7 can be permuted cyclically. Alternative optimization algorithms are possible. In general, every possible allocation can be generated by applying a suitable permutation, the length of the permutation being equal to the number of field facets 7. Optimization thus means finding the best or at least a good permutation. The optimization algorithm will frequently converge much faster if shorter permutation cycles are used, i.e., the allocation of only a small subset of the field facets 7 is permuted at once. The number of elements of such a subset can itself be a random number that is larger or equal to 2 but much smaller than the number of field facets 7. It is also possible to apply several such permutations before the value of the merit-function is evaluated.

20

The merit-function can also take into account deviations of an imaging pupil from a flat top pupil. This is a special case of trying to minimize the difference between two light sources so we refer to the description on the latter subject which will be given next.

25

Alternatively, the merit-function can take into account variations of an imaging pupil due to differences between different light sources. In this case the criterion f can have the following functional form:

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$$f(I_l^{\text{pf}}(x)) = \|I_l^{(\text{pf}), \text{LS1}}(x) - I_l^{(\text{pf}), \text{LS2}}(x)\|^4$$

Herein, LS1 denotes a first light source 2, LS2 denotes a second light source 2. For example, the first light source may be a so-called GDPP-EUV-source and the second light source may be a LPP-EUV-source. Such light sources lead to a different far field illumination and thus lead to differences in the pupil associated with a given allocation of pupil facets 11 to field facets 7. The principle of the optimization taking into account surroundings of different length-scales is the same as described above.

Effects of the improved design of the illumination optics 23 on imaging properties are exemplarily depicted in Figs. 9a to 9c and Figs. 10a and 10b.

Fig. 9a shows the value of the overlay for different values of a defocus with a standard allocation of the pupil facets 11 to the field facets 7 (open symbols) and with an allocation to the invention (hatched symbols). The different symbols for one value of the defocus correspond to different field points x . Fig. 9a shows the case for a structure with a pitch of 16 nm and a y-dipole-illumination. Fig. 9b shows the corresponding result for an x-dipole-illumination. Fig. 9c shows the result for an annular illumination setting. The figures show a marked improvement due to the design of the illumination optics according to the invention.

Similarly, Fig. 10a shows the difference of the critical dimension, ΔCD between the use of an LPP-EUV-source and a GDPP-EUV-source in dependence of the field points x and the pitch for a standard allocation of the pupil facets 11 to the field facets 7. Fig. 10b shows the corresponding result for an allocation according to the invention. As can be seen, the allocation

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according to the invention leads to a marked improvement. Thus, with the allocation according to the invention, a masked designed for use with an LPP-source could be used, even if this source is exchanged by a GDPP-source.

Claims

1. A method for designing an illumination optics (23) for an EUV-projection exposure system (1) comprising the following steps:
 - 5 a. providing an illumination optics (23) with
 - i. a field facet mirror (6) with a plurality of field facets (7) and
 - ii. a pupil facet mirror (10) with a plurality of pupil facets (11),
 - b. choosing an allocation of at least one of the pupil facets (11) to each of the field facets (7) to form a plurality of illumination chan-
 - 10 nels for illumination of an object field (18) with illumination radiation (3),
 - c. wherein each illumination channel leads to a certain intensity contribution of the illumination of the object field (18),
 - d. defining a merit-function to assign an assessment value to the cho-
 - 15 sen allocation,
 - e. defining a target for a value of the merit-function,
 - f. defining for each pupil facet (11) a number (l) of at least two surroundings ($U_l(pf)$) of different length-scales,
 - g. wherein the merit-function comprises a weighted sum of terms cor-
 - 20 responding to a total intensity (I) of illumination radiation (3) guided to the object field (18) from all pupil facets (11) within the different surroundings ($U_l(pf)$) of each pupil facet (11),
 - h. optimizing the allocation such, that the value of the merit-function falls within the target.
 - 25
2. A method according to claim 1, wherein the surroundings ($U_l(pf)$) of each pupil facet (11) are defined to comprise a predefined number ($n(l)$) of pupil facets (11), which are n nearest neighbors for the respective pupil facet (11).

3. A method according to one of the preceding claims, wherein the merit-function takes into account deviations of an imaging pupil from predefined symmetry properties.
- 5 4. A method according to one of the preceding claims, wherein the merit-function takes into account deviations of an imaging pupil from a flat-top pupil.
- 10 5. A method according to one of the preceding claims, wherein the merit-function takes into account variations due to differences between different light sources.
- 15 6. A method according to one of the preceding claims, wherein weights for the terms corresponding to contributions from different surroundings to the merit-function are determined as a function of the number of pupil facets (11) in these surroundings.
- 20 7. A method according to one of the preceding claims, wherein weights of the merit-function are determined such that terms corresponding to larger surroundings have allocated larger weights than those allocated to smaller surroundings
- 25 8. A method according to one of claim 1 to 6, wherein a first allocation of the pupil facets (11) to the field facets (7) is chosen and weights for the terms corresponding to contributions from different surroundings to the merit-function are determined as an inverse of an unweighted contribution of each of these terms, respectively.

9. An illumination optics (23) for an EUV-projection exposure system (1) comprising
- a. a field facet mirror (6) with a plurality of field facets (7) and
 - b. a pupil facet mirror (10) with a plurality of pupil facets (11),
 - 5 c. wherein an allocation of at least one of the pupil facets (11) to each of the field facets (7) is provided to form a plurality of illumination channels for illumination of an object field (18) with illumination radiation (3),
 - i. wherein each illumination channel leads to a certain intensity
 - 10 contribution of the illumination of the object field (18),
 - d. wherein the allocation of the pupil facets (22) to the field facets (7) is such, that a merit-function comprising a weighted sum of terms corresponding to a total intensity (I) of illumination radiation (3) guided to the object field (18) from all pupil facets (11) within at
 - 15 least two different surroundings ($U_i(pf)$) of each pupil facet (11) has a value, which falls within a predefined target.
10. An illumination system for an EUV-projection exposure system (1) comprising
- 20 a. an illumination optics (23) according to any of claims 1 to 8 and
 - b. an illumination source (2) for generation of illumination radiation (3).
11. An EUV-projection exposure system (1) comprising
- 25 a. an illumination optics (23) according to any of claims 1 to 8 and
 - b. an imaging optics (19) to image an object field (18) into an image field (20).

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12. A method for production of microstructured components comprising the following steps:
- providing a wafer (22), on which a layer of a light-sensitive material is at least partially applied,
 - 5 - providing a reticle (17), which has structures to be imaged,
 - providing an EUV-projection exposure system (1) according to claim 11,
 - projecting at least a part of the reticle (17) onto a region of the layer of the wafer (22) with the aid of the EUV-projection
 - 10 exposure system (1).
13. A microstructured component produced by a method according to claim 12.

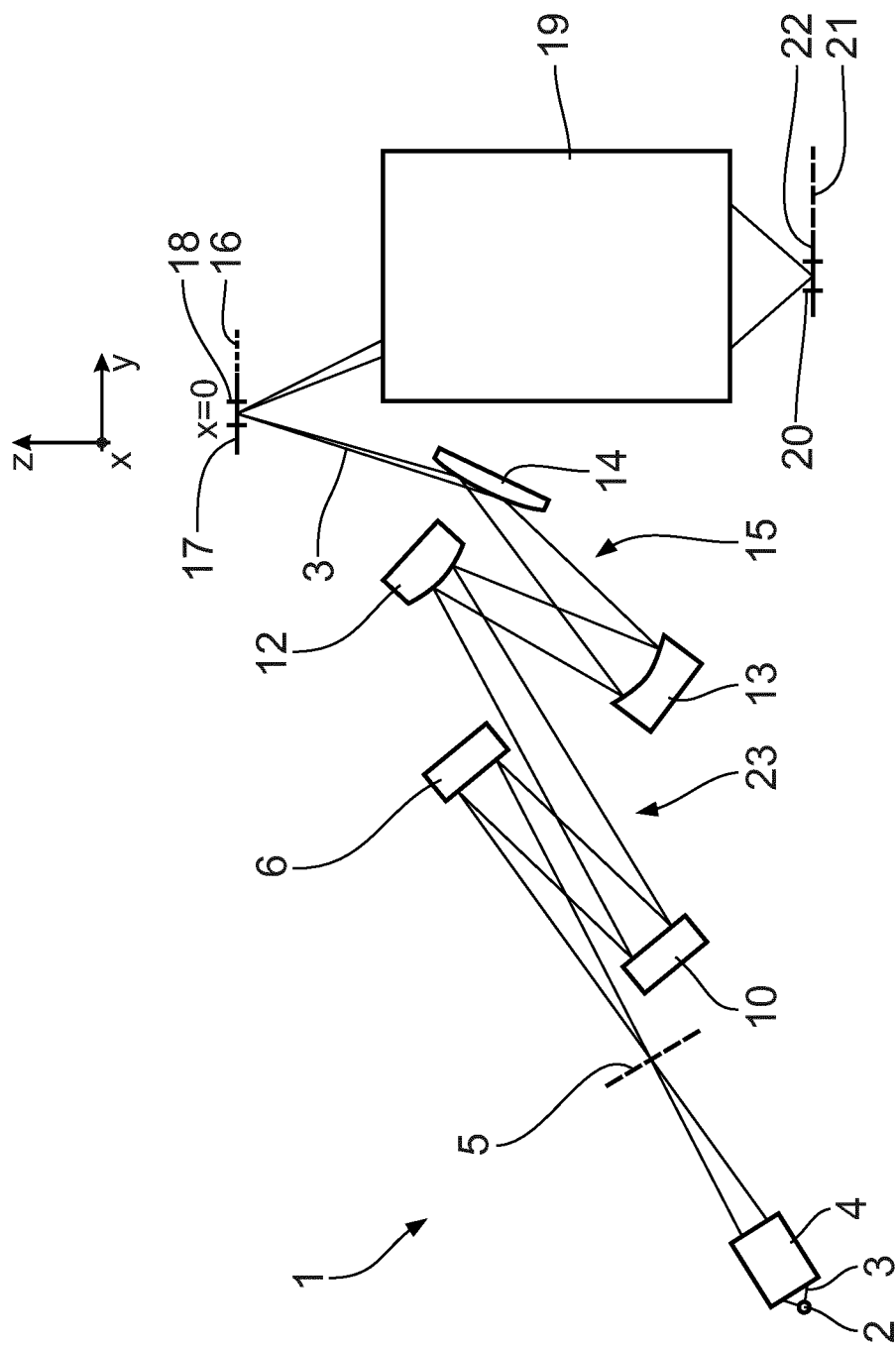


Fig. 1

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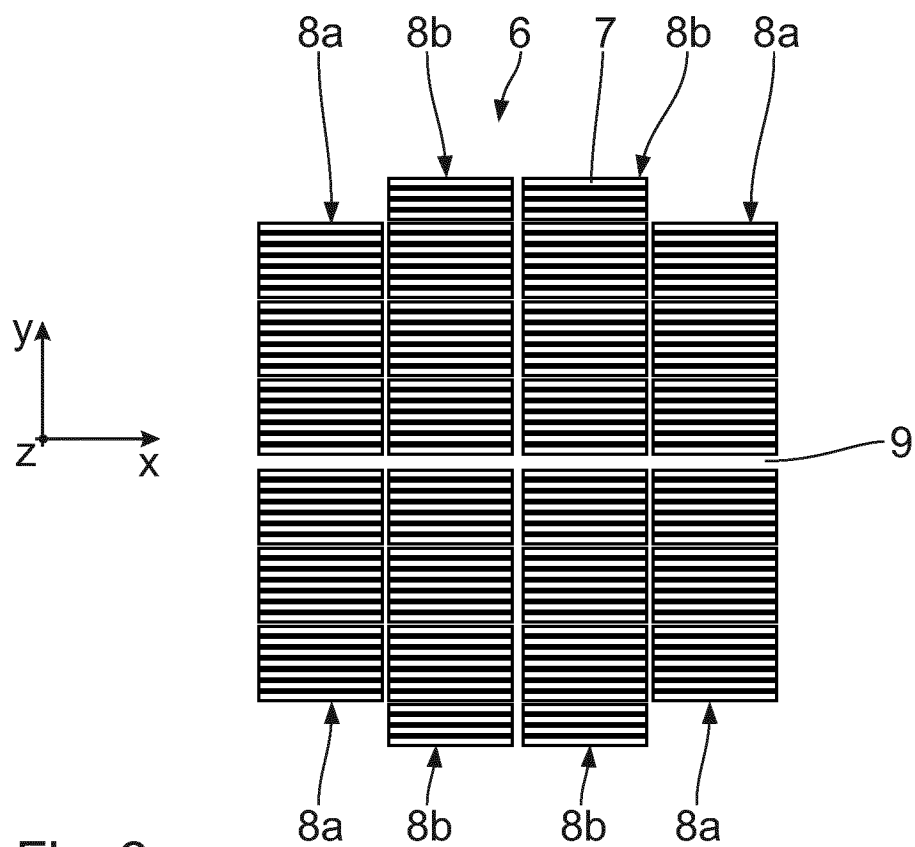


Fig. 2

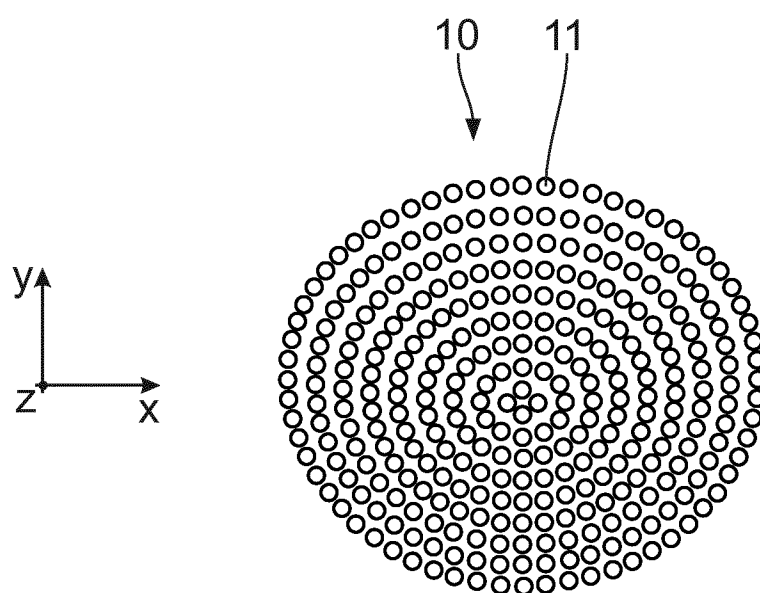


Fig. 3

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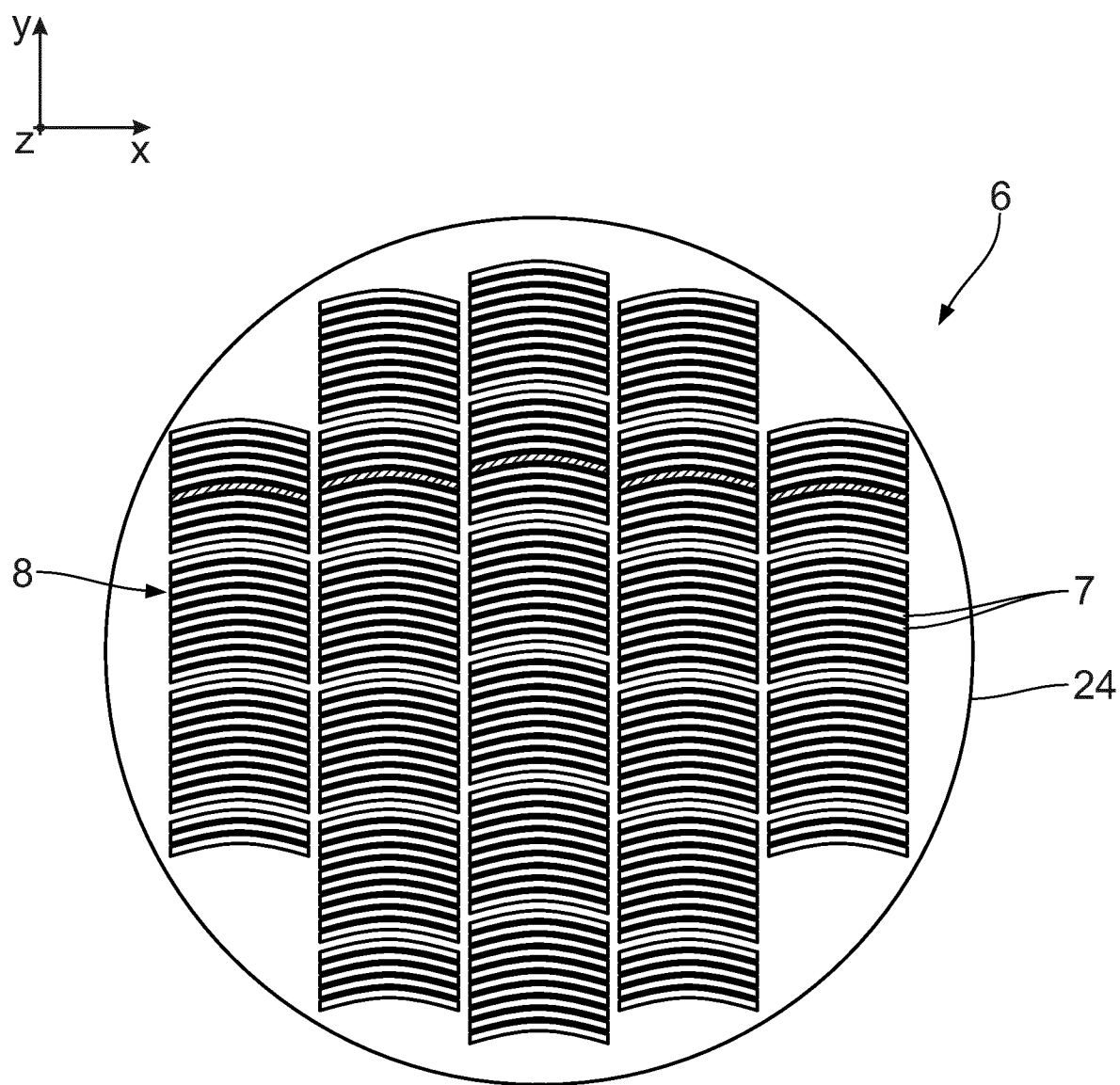


Fig. 4

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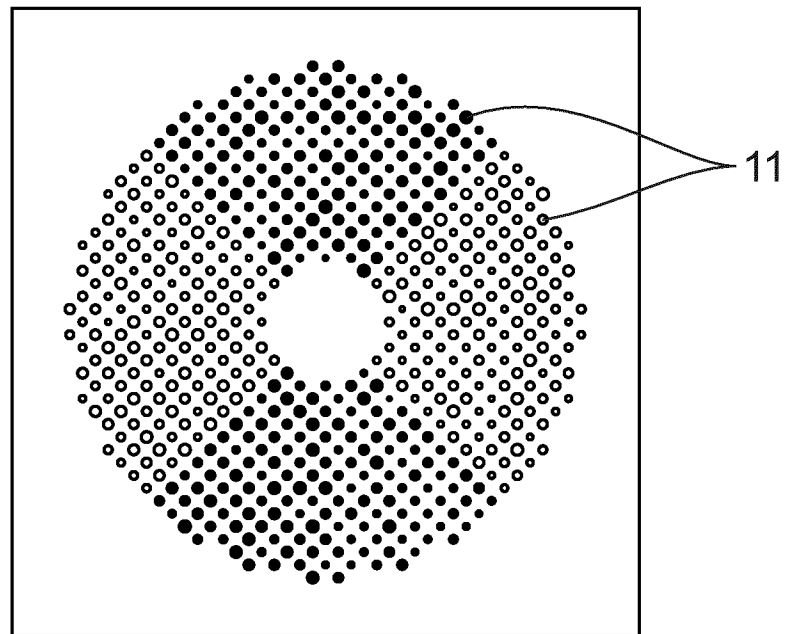


Fig. 5

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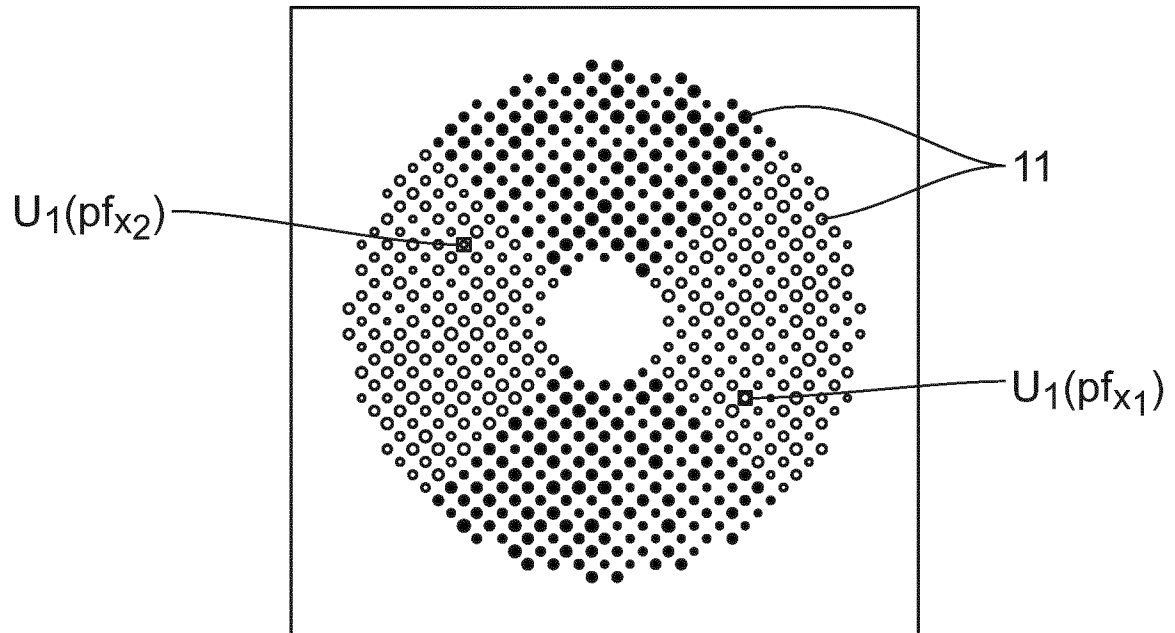


Fig. 6a

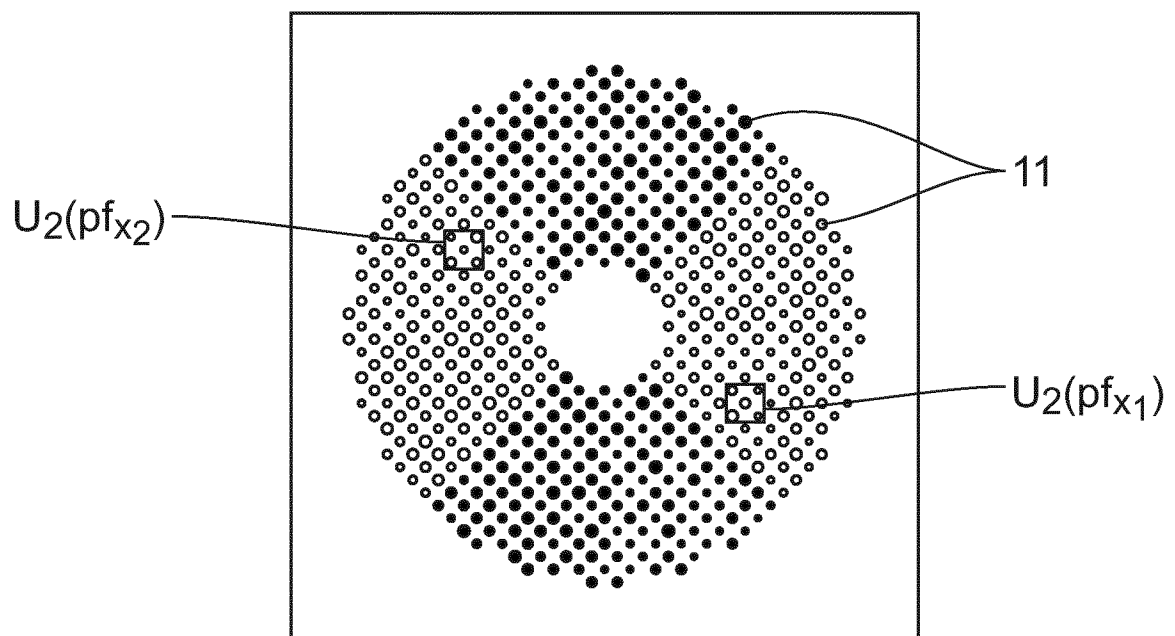


Fig. 6b

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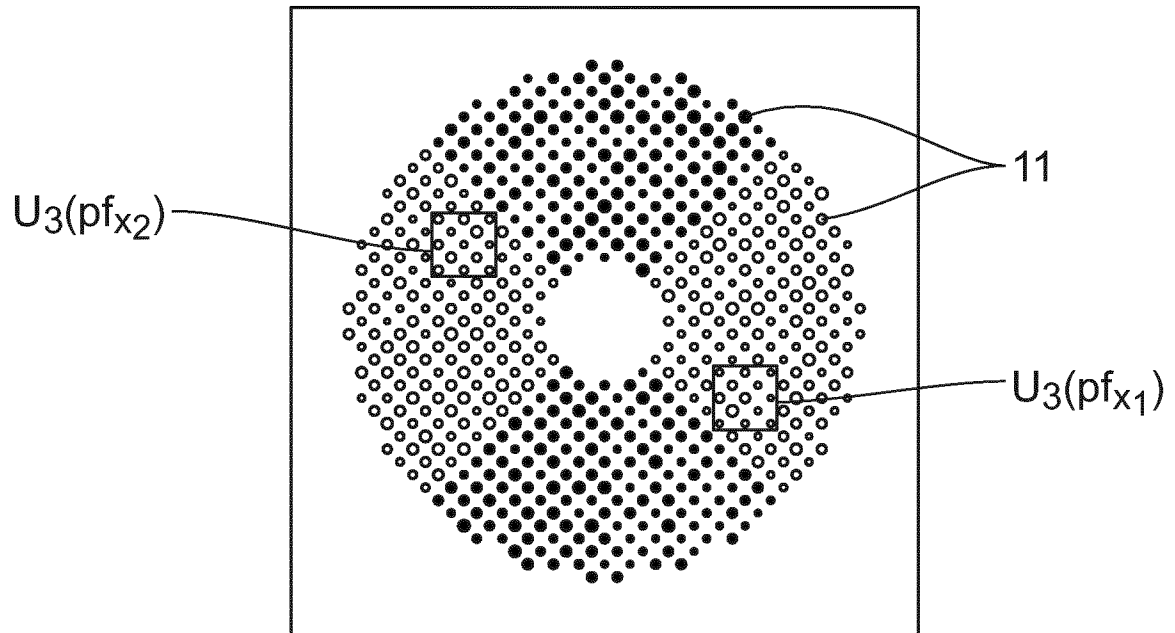


Fig. 6c

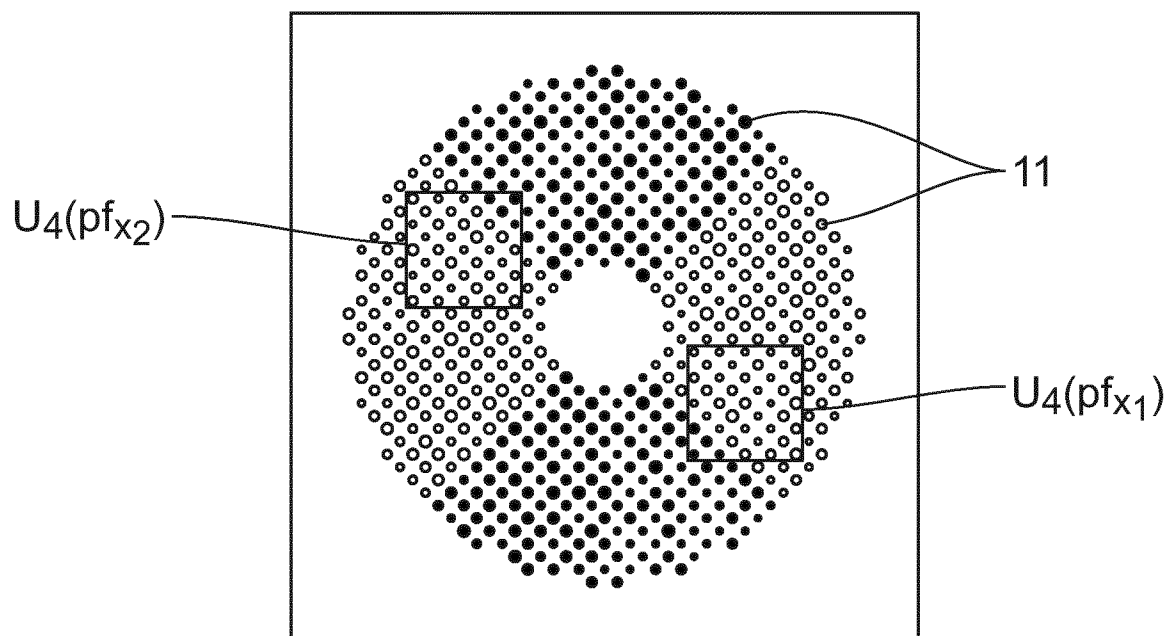


Fig. 6d

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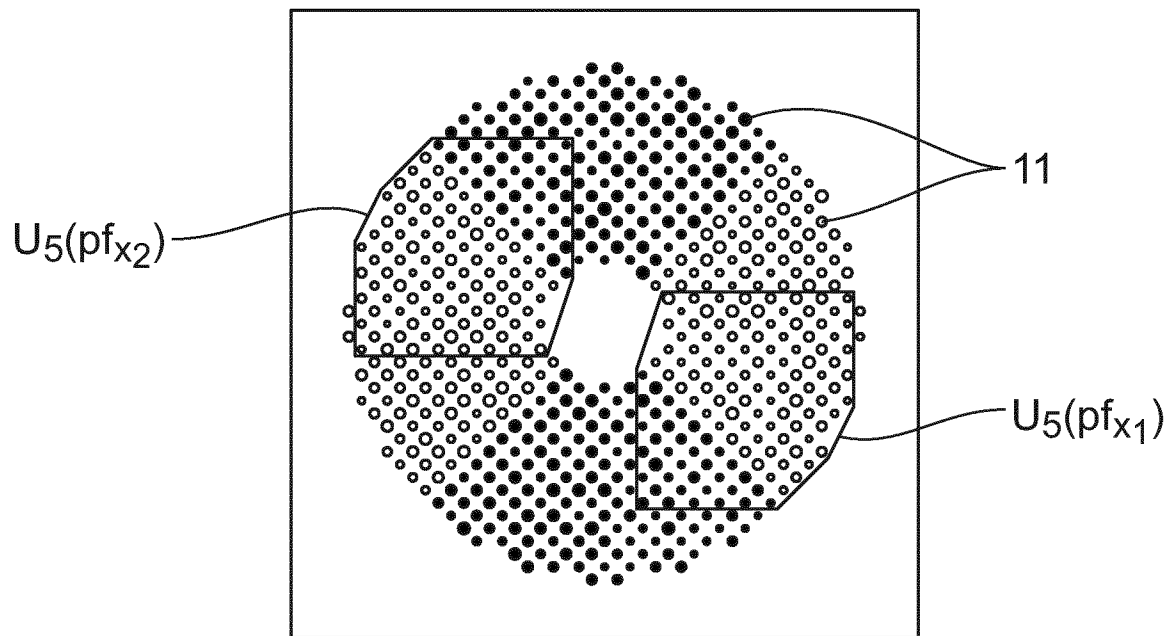


Fig. 6e

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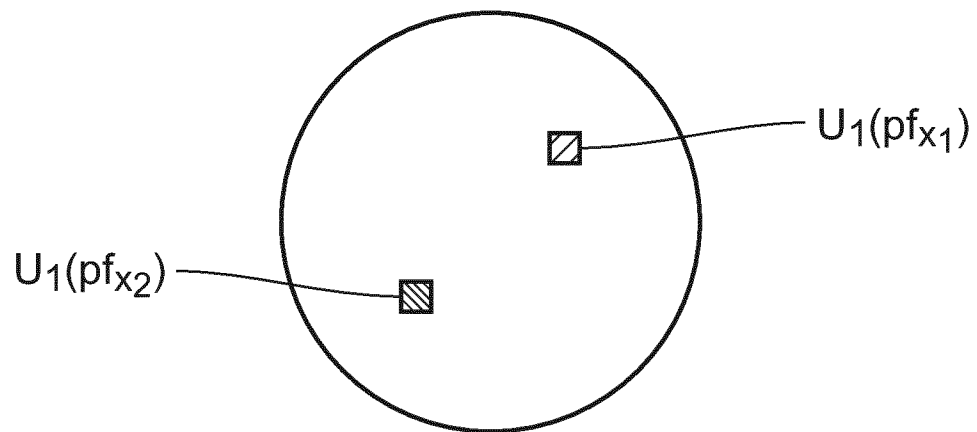


Fig. 7a

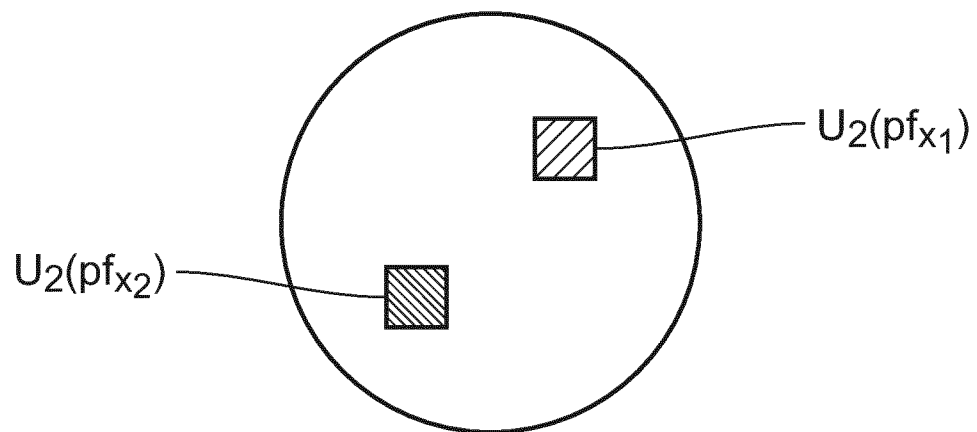


Fig. 7b

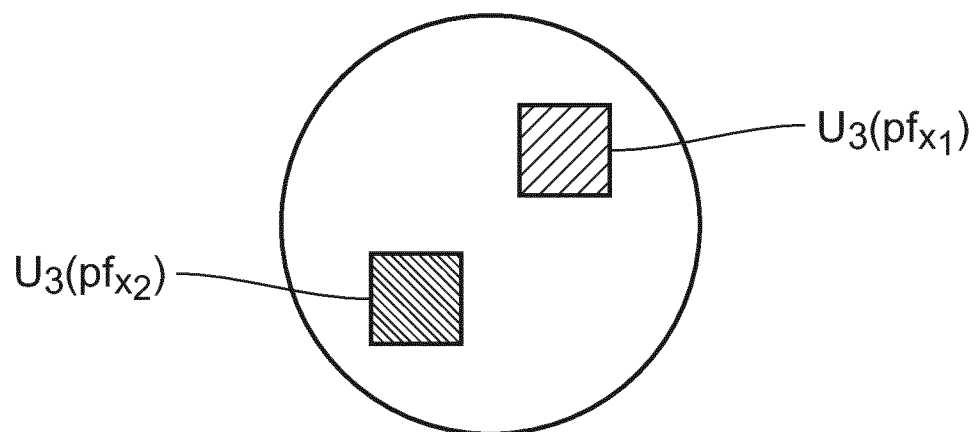


Fig. 7c

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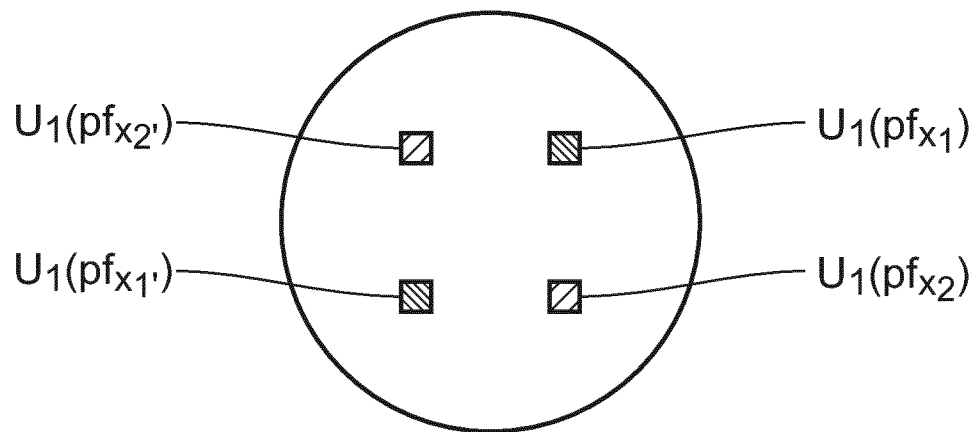


Fig. 8a

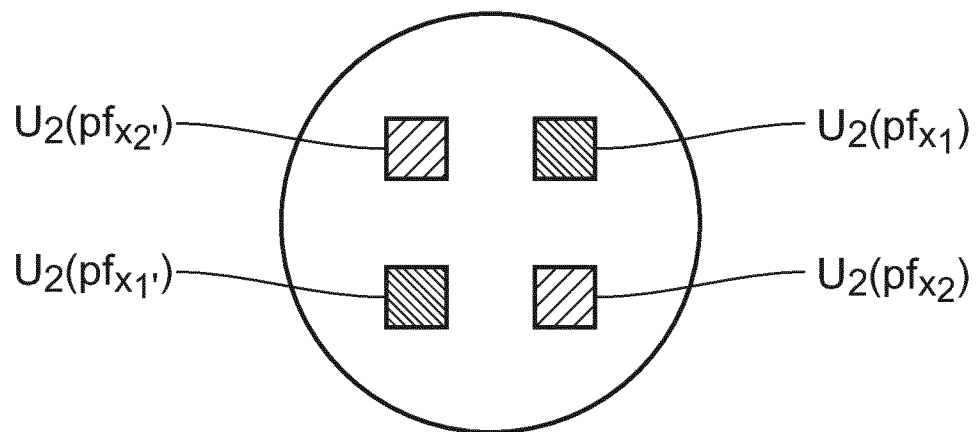


Fig. 8b

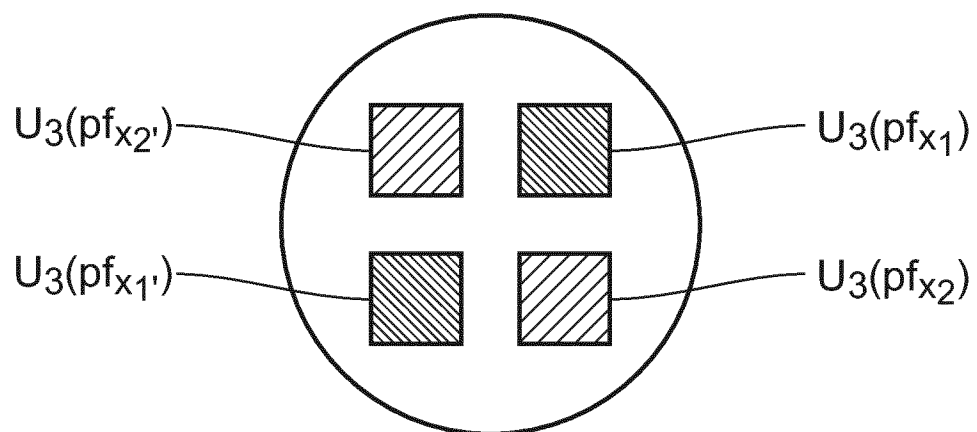


Fig. 8c

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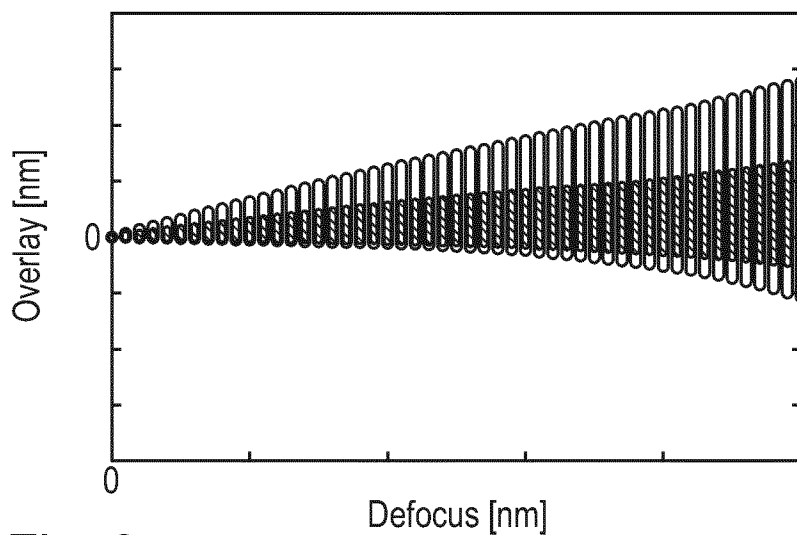


Fig. 9a

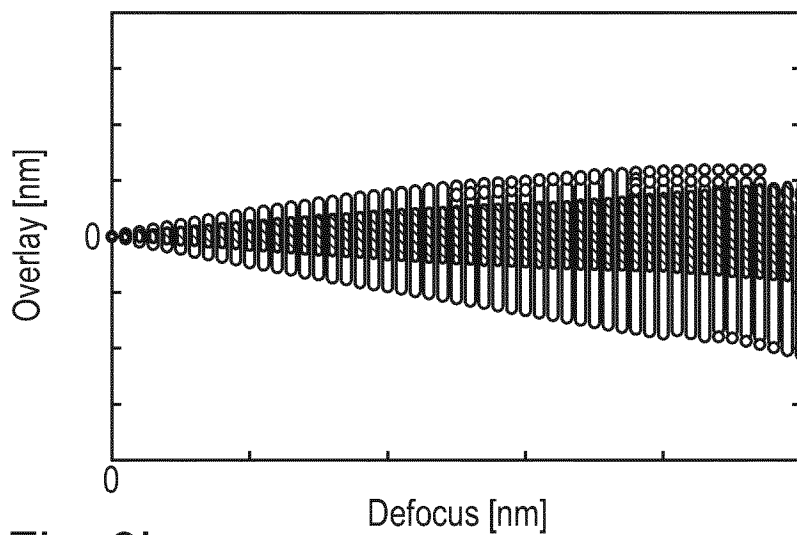


Fig. 9b

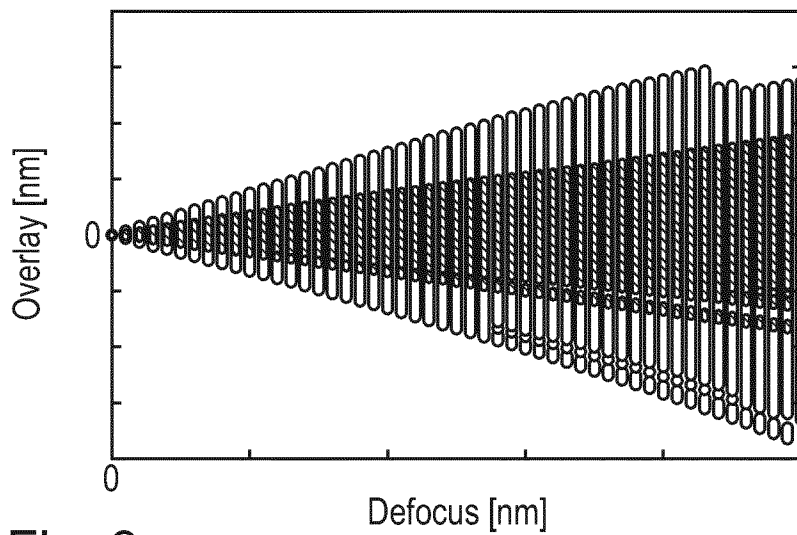


Fig. 9c

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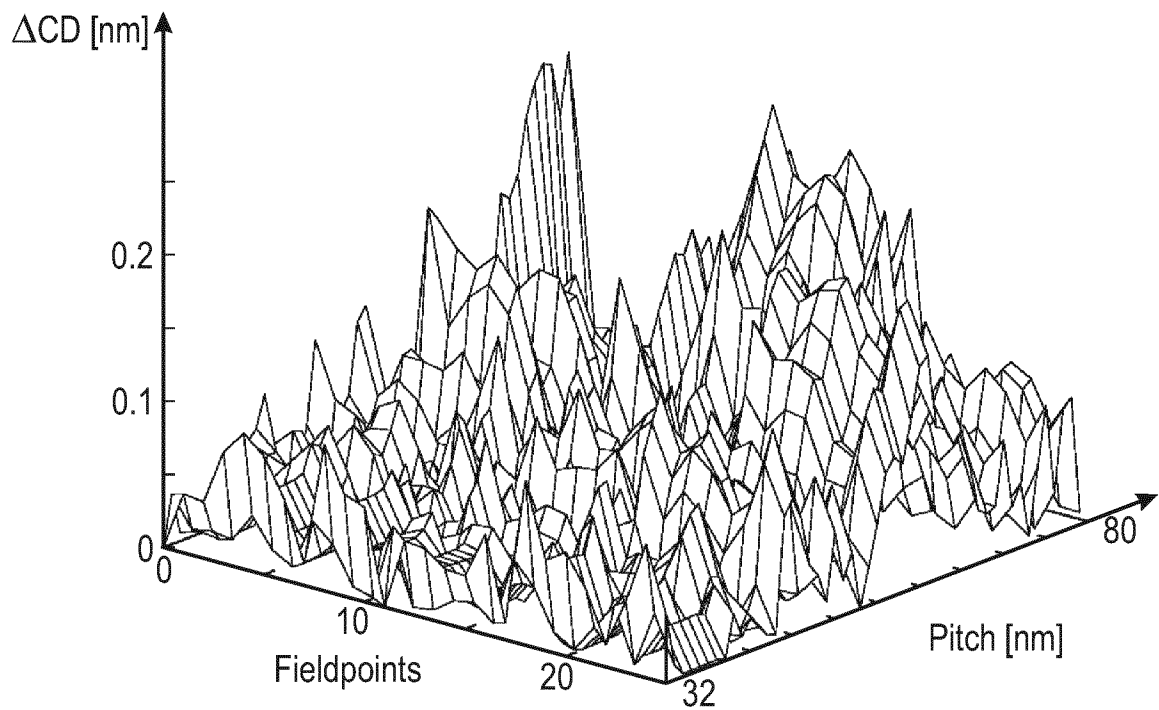


Fig. 10a

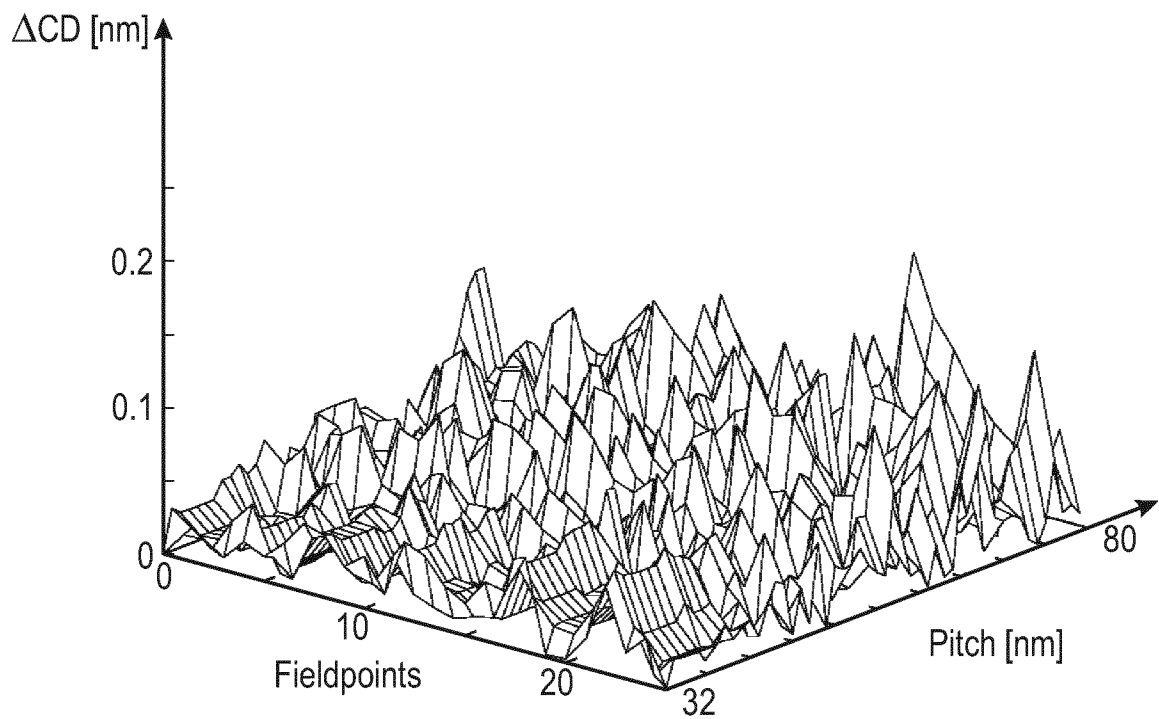


Fig. 10b

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/062254

A. CLASSIFICATION OF SUBJECT MATTER
INV. G03F7/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G03F G02B H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/060975 A1 (ASML NETHERLANDS BV [NL]; VAN SCHOOT JAN [NL]; VAN INGEN SCHENAU KOEN) 26 May 2011 (2011-05-26)	13
A	paragraphs [0060] - [0064]; figures 2, 4, 6, 7	1-12
A	----- WO 2011/154244 A1 (ZEISS CARL SMT GMBH [DE]; PATRA MICHAEL [DE]; DITTMANN OLAF [DE]; KIRC) 15 December 2011 (2011-12-15)	1-13
	page 16, line 11 - page 19, line 18; claims 1, 4; figures 1, 4, 5	
A	----- US 2012/134016 A1 (FELDMANN HEIKO [DE] ET AL) 31 May 2012 (2012-05-31)	1-13
	paragraph [0002]; claim 1 -----	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

21 March 2013

Date of mailing of the international search report

05/04/2013

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Eisner, Klaus

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/062254

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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WO 2011154244 A1	15-12-2011	DE 102010029765 A1 TW 201214064 A WO 2011154244 A1	08-12-2011 01-04-2012 15-12-2011
US 2012134016 A1	31-05-2012	EP 1927890 A1 US 2009207487 A1 US 2012134016 A1 WO 2008064845 A1	04-06-2008 20-08-2009 31-05-2012 05-06-2008