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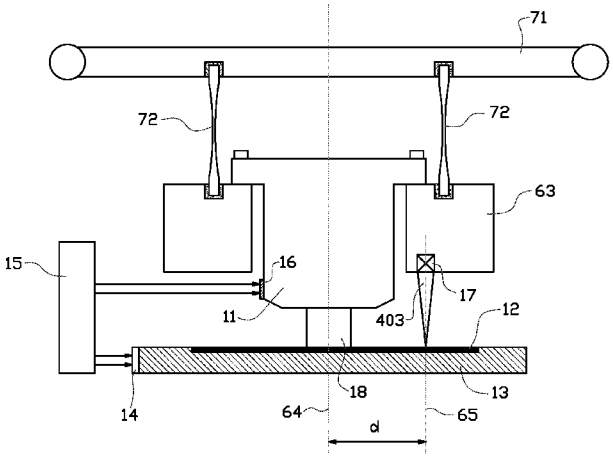
[Continued on next page]

(54) Title: LITHOGRAPHY SYSTEM FOR PROCESSING A TARGET, SUCH AS A WAFER, AND A METHOD FOR OPERATING A LITHOGRAPHY SYSTEM FOR PROCESSING A TARGET, SUCH AS A WAFER



FIG, 1

(57) Abstract: The invention relates to a lithography system for processing a target, such as a wafer. The lithography system comprises a beam source arranged for providing a patterning beam, a final projection system arranged for projecting a pattern on the target surface, a chuck arranged for supporting the target and a mark position system connected to the final projection system and arranged for detecting a position mark on a surface.

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AMENDED CLAIMS
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1. Lithography system for processing a target, such as a wafer, the target comprising a target surface, the lithography system comprising:

- a beam source arranged for providing a patterning beam, preferably light beam or a charged particle beam, such as an electron beam, the beam preferably comprising at least two beamlets;

- a final projection system arranged for projecting a pattern on the target surface with said patterning beam;

- a chuck arranged for supporting the target, wherein the chuck is provided with a beam measurement sensor and a chuck surface provided with at least one chuck position mark thereon, the beam measurement sensor being arranged for measuring beam properties of the patterning beam, the beam properties comprising a spatial distribution of an intensity of the patterning beam and/or preferably a spatial distribution of the at least two beamlets;

- a chuck position sensor system, arranged for measuring the position of the chuck with respect to the final projection system in chuck position coordinates;

- a mark position system connected to the final projection system and arranged for detecting a position mark on a surface, such as the at least one chuck position mark on the chuck surface, wherein the mark position system is connected to the final projection system via a support; and,

- a frame and at least three flexures, wherein the support is suspended from the frame with the at least three flexures.

2. Lithography system according to claim 1, wherein said support ring is supporting both the final projection system and the mark position system.

3. Lithography system according to claim 1 or 2, wherein the support comprises a low thermal expansion material, such as a glass-ceramic; and/or,
wherein a distance between a beam axis of the mark position system and a beam axis of the final projection system is relatively small compared to dimensions of the chuck, and/or is in the range of 10-100 mm or preferably in the range of 30-60 mm or more preferably about 45 mm.

4. Lithography system according to claim 3, wherein a distance between a centre of the beam measurement sensor and the chuck position mark corresponds to the distance between the beam axis of the mark position system and the beam axis of the final projection system.

5. Lithography system according to any of claims 1-4, further comprising:

- an actuator system arranged for moving the chuck in at least one dimension with respect to the final projection system.

6. Lithography system according to claim 5, wherein the frame comprises a high thermal expansion material, such as aluminium.

7. Lithography system according to any of claims 1-6, wherein :
the beam measurement sensor is further arranged for providing beam properties information based on the measured beam properties of the patterning beam;
the chuck position sensor is further arranged for providing chuck position information based on a measured position of the chuck;

the mark position system is further arranged for providing mark detection information based on a detected mark; and, the lithography system further comprises a processing unit arranged for:

- controlling the actuator;
- receiving the mark detection information, chuck position information and beam properties information;
- determining the position of the at least one chuck position mark in chuck coordinates;
- determining a spatial distribution of beam properties in chuck coordinates; and,
- determining a spatial distribution of beam properties with respect to the position of the at least one chuck position mark.

8. Lithography system according to any of claims 1-7, wherein the target surface is provided with at least one target position mark thereon, and the mark position system is further arranged for detecting the at least one target position mark on the target surface.

9. Lithography system according to claim 8, further comprising said target.

10. Lithography system according to any of claims 7-9, wherein the processing unit is further arranged for:

- determining the position of the at least one target position mark in chuck coordinates;
- determining a spatial distribution of beam properties with respect to the position of the at least one target position mark using the spatial distribution of beam properties with respect to the position of the at least one chuck position mark; and,
- controlling the projecting of the pattern on the surface using the spatial distribution of beam properties with respect to the position of the at least one target position mark.

11. Lithography system according to any of claims 1-10, wherein the patterning beam comprises at least two separate patterning beamlets and wherein the beam properties further comprises a spatial distribution of the at least two patterning beamlets and/or a spatial distribution of a light intensity of the at least two patterning beamlets .

12. Lithography system according to any of claims 1-11, wherein the at least one chuck position mark comprises four chuck position marks, and/or the at least one target position mark comprises four target position marks.

13. Lithography system according to any of claims 1-12, wherein the mark position system comprises at least one alignment sensor, the alignment sensor being arranged for providing an alignment light beam, for measuring a light intensity of a reflected alignment light beam, wherein the reflected alignment light beam is generated by reflection on the surface and, preferably, for providing mark detection information based on a measured light intensity.

14. Lithography system according to any of claims 1-13, wherein the chuck position mark and/or the target position mark comprises at least a first and a second reflective area, wherein the first reflective area has a higher reflection coefficient that the second reflective area .

15. Lithography system according to claims 13 and 14, wherein the alignment sensor is arranged for providing the alignment light beam with a wavelength and at least one of the first and second reflective area comprises structures with dimensions smaller than said wavelength.

16. Lithography system according to any of claims 1-15, wherein the chuck position mark and/or the target position mark comprises an NVSM-X mark.

17. Method for operating a lithography system for processing a target, such as a wafer, said method comprising:

during an initialization phase:

a1) providing a chuck, the chuck is provided with a beam measurement sensor and a chuck surface, the chuck surface provided with at least one chuck position mark thereon, wherein the chuck is moveable in chuck coordinates;

a2) determining a position of the at least one chuck position mark in chuck coordinates;

a3) providing a patterning beam, preferably comprising at least two beamlets;

a4) measuring beam properties of the patterning beam, the beam properties comprising a spatial distribution of an intensity of the patterning beam; and/or preferably a spatial distribution of the at least two beamlets;

a5) determining a spatial distribution of beam properties in chuck coordinates;

a6) determining a spatial distribution of beam properties with respect to the position of the at least one chuck position mark.

18. Method according to claim 17, further comprising:

during an exposure phase:

b1) providing a target with a target surface, the target surface provided with at least one target position mark thereon;

b2) determining the position of the at least one target position mark in chuck coordinates;

b3) determining a spatial distribution of beam properties with respect to the position of the at least one target position mark using the spatial distribution of beam prop-

erties with respect to the position of the at least one chuck position mark; and,

b4) patterning the target surface using the spatial distribution of beam properties with respect to the position of the at least one target position mark.

19. Method according to claim 17 and 18, further comprising the step of:

- maintaining a distance between a beam axis of the final projection system and a beam axis of mark position system constant during the initialization phase and the exposure phase .

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Statement under article 19 PCT

None of documents cited in the International Search Report discloses the following features of the amended claim 1: "wherein the mark position system is connected to the final projection system via a support; and [the lithography system comprising] a frame and at least three flexures, wherein the support is suspended from the frame with the at least three flexures." These features were described in claims 2 and 5 as originally filed.

Therefore, the amended claim 1 is deemed new in the light of the documents cited in the International Search Report. Indeed, in the Written Opinion it is indicated that claim 5 as originally filed is considered new.

An advantage of the configuration of amended claim 1 is that the frame and/or the final projection system may expand due to temperature changes, while the beam axis remains at the same position. In that case, the position of the patterning of the surface may be independent of thermal expansion of the frame carrier and/or final projection system.

None of documents cited in the International Search Report discloses a hint or suggestion for adjusting the embodiments found in the cited documents such that the person skilled in the art would arrive at the embodiment of amended claim 1. Therefore, amended claim 1 comprises an inventive step over the cited documents. Indeed, in the Written Opinion it is indicated that claim 5 as originally filed is considered inventive.

In line with item V.4 of the Written Opinion, independent method claim 17 is deemed new and inventive over the documents cited in the International Search Report.

In reply to item VIII of the Written Opinion the applicant respectfully submits that in the field of wafer alignment marks, the technical features of the NVSM (Narrow Versatile Scribe-lane primary Marks) group of wafer alignment marks are well known, and the term NVSM-X has thus a well accepted meaning for the person skilled in the art.