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(54) Title: LITHOGRAPHIC APPARATUS AND DEVICE MANUFACTURING METHOD

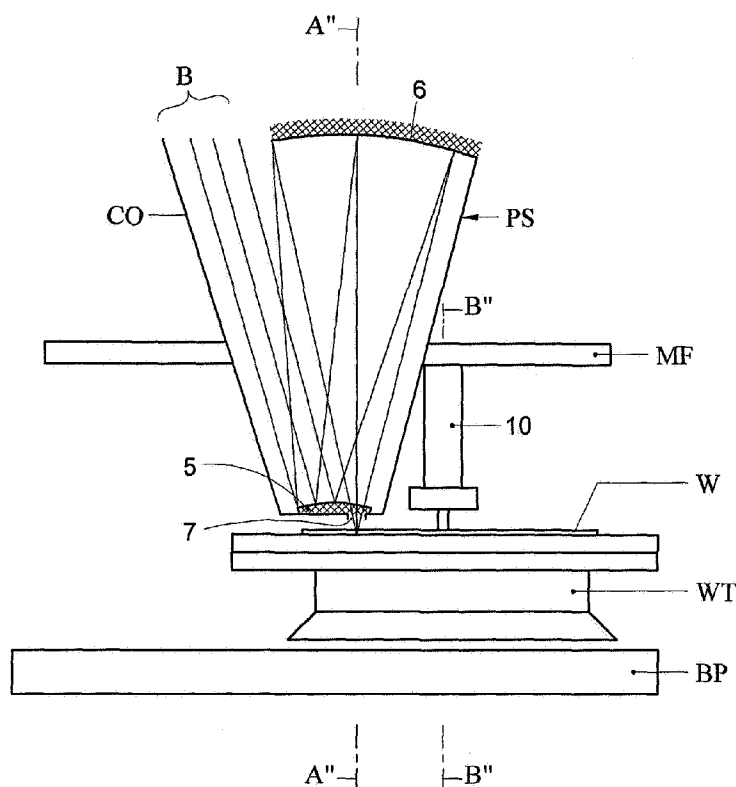


Fig. 2

(57) Abstract: A lithographic apparatus comprising: an illumination system configured to condition a radiation beam; a support constructed to support a patterning device, the patterning device being capable of imparting the radiation beam with a pattern in its cross-section to form a patterned radiation beam; a substrate table constructed to hold a substrate W; a projection system PS configured to project the patterned radiation beam in an exposure slit at the focal plane on a target portion of the substrate W, wherein the projection system is provided with an optical element close to the exposure slit, and the apparatus further comprises a levelling system 10 for measuring a height of the substrate W on a position away from the exposure slit and a controller for controlling a position of the substrate table WT so that the substrate is in the focal plane of the projection system PS at the exposure slit.



Published:

— *with international search report*

Lithographic Apparatus and Device Manufacturing Method

Field

The present invention relates to a lithographic apparatus and a method for manufacturing a device. The lithographic apparatus comprising:
an illumination system configured to condition a radiation beam;
a support constructed to support a patterning device, the patterning device being capable of imparting the radiation beam with a pattern in its cross-section to form a patterned radiation beam; and,
a substrate table constructed to hold a substrate.

Background

A lithographic apparatus is a machine that applies a desired pattern onto a substrate, usually onto a target portion of the substrate. A lithographic apparatus can be used, for example, in the manufacture of integrated circuits (ICs). In that instance, a patterning device, which is alternatively referred to as a mask or a reticle, may be used to generate a circuit pattern to be formed on an individual layer of the IC. This pattern can be transferred onto a target portion (e.g. comprising part of, one, or several dies) on a substrate (e.g. a silicon wafer). Transfer of the pattern is typically via a projection system that images the pattern in an optical slit onto a layer of radiation-sensitive material (resist) provided on the substrate. In general, a single substrate will contain a network of adjacent target portions that are successively patterned. Known lithographic apparatus include so-called steppers, in which each target portion is irradiated by exposing an entire pattern onto the target portion at one time, and so-called scanners, in which each target portion is irradiated by scanning the pattern through a radiation beam in a given direction (the "scanning"-direction) while synchronously scanning the substrate through the optical slit parallel or anti-parallel to this direction.

To be able to project patterns with a smaller feature size it may be advantageous to use radiation with a smaller wavelength. For example, one can use extreme ultraviolet radiation with a wavelength of approximately 13 nm instead of radiation with a wavelength of 193, 248 or 365 nm to project smaller features. A projection system capable of projecting radiation with a wavelength of 13 nm need to be provided with reflective optical elements such as reflective multilayer mirrors and

should be provided in a vacuum environment. In general such projection systems will have an optical element that is provided very close to the exposure slit at the focal plane on a target portion of the substrate which limits the space that is available around the exposure slit. This may be troublesome for the leveling system that is needed to bring the substrate surface into the focal plane of the projection system. There may not be enough space underneath the projection system to locate the levelling system to measure the height of the substrate underneath the projection system at the exposure slit.

SUMMARY

It is desirable to provide a lithographic projection apparatus that has a levelling system and a projection system configured to project the patterned radiation beam in an exposure slit at the focal plane on a target portion of the substrate.

According to an aspect of the invention, there is provided a lithographic apparatus comprising:
an illumination system configured to condition a radiation beam;
a support constructed to support a patterning device, the patterning device being capable of imparting the radiation beam with a pattern in its cross-section to form a patterned radiation beam;
a substrate table constructed to hold a substrate;
a projection system configured to project the patterned radiation beam in an exposure slit at the focal plane on a target portion of the substrate, wherein the projection system is provided with an optical element close to the exposure slit, and the apparatus further comprises a levelling system for measuring a height of the substrate on a position away from the exposure slit and a controller for controlling a position of the substrate table so that the substrate is in the focal plane of the projection system at the exposure slit.

With the levelling system for measuring the height of the substrate on a position away from the exposure slit, space is created to move the optical element very close to the exposure slit. An advantage of the projection system being designed very close to the exposure slit is that the cover which is necessary to protect the optical elements in the projection system from contamination produced by outgassing of the resist on the substrate only needs a very small opening if it is located close to the exposure slit on the substrate. The beam from the projection system is convergent and has

its smallest size at the exposure slit at the focal plane on a target portion of the substrate, the closer the opening in the cover is to the exposure slit the smaller the opening can be made and as a consequence less contamination will contaminate the optical element through the opening.

According to a further aspect of the invention there is provided a device manufacturing method comprising projecting a patterned beam of radiation at an exposure slit at the focal plane of a target portion of a substrate with a projection system, wherein the projection system is provided with an optical element close to the exposure slit, and the apparatus further comprises a levelling system for measuring a height of the substrate on a position away from the exposure slit and a controller for controlling a position of the substrate table so that the substrate is in the focal plane of the projection system at the exposure slit.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, and in which:

- Figure 1 depicts a lithographic apparatus according to an embodiment of the invention;
- Figure 2 depicts a cross-sectional view on the projection system, level system and the wafer table of the lithographic apparatus according to the invention;
- Figure 3 depicts a cross-sectional view along the line 'A - "A of Figure 2; and
- Figure 4 depicts a cross-sectional view along the line 'B - "B in Figure 2.

DETAILED DESCRIPTION

Figure 1 schematically depicts a lithographic apparatus according to an embodiment of the invention. The apparatus comprises:

- an illumination system (illuminator) IL configured to condition a radiation beam B (e.g. UV radiation or extreme ultraviolet radiation).
- a support structure (e.g. a mask table) MT constructed to support a patterning device (e.g. a

mask) MA and connected to a first positioner PM configured to accurately position the patterning device in accordance with certain parameters;

- a substrate table (e.g. a wafer table) WT constructed to hold a substrate (e.g. a resist-coated wafer) W and connected to a second positioner PW configured to accurately position the substrate in accordance with certain parameters; and
- a projection system (e.g. a refractive projection lens system) PS configured to project a pattern imparted to the radiation beam B by patterning device MA onto a target portion C (e.g. comprising one or more dies) of the substrate W.

The illumination system may include various types of optical components, such as refractive, reflective, magnetic, electromagnetic, electrostatic or other types of optical components, or any combination thereof, for directing, shaping, or controlling radiation.

The support structure supports, i.e. bears the weight of, the patterning device. It holds the patterning device in a manner that depends on the orientation of the patterning device, the design of the lithographic apparatus, and other conditions, such as for example whether or not the patterning device is held in a vacuum environment. The support structure can use mechanical, vacuum, electrostatic or other clamping techniques to hold the patterning device. The support structure may be a frame or a table, for example, which may be fixed or movable as required. The support structure may ensure that the patterning device is at a desired position, for example with respect to the projection system. Any use of the terms “reticle” or “mask” herein may be considered synonymous with the more general term “patterning device.”

The term “patterning device” used herein should be broadly interpreted as referring to any device that can be used to impart a radiation beam with a pattern in its cross-section such as to create a pattern in a target portion of the substrate. It should be noted that the pattern imparted to the radiation beam may not exactly correspond to the desired pattern in the target portion of the substrate, for example if the pattern includes phase-shifting features or so called assist features. Generally, the pattern imparted to the radiation beam will correspond to a particular functional layer in a device being created in the target portion, such as an integrated circuit.

The patterning device may be transmissive or reflective. Examples of patterning devices include masks, programmable mirror arrays, and programmable LCD panels. Masks are well known in lithography, and include mask types such as binary, alternating phase-shift, and attenuated phase-shift,

as well as various hybrid mask types. An example of a programmable mirror array employs a matrix arrangement of small mirrors, each of which can be individually tilted so as to reflect an incoming radiation beam in different directions. The tilted mirrors impart a pattern in a radiation beam which is reflected by the mirror matrix.

The term "projection system" used herein should be broadly interpreted as encompassing any type of projection system, including refractive, reflective, catadioptric, magnetic, electromagnetic and electrostatic optical systems, or any combination thereof, as appropriate for the exposure radiation being used, or for other factors such as the use of an immersion liquid or the use of a vacuum. Any use of the term "projection lens" herein may be considered as synonymous with the more general term "projection system".

As here depicted, the apparatus is of a reflective type (e.g. employing a reflective mask). Alternatively, the apparatus may be of a transmissive type (e.g. employing a transmissive mask).

The lithographic apparatus may also be of a type wherein at least a portion of the substrate may be covered by a liquid having a relatively high refractive index, e.g. water, so as to fill a space between the projection system and the substrate. An immersion liquid may also be applied to other spaces in the lithographic apparatus, for example, between the mask and the projection system. Immersion techniques are well known in the art for increasing the numerical aperture of projection systems. The term "immersion" as used herein does not mean that a structure, such as a substrate, must be submerged in liquid, but rather only means that liquid is located between the projection system and the substrate during exposure.

Referring to figure 1, the illuminator IL receives a radiation beam from a radiation source SO. The source and the lithographic apparatus may be separate entities, for example when the source is an excimer laser. In such cases, the source is not considered to form part of the lithographic apparatus and the radiation beam is passed from the source SO to the illuminator IL with the aid of a beam delivery system BD comprising, for example, suitable directing mirrors and/or a beam expander. In other cases the source may be an integral part of the lithographic apparatus, for example when the source is a mercury lamp. The source SO and the illuminator IL, together with the beam delivery system BD if required, may be referred to as a radiation system.

The illuminator IL may comprise an adjuster AD for adjusting the angular intensity distribution of the radiation beam. Generally, at least the outer and/or inner radial extent (commonly referred to as

σ -outer and σ -inner, respectively) of the intensity distribution in a pupil plane of the illuminator can be adjusted. In addition, the illuminator IL may comprise various other components, such as an integrator IN and a condenser CO. The illuminator may be used to condition the radiation beam, to have a desired uniformity and intensity distribution in its cross-section.

The radiation beam B is incident on the patterning device (e.g., mask MA), which is held on the support structure (e.g., mask table MT), and is patterned by the patterning device. Having traversed the mask MA, the radiation beam B passes through the projection system PS, which focuses the beam onto a target portion C of the substrate W. With the aid of the second positioner PW and position sensor IF2 (e.g. an interferometric device, linear encoder or capacitive sensor), the substrate table WT can be moved accurately, e.g. so as to position different target portions C in the path of the radiation beam B. Similarly, the first positioner PM and another position sensor IF1 can be used to accurately position the mask MA with respect to the path of the radiation beam B, e.g. after mechanical retrieval from a mask library, or during a scan. In general, movement of the mask table MT may be realized with the aid of a long-stroke module (coarse positioning) and a short-stroke module (fine positioning), which form part of the first positioner PM. Similarly, movement of the substrate table WT may be realized using a long-stroke module and a short-stroke module, which form part of the second positioner PW. In the case of a stepper (as opposed to a scanner) the mask table MT may be connected to a short-stroke actuator only, or may be fixed. Mask MA and substrate W may be aligned using mask alignment marks M1, M2 and substrate alignment marks P1, P2. Although the substrate alignment marks as illustrated occupy dedicated target portions, they may be located in spaces between target portions (these are known as scribe-lane alignment marks). Similarly, in situations in which more than one die is provided on the mask MA, the mask alignment marks may be located between the dies.

The depicted apparatus could be used in at least one of the following modes:

1. In step mode, the mask table MT and the substrate table WT are kept essentially stationary, while an entire pattern imparted to the radiation beam is projected onto a target portion C at one time (i.e. a single static exposure). The substrate table WT is then shifted in the X and/or Y direction so that a different target portion C can be exposed. In step mode, the maximum size of the exposure field limits the size of the target portion C imaged in a single static exposure.
2. In scan mode, the mask table MT and the substrate table WT are scanned synchronously while a pattern imparted to the radiation beam is projected onto a target portion C (i.e. a single dynamic

exposure). The velocity and direction of the substrate table WT relative to the mask table MT may be determined by the (de-)magnification and image reversal characteristics of the projection system PS. In scan mode, the maximum size of the exposure field limits the width (in the non-scanning direction) of the target portion in a single dynamic exposure, whereas the length of the scanning motion determines the height (in the scanning direction) of the target portion.

3. In another mode, the mask table MT is kept essentially stationary holding a programmable patterning device, and the substrate table WT is moved or scanned while a pattern imparted to the radiation beam is projected onto a target portion C. In this mode, generally a pulsed radiation source is employed and the programmable patterning device is updated as required after each movement of the substrate table WT or in between successive radiation pulses during a scan. This mode of operation can be readily applied to maskless lithography that utilizes programmable patterning device, such as a programmable mirror array of a type as referred to above.

Combinations and/or variations on the above described modes of use or entirely different modes of use may also be employed.

Figure 2 depicts a lithographic apparatus according to the invention. It shows partially the projection system PS of figure 1 with the last two optical elements of the projection system PS e.g. the last and the for last multilayer mirror 5, 6. The beam B which is reflected by other optical elements (not depicted) in the projection system PS will be focused by the reflective multilayer 5, 6, through an opening 7 in the cover CO at an exposure slit at the focal plane at the substrate W. The substrate W is held by the substrate table WT and will be moved along the base BP. The second positioner (PW in figure 1) can be used to position the substrate in six degrees of freedom underneath the projection system PS. The levelling system 10 is used for measuring a height of the substrate on a position away from the exposure slit and a controller (not depicted) is connected with the levelling system 10 and the second positioner so as to bring the surface of the substrate W at the exposure slit in the focal plane of the projection system PS. The distance between the projection system PS and the substrate W may be less than 5 cm, or even less than 1 cm, preferably less than 5mm. As a consequence the distance between the optical element and the exposure slit at the focal plane on the substrate is less than 5 cm preferably less than 1 cm. The distance between the levelling system and the exposure slit may be less than 20 cm, preferably less than 10 cm.

Figure 3 depicts a cross sectional view along the line 'A-A' in figure 2. The details of the projection system PS are left away. Figure 3 shows the metrology system for measuring the position of the substrate table in the Z-direction. In this case two interferometer beams ZIF are directed into the direction of the 45 degrees mirror 31 which reflects the interferometer beam in the direction of the mirrors 35 and 34 that are mounted on the metrology frame MF and provide good reference in the Z-direction. Not depicted in figure 3 is the rest of the metrology system which make it possible to position the substrate table WT in six degrees of freedom (X, Y, Z, RX, RY and RZ) More information with respect to such a metrology system can be gleaned from US 5,801, 832 which shows an interferometer system for measuring five degrees of freedom which in combination with the interferometer system of figure 3 can provide for information with respect to an interferometer system for measuring six degrees of freedom. Alternatively, incremental encoders can be used in the metrology system to measure the position of the substrate table WT. More information with respect to the use of incremental encoders can be gleaned from US 7,102,729.

Figure 4 depicts a cross sectional view along the line 'B-B' in figure 2. Figure 4 shows the levelling system 10 in more detail. The levelling system 10 for measuring a height of the substrate on a position away from the exposure slit comprises a light source 11 which direct a detection beam to the substrate surface and a detector 12 for detecting a reflection of the surface so as to determine the position of the substrate surface. During levelling the metrology system is used to control the position of the substrate table WT in six degrees of freedom so that an accurate height map can be made from the substrate W. There are two modes of operating the lithographic apparatus according to the invention. The first mode is that of simultaneously performing levelling while at the same time operating the projection system PS to expose the substrate on another part of the substrate W. The other mode is first perform levelling underneath the levelling system and than later on when a height map for the substrate is finished patterning the substrate underneath the projection system using the height information of the levelling.

The lithographic apparatus may be of a type having two (dual stage) or more substrate tables (and/or two or more mask tables). In such "multiple stage" machines the additional tables may be used in parallel, or preparatory steps may be carried out on one or more tables while one or more other tables are being used for exposure. A dual stage lithographic apparatus comprises two substrate tables that can swap from a measurement position underneath the levelling system and a projection position

underneath the projection system and the controller is constructed and arranged for using measurement information obtained underneath the measurement position at the projection position so as to bring the substrate at the exposure slit in the focal plane. Again the advantage is that there is no space required for the levelling system underneath the projection system and that the projection system can be mounted very close to the substrate so that there is only a very small space between the optical element and the exposure slit. Another advantage of a dual stage lithographic apparatus is that the levelling system can be employed independently of the exposure system allowing for a more economical use of the lithographic apparatus. More information with respect to a dual stage lithographic apparatus can be gleaned from EP 1037117 incorporated herein by reference.

Although specific reference may be made in this text to the use of lithographic apparatus in the manufacture of ICs, it should be understood that the lithographic apparatus described herein may have other applications, such as the manufacture of integrated optical systems, guidance and detection patterns for magnetic domain memories, flat-panel displays, liquid-crystal displays (LCDs), thin-film magnetic heads, etc. The skilled artisan will appreciate that, in the context of such alternative applications, any use of the terms "wafer" or "die" herein may be considered as synonymous with the more general terms "substrate" or "target portion", respectively. The substrate referred to herein may be processed, before or after exposure, in for example a track (a tool that typically applies a layer of resist to a substrate and develops the exposed resist), a metrology tool and/or an inspection tool. Where applicable, the disclosure herein may be applied to such and other substrate processing tools. Further, the substrate may be processed more than once, for example in order to create a multi-layer IC, so that the term substrate used herein may also refer to a substrate that already contains multiple processed layers.

The terms "radiation" and "beam" used herein encompass all types of electromagnetic radiation, including ultraviolet (UV) radiation (e.g. having a wavelength of or about 365, 355, 248, 193, 157 or 126 nm) and extreme ultra-violet (EUV) radiation (e.g. having a wavelength in the range of 5-20 nm), as well as particle beams, such as ion beams or electron beams.

The term "lens", where the context allows, may refer to any one or combination of various types of optical components, including refractive, reflective, magnetic, electromagnetic and electrostatic optical components.

The descriptions above are intended to be illustrative, not limiting. Thus, it will be apparent to

one skilled in the art that modifications may be made to the invention as described without departing from the scope of the claims set out below.

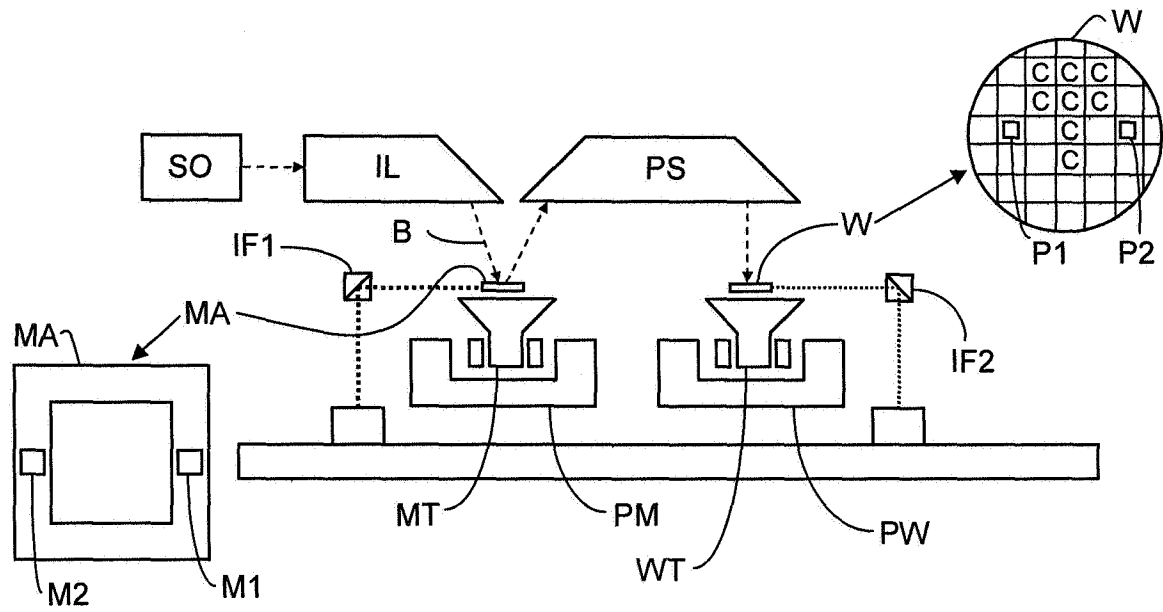
CLAIMS

1. A lithographic apparatus comprising:
an illumination system configured to condition a radiation beam;
a support constructed to support a patterning device, the patterning device being capable of imparting the radiation beam with a pattern in its cross-section to form a patterned radiation beam;
a substrate table constructed to hold a substrate;
a projection system configured to project the patterned radiation beam in an exposure slit at the focal plane on a target portion of the substrate, wherein the projection system is provided with an optical element close to the exposure slit, and the apparatus further comprises a levelling system for measuring a height of the substrate on a position away from the exposure slit and a controller for controlling a position of the substrate table so that the substrate is in the focal plane of the projection system at the exposure slit.
2. A lithographic apparatus according to claim 1, wherein the apparatus comprises a metrology system for measuring the position of the substrate table in the Z-direction.
3. A lithographic apparatus according to claim 2, wherein the metrology system comprises an interferometer which measures the position of a mirror on the substrate table in the Z-direction.
4. A lithographic apparatus according to claim 1, wherein the optical element is a reflective optical element.
5. A lithographic apparatus according to claim 1, wherein the projection system is provided with a cover for shielding the optical elements from contamination that may come from the substrate, the cover being provided with an opening through which the patterned beam can traverse to form the exposure slit on the substrate.
6. A lithographic apparatus according to claim 1, wherein the distance between the projection system and the surface of the substrate is less than 5 cm.

7. A lithographic apparatus according to claim 5, wherein the distance between the projection system and the surface of the substrate is less than 1 cm.
8. A lithographic apparatus according to claim 6, wherein the distance between the projection system and the surface of the substrate is less than 5 mm.
9. A lithographic apparatus according to claim 2, wherein the apparatus comprises a six axis metrology system for measuring the position of the substrate table in six degrees of freedom.
10. A lithographic apparatus according to claim 1, wherein the levelling system comprises a light source which direct a detection beam to the substrate surface and a detector for detecting a reflection of the surface so as to determine the position of the substrate.
11. A lithographic apparatus according to claim 1, wherein the distance between the optical element and the exposure slit at the focal plane on the substrate is less than 5 cm.
12. A lithographic apparatus according to claim 1, wherein the distance between the optical element and the exposure slit at the focal plane on the substrate is less than 1 cm.
13. A lithographic apparatus according to claim 1, wherein the levelling sensor is less than 20 cm. away from the exposure slit at the focal plane on the substrate.
14. A lithographic apparatus according to claim 1, wherein the levelling system is less than 10 cm away from the exposure slit at the focal plane on the substrate.
15. A lithographic projection apparatus according to claim 1, wherein the apparatus comprises two substrate tables that can swap from a measurement position underneath the levelling system and a projection position underneath the projection system and the controller is constructed and arranged for using measurement information obtained underneath the measurement position at the projection position so as to bring the substrate in the focal plane at the exposure slit.

16. A device manufacturing method comprising projecting a patterned beam of radiation at an exposure slit at the focal plane of a target portion of a substrate with a projection system, wherein the projection system is provided with an optical element close to the exposure slit, and the apparatus further comprises a levelling system for measuring a height of the substrate on a position away from the exposure slit and a controller for controlling a position of the substrate table so that the substrate is in the focal plane of the projection system at the exposure slit.

FIG 1



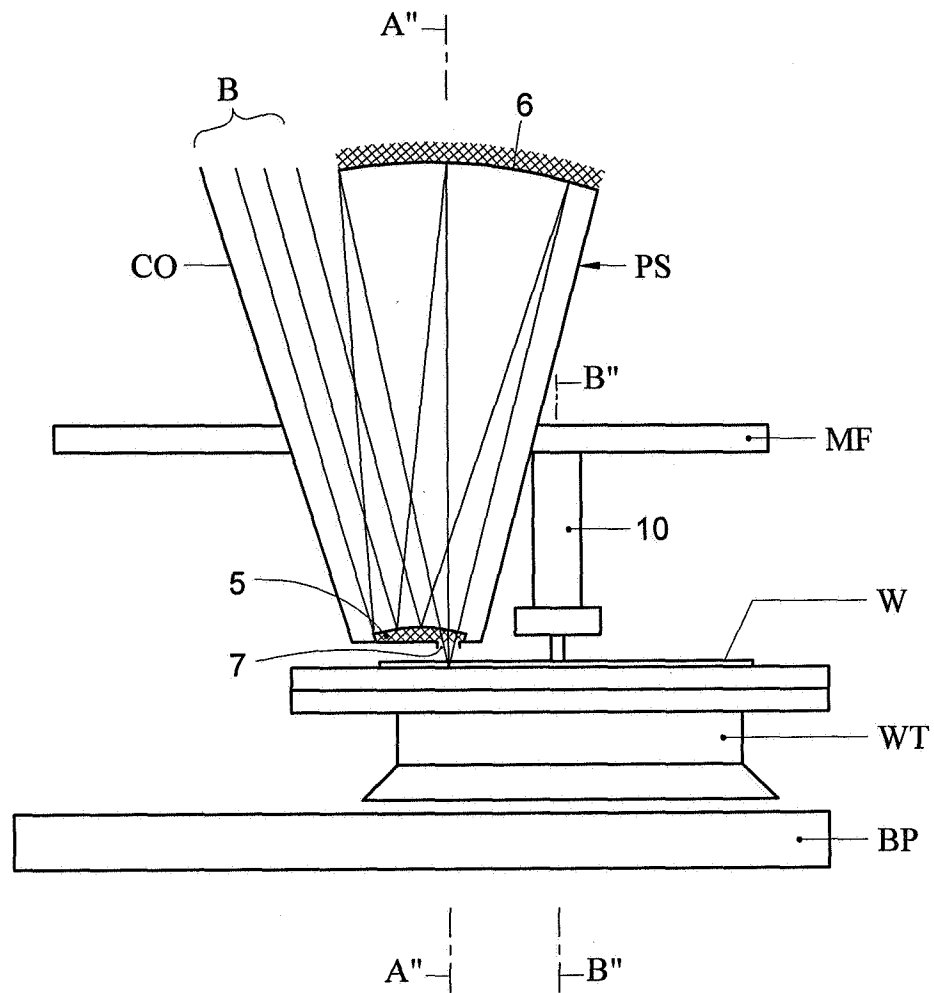


Fig. 2

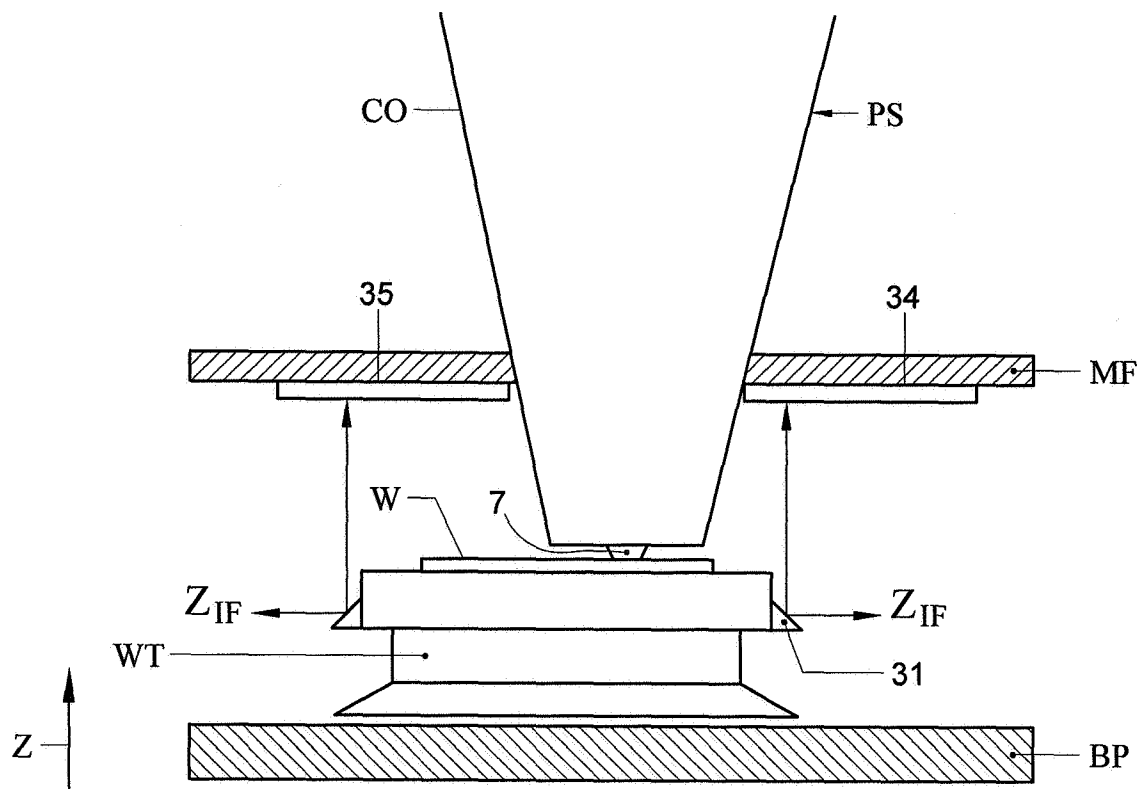


Fig. 3

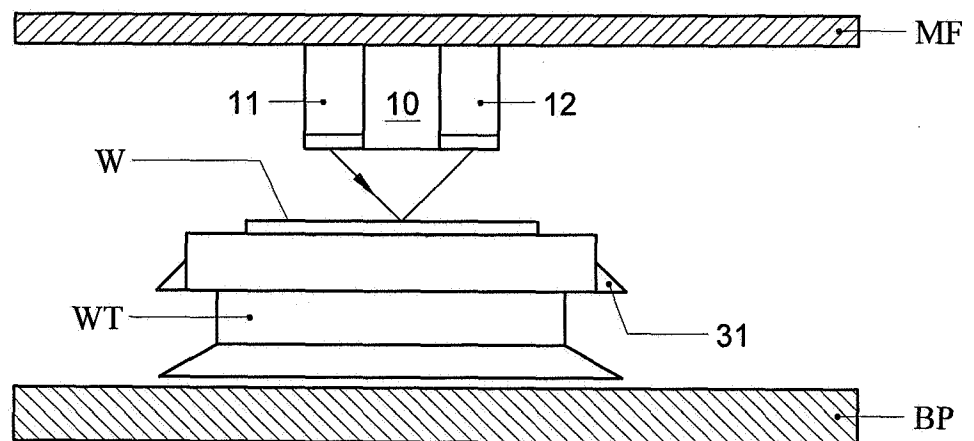


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2007/050247

A. CLASSIFICATION OF SUBJECT MATTER
INV. G03F7/20

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

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 037 117 A (ASM LITHOGRAPHY BV [NL] ASML NETHERLANDS BV [NL]) 20 September 2000 (2000-09-20) the whole document	1-4, 9, 10, 15, 16
Y		5-8, 11, 12
X	WO 99/32940 A (ASM LITHOGRAPHY BV [NL]) 1 July 1999 (1999-07-01) the whole document	1-3, 6, 8-12, 15, 16
X	EP 1 571 696 A (NIPPON KOGAKU KK [JP]) 7 September 2005 (2005-09-07) paragraphs [0057] - [0067]; figures 5, 6 -/--	1-3, 9, 10, 13-16

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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- *A* document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search

13 February 2008

Date of mailing of the international search report

22/02/2008

Name and mailing address of the ISA/

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Authorized officer

Roesch, Guillaume

INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2007/050247

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/243292 A1 (BASELMANS JOHANNES JACOBUS M [NL] ET AL) 3 November 2005 (2005-11-03) paragraphs [0006] - [0037], [0047], [0071] - [0089]; figures 2-7 -----	1,10, 13-16
Y	WO 2005/083759 A (NIPPON KOGAKU KK [JP]; AOKI TAKASHI [JP]; ISOGAMI TOHRU [JP]) 9 September 2005 (2005-09-09) abstract pages 12,24; figures 1-12 -----	5-8,11, 12
Y	EP 1 229 573 A1 (NIPPON KOGAKU KK [JP]) 7 August 2002 (2002-08-07) paragraphs [0001] - [0023], [0051]; figures 1-6 -----	5-8,11, 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NL2007/050247

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-12,15,16

exposure apparatus with a contamination shielding cover or
an arrangement of the projection optics with respect to the
substrate

1.1. claims: 1-5,7,9,10,15,16

exposure apparatus with a contamination shielding cover

1.2. claims: 6,8,11,12

arrangement of the projection optics with respect to the
substrate

2. claims: 13,14

arrangement of a levelling sensor with respect to the
exposure slit

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/NL2007/050247

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