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**Datasheet for the decision of 28 September 2010**

**Case Number:** T 1708/06 - 3.4.03

**Application Number:** 03078743.6

**Publication Number:** 1413928

**IPC:** G03F 9/00

**Language of the proceedings:** EN

**Title of invention:**
Apparatus and method for scanning exposure

**Patentee:**
CANON KABUSHIKI KAISHA

**Opponent:**
-

**Headword:**
-

**Relevant legal provisions:**
EPC Art. 123(2)

**Relevant legal provisions (EPC 1973):**
EPC Art. 56, 84

**Keyword:**
"Inventive step - auxiliary request (yes)"
"Added subject-matter - main request"
"Double patenting (no)"

**Decisions cited:**
-

**Catchword:**
-

**Case Number:** T 1708/06 - 3.4.03

# D E C I S I O N
## of the Technical Board of Appeal 3.4.03
## of 28 September 2010

**Appellant:** CANON KABUSHIKI KAISHA
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**Decision under appeal:** **Decision of the Examining Division of the European Patent Office posted 26 May 2006 refusing European patent application No. 03078743.6 pursuant to Article 97(1) EPC 1973.**

**Composition of the Board:**

**Chairman:** G. Eliasson
**Members:** T. Häusser
P. Mühlens

## Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the Examining Division refusing the European patent application No. 03 078 743.

The Examining Division held that the application did not meet the requirements of Articles 52(1) and 56 EPC 1973, because the invention did not involve an inventive step, having regard to the following documents:
D1: US 5 194 893 A,
D2: US 5 118 957 A.

II. At oral proceedings before the Board, the appellant requested that the decision be set aside and a patent be granted on the basis of the following documents:

Main request:
- claims 1 to 12 as filed with the letter dated 26 August 2010.

Auxiliary request:
- claims 1 to 10 as filed at the oral proceedings of 28 September 2010.

III. The wording of claim 1 according to the main request, reads as follows:

"1. A scanning exposure apparatus having a projection optical system (1) for projecting light from a reticle (2) to a wafer (4) and performing a scanning exposure of a shot area on the wafer to light via the reticle and said projection optical system, while the wafer and

the reticle (2) are scanned relative to each other in a scanning direction across an optical axis (AX) of said projection optical system, said apparatus comprising:

measurement means (10-19) for measuring a position of a region in the shot area in a direction of the optical axis with respect to each of a plurality of points in the shot area during scanning of the wafer in the scanning direction, the plurality of points being different from each other in position in the scanning direction; and

moving means (5) for moving the wafer in the direction of the optical axis during the scanning exposure, on the basis of the position of the region measured by said measurement means (10-19) with respect to each of the plurality of points during the scanning exposure, and

characterized by further comprising:
calculating means (27) arranged to calculate an offset (Cjk) used for offsetting a position of a region in a first shot area on a first wafer measured by said measurement means (10-19) with respect to each of a first plurality of points in the first shot area during a scanning exposure of the first shot area, said calculating means (27) calculating the offset on the basis of a position of a region in each of sample shot areas on a second wafer measured by said measurement means (10-19) with respect to each of a second plurality of points in each of the sample shot areas during scanning of the second wafer in the scanning direction before the scanning exposure of the first shot area, positions of the second plurality of points relative to a region of each of the sample shot areas corresponding to positions of the first plurality of points relative to a region of the first shot area,

said calculating means (27) being arranged to calculate the offset such that the offset approximates a difference between a position (Zjk) of a region measured by said measurement means (10-19) with respect to each of the second plurality of points and a reference position (Z21) of a region measured by said measurement means (10-19) with respect to one of the second plurality of points over the sample shot areas; and

offsetting means (27) arranged to offset the position of the region measured by said measurement means (10-19) with respect to each of the first plurality of points, with the calculated offset corresponding thereto, during the scanning exposure of the first shot area,

wherein said moving means (5) is arranged to move the first wafer during the scanning exposure of the first shot area on the basis of the offset position obtained by said offsetting means (27) with respect to each of the first plurality of points."

IV. Independent claims of the auxiliary request, namely claims 1, 5 and 10, read as follows:

"1. A scanning exposure apparatus having a projection optical system (1) for projecting light from a reticle (2) to a wafer (4) and performing a scanning exposure of a shot area on the wafer to light via the reticle (2) and said projection optical system while the wafer and the reticle (2) are scanned relative to each other in a scanning direction across an optical axis (AX) of said projection optical system, said apparatus comprising:

measurement means (10-19) for measuring a position of a region in the shot area in a direction of the

optical axis with respect to each of a plurality of points in the shot area during scanning of the wafer in the scanning direction, the plurality of points being different from each other in position in the scanning direction; and

moving means (5) for moving the wafer in the direction of the optical axis during the scanning exposure, on the basis of the position of the region measured by said measurement means (10-19) with respect to each of the plurality of points during the scanning exposure, and

wherein said apparatus further comprises:

calculating means (27) arranged to calculate an offset (Cjk) used for offsetting a position of a region in a first shot area on a first wafer measured by said measurement means (10-19) with respect to each of a first plurality of points in the first shot area during a scanning exposure of the first shot area, said calculating means (27) calculating the offset on the basis of a position of a region in each of sample shot areas on a second wafer measured by said measurement means (10-19) with respect to each of a second plurality of points in each of the sample shot areas during scanning of the second wafer in the scanning direction before the scanning exposure of the first shot area, positions of the second plurality of points relative to a region of each of the sample second shot areas corresponding to positions of the first plurality of points relative to a region of the first shot area, said calculating means (27) being arranged to calculate the offset such that the offset approximates a difference between a position (Zjk) of a region measured by said measurement means (10-19) with respect to each of the second plurality of points and a

reference position (Z21) of a region measured by said measurement means (10-19) with respect to one of the second plurality of points over the sample shot areas, by finding a function that represents a shape of the second wafer on the basis of positions of regions respectively measured by said measurement means (10-19) with respect to the second plurality of points over the sample shot areas;

offsetting means (27) arranged to offset the position of the region measured by said measurement means (10-19) with respect to each of the first plurality of points, with the calculated offset corresponding thereto, during the scanning exposure of the first shot area,

wherein said moving means (5) is arranged to move the first wafer during the scanning exposure of the first shot area on the basis of the offset position obtained by said offsetting means (27) with respect to each of the first plurality of points."

"5. A scanning exposure method of performing a scanning exposure of a shot area on a wafer (4) to light via a reticle (2) and a projection optical system (1) for projecting light from the reticle (2) to the wafer, while the wafer and the reticle (2) are scanned relative to each other in a scanning direction across an optical axis (AX) of the projection optical system, said method comprising:

a first measurement step (105) of measuring a position of a region in a first shot area on a first wafer in a direction of the optical axis with respect to each of a first plurality of points in the first shot area during scanning exposure of the first shot area, the first plurality of points being different

from each other in position in the scanning direction; and

a moving step of moving the first wafer during the scanning exposure of the first shot area, on the basis of the position of the region measured in said first measurement step (105) with respect to each of the first plurality of points,

wherein said method further comprises:

a second measurement step (103) of measuring a position of a region in each of sample shot areas on a second wafer in the direction of the optical axis with respect to each of a second plurality of points in each of the sample shot areas during scanning of the second wafer in the scanning direction before the scanning exposure of the first shot area, positions of the second plurality of points relative to a region of each of the sample shot areas corresponding to positions of the first plurality of points relative to a region of the first shot area;

a calculating step (104) of calculating an offset (Cjk) used for offsetting the position of the region measured in said first measurement step (105) with respect to each of the first plurality of points, on the basis of the position of the region measured in said second measurement step (103) with respect to each of the second plurality of points, such that the offset approximates a difference between a position (Zjk) of a region measured in said second measurement step (103) with respect to each of the second plurality of points and a reference position (Z21) of a region measured in said second measurement step (103) with respect to one of the second plurality of points over the sample shot areas, by finding a function that represents a shape of the second wafer on the basis of positions of regions

respectively measured in said second measurement step (103) with respect to the second plurality of points over the sample shot areas in each of the plurality of second shot areas; and

an offsetting step of offsetting the position of the region measured in said first measurement step (105) with respect to each of the first plurality of points, with the calculated offset corresponding thereto, during the scanning exposure of the first shot area,

wherein said moving step moves the first wafer during the scanning exposure of the first shot area, on the basis of the offset position obtained in said offsetting step with respect to each of the first plurality of points."

"10. A method of fabricating a semiconductor device, said method comprising steps of:

exposing a wafer to light via a reticle using a scanning exposure apparatus according to claim 1; and

fabricating the semiconductor device from the exposed wafer."

V. In relation to the main request the appellant argued essentially as follows:

The basis in the application documents as originally filed for introducing the following feature:

(a) "said calculating means (27) being arranged to calculate the offset such that the offset approximates a difference between a position (Zjk) of a region measured by said measurement means (10-19) with respect to each of the second plurality of points and a reference position (Z21) of a region measured by said measurement means

(10-19) with respect to one of the second plurality of points over the sample shot areas" into claim 1 was page 29, line 22 - page 33, line 26. In particular, page 31, lines 17-24 stated in relation to a certain measurement point that since "the pattern in this exposure region is consistent within the range of alignment precision, when the sample shots of m = 1 to 3 are measured, the surface position measured value Zjk is reproduced". The reference to an alignment precision implied that the difference claimed in feature (a) was merely approximate.

Furthermore, feature (a) was also clear when read by a person skilled in the art in the light of the description, especially the part of the description pointed out above.

## Reasons for the Decision

1. Admissibility

The appeal is admissible.

2. Main request - non-compliance of the amendments with Article 123(2) EPC

The application has been amended by introducing feature (a) (for the wording see point V above) into claim 1.

In the description it is disclosed that surface shape functions Fjk are determined to represent the wafer surface shape on the basis of measured values Zjk at measurement points (page 30, lines 8-26). One of the measured values (Z21) is taken as a reference and the surface shape functions are then used to determine the required offsets with respect to this reference (see page 31, line 25 - page 32, line 21). The determination of the surface wave functions using a predetermined polynomial and a surface integral is approximate (page 30, lines 16-26; see also original claims 2 and 9) and introduces therefore also an approximation into the determination of the offsets.

As a basis for the feature (a) the appellant referred to the passage on page 31, lines 17-24 mentioning "alignment precision" (page 31, line 22). "Alignment precision" is however not related to the precision with which the offsets are determined, but rather to the lateral precision with which the alignment data are produced and the shot layout data upon the wafer are thus (laterally) corrected (see page 25, lines 9-19).

Feature (a) of claim 1, on the other hand, relates *generally* to calculating means for calculating offsets which approximate differences between measured positions and a reference position without indicating how the approximation is done. That feature is therefore considered to extend beyond the application as filed, in which it has merely been disclosed that such approximation results from using predetermined surface shape functions.

The European patent application has therefore been amended in such a way that it contains subject-matter which extends beyond the content of the application as filed, contrary to the provisions of Article 123(2) EPC.

3. Main request - lack of clarity

Notwithstanding the above objection, claim 1 relates to calculating means for calculating offsets which *approximate* differences between measured positions and a reference position. It is however not defined in the claim how the approximation is done. It is therefore not clear from the claim itself how to achieve the approximation. Claim 1 therefore lacks clarity contrary to the requirements of Article 84 EPC 1973.

4. Auxiliary request - amendments and clarity

Claim 1 is based on originally filed claims 1, 4, and 6 supplemented with features from the original disclosure, in particular with features based on the embodiment originally disclosed with reference to the flow chart shown in Figure 7, especially steps 8 and 9.

Method claim 5 corresponds to apparatus claim 1 and is based on the parts of the original application documents and on originally filed claim 8.

Claim 10 relating to a method of fabricating a semiconductor device, claims 2-4, which depend on claim 1, and claims 6-9, which depend on claim 5, are essentially based on the originally filed claims.

The description has been brought into conformity with the amended claims and supplemented with a brief summary of the relevant content of document D1 to comply with the requirements of Article 84 EPC 1973 and Rule 27(1)(b) EPC 1973.

Accordingly, the Board is satisfied that the amendments comply with the requirements of Article 123(2) EPC and Article 84 EPC 1973.

5. Auxiliary request - inventive step

5.1 The invention relates to a surface position detecting technique applicable to a scanning exposure type apparatus, in which the position of the surface of a wafer with respect to the direction of an optical axis is continuously detected (see the description, page 1, lines 5-11).

Document D1 relates to a scanning exposure technique (D1, column 2, lines 46-50), whereas document D2 relates to a step-and-repeat exposure technique (D2, column 6, lines 19-27). Document D1 is thus related to

the same technique as the invention and is to be regarded as the closest state of the art.

5.2 Document D1 discloses a scanning exposure apparatus having a projection optical system for projecting light from a mask to a wafer and performing a scanning exposure of a shot area on the wafer to light via the mask and the projection system while the wafer and the mask are scanned relative to each other in a scanning direction across an optical axis of the projection system (D1, Figure 1 and column 3, lines 1-13). The apparatus comprises measurement means for measuring a position of a region in the shot area in a direction of the optical axis using a slit light projected onto the shot area during scanning of the wafer in the scanning direction and moving means for moving the wafer in the direction of the optical axis during the scanning exposure, on the basis of the position of the region measured by said measurement means (D1, Figures 3A, 3B and column 6, lines 28-66).

5.3 Document D1 does not disclose the features of claim 1 relating to the calculating means arranged to calculate an offset, the offsetting means arranged to offset the position of the region measured by the measurement means, and the moving means being arranged to move the first wafer on the basis of the offset position obtained by the offsetting means.

5.4 The formulation of the objective technical problem should normally start from the problem described in the application. Only if examination shows that the problem disclosed has not been solved or if inappropriate prior art was used to define the problem, it is necessary to

investigate which other problem objectively existed (Case Law of the Boards of Appeal of the European Patent Office, 6th edition, I.D.4.3.2).

In the present case, the application documents clearly describe (see Figures 4A and 4B; page 4, line 22 - page 6, line 8) the following problem, which the appellant regards as the objective technical problem:

(P-A) how to avoid defocus in wafer regions near a surface step.

In the decision under appeal the Examining Division regarded the objective technical problem as:

(P-E) how to allow faster focussing of a wafer (to enhance throughput) in a scanning exposure apparatus.

Even though the problem (P-E) can also be deduced from the application (see e. g. page 35, lines 3-17), that problem appears to be of secondary importance as its solution is described as optional (see the optional "may" on page 35, line 14, and the fact that the solution only appears in dependent claim 6 as originally filed). It is thus believed that the formulation of the objective problem should start from problem (P-A).

Furthermore, the distinguishing features mentioned in 5.3 above solve indeed the problem (P-A) and the prior art used to formulate that problem (see the description, page 2, line 8 - page 3, line 12) was not inappropriate, but corresponds essentially to document D1. The objective technical problem is thus regarded as the problem (P-A).

5.5 The skilled person, faced with the technical problem of avoiding defocus in wafer regions near a step, would consider whether the closest prior art document D1 provided any indications for solving the problem. That document is primarily concerned with increasing the depth of focus (D1, column 2, lines 46-50) and in particular with increasing the depth of focus beyond the value of the projection optical system (D1, column 8, lines 13-24). This is achieved by inclining the wafer surface with respect to the best focal plane of the projection optical system (D1, column 2, lines 64-68). By scanning the mask and the inclined wafer synchronously (D1, Figures 4A-4C and column 7, line 49 - column 8, line 5), an increased depth of focus is achieved. In particular, the depth of focus can be controlled by adjusting the width of the illumination area and/or the inclination angle (D1, column 8, lines 13-24). This can simply be achieved by motion of movable blades defining the illumination area (D1, column 4, lines 50-61) and by use of levelling drive sections (D1, column 6, lines 41-45), respectively. Document D1 therefore provides a simple solution to the technical problem, namely the depth of focus can be increased by adjusting the width of the illumination area and/or the angle of inclination. In this way, the levels on either side of a surface step would remain within the depth of focus, so that defocus in wafer regions near a surface step is avoided. Thus, although document D1 addresses the same problem as that of the present application its suggested solution teaches away from that of the claimed invention.

5.6 Document D2 is concerned with a lithography process for the production of semiconductor elements and is therefore regarded to be in the same field of technology as the invention. The skilled person would therefore consider document D2 when attempting to find solutions for the objective technical problem. In that document, the influence of surface steps on the detection of the surface position is recognized (D2, column 6, lines 3-18) and D2 aims to detect the surface position with high precision (D2, column 2, lines 65-68) in order to allow the exposure area to be moved to the best imaging surface of the projection lens system (D2, column 10, lines 38-48). Such positioning contributes to keeping the surface structures within the available depth of focus (see also D2, column 11, lines 33-58). Hence the problem of avoiding defocus in wafer regions near a step (P-A) is also addressed in document D2. However, in document D2 it is stated that, as the offset values are small, they can be omitted in an apparatus that uses a projection lens system having a large depth of focus (D2, column 11, lines 33-35). As document D1 describes ways to increase the depth of focus of a projection lens system, the skilled person would therefore be discouraged from using the teaching of document D2 on the apparatus of document D1.

Furthermore, in the step-and-repeat exposure technique according to document D2 the position of the wafer during exposure of each of the exposure regions previously formed on the wafer is corrected so that the whole exposure region is moved to the best imaging surface of the projection lens system (D2, column 10, lines 38-55; Figures 12A and 12B). In contrast, the apparatus of claim 1 has the moving means arranged to

move the wafer *during scanning exposure* of the wafer. Therefore even if it were assumed that the skilled person would have considered the application of the correction means in document D2 to the scanning exposure apparatus of document D1, he would not have arrived at the apparatus defined in claim 1. Rather, the application of the teaching of document D2 to the apparatus of document D1 would result in an exposure apparatus in which each exposure region previously formed in the wafer is first brought into the best imaging surface of the projection lens system and then inclined at the desired inclination angle before scanning exposure takes place.

5.7 For these reasons, the apparatus as defined in claim 1 is regarded to involve an inventive step over prior art documents D1 and D2. The remaining citations on file do not come closer to the claimed subject-matter than documents D1 and D2. Therefore, the subject-matter of claim 1 involves an inventive step within the meaning of Article 56 EPC 1973.

For corresponding reasons, the subject-matter of method claim 5, which corresponds to apparatus claim 1, is considered to involve an inventive step.

The same conclusion applies to claims 2-4, which depend on claim 1, to claims 6-9, which depend on claim 5, as well as claim 10, which relates to a method of fabricating a semiconductor device comprising an exposure step using an apparatus according to claim 1.

6. Double patenting

The claimed invention of the parent application (application number 96305593) relates in particular to an exposure method comprising the step of storing positional information relative to said plurality of measurement points and their respective calculated correction amounts, whereas the current application relates to a scanning exposure apparatus and method comprising moving means arranged to move a first wafer in the direction of the optical axis and calculating means arranged to calculate offsets on the basis of positions of a second wafer. Therefore, notwithstanding the question whether the principle of prohibition of double-patenting applies under the EPC, the two applications do not relate to the same invention and the issue of "double patenting" does not arise.

**Order**

**For these reasons it is decided that:**

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in the following version:

   - claims 1 to 10 of the first auxiliary request filed at the oral proceedings of 28 September 2010;
   - description pages 1 to 8 and 10 to 37 filed at the oral proceedings of 28 September 2010;
   - drawings figures 1 to 10 as originally filed.

The Registrar: The Chairman:

S. Sánchez Chiquero G. Eliasson