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**Datasheet for the decision
of 24 November 2015**

Case Number: T 2287/10 - 3.4.03

Application Number: 01935277.2

Publication Number: 1297569

IPC: H01L21/66

Language of the proceedings: EN

Title of invention:

METHOD AND APPARATUS FOR USING SCATTEROMETRY TO PERFORM
FEEDBACK AND FEED-FORWARD CONTROL

Applicant:

ADVANCED MICRO DEVICES, INC.

Headword:

Relevant legal provisions:

EPC Art. 123(2)

Keyword:

Amendments - intermediate generalisation - added subject-
matter (yes) - all requests

Decisions cited:

G 0002/10

Catchword:



**Beschwerdekammern
Boards of Appeal
Chambres de recours**

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Case Number: T 2287/10 - 3.4.03

**D E C I S I O N
of Technical Board of Appeal 3.4.03
of 24 November 2015**

Appellant: ADVANCED MICRO DEVICES, INC.
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted on 19 July 2010
refusing European patent application No.
01935277.2 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman G. Eliasson
Members: T. M. Häusser
T. Bokor

Summary of Facts and Submissions

- I. The appeal concerns the decision of the examining division refusing the European patent application No. 01 935 277 for added subject-matter (Article 123(2) EPC) in relation to the former main request; the former auxiliary request was not admitted into the proceedings under Rule 137(3) EPC.
- II. Oral proceedings before the board of appeal took place in the appellant's absence, of which the board had been notified beforehand.
- III. The appellant requested in writing that the decision under appeal be set aside and that a patent be granted on the basis of claims 1-10 of the main request, or alternatively on the basis of any of the 1st or 2nd auxiliary requests, all filed with the statement of the grounds of appeal dated 2 November 2010.
- IV. In the communication pursuant to Article 15(1) RPBA accompanying the summons to attend oral proceedings, the board stated *inter alia* that it would be discussed during the oral proceedings whether the subject-matter of claim 1 of the main request contravened Article 123(2) EPC, particularly in view of its last feature. Furthermore, it was stated that this issue was also concerned in relation to the 1st and 2nd auxiliary requests.
- V. The wording of claim 1 of the various requests is as follows (board's labelling "(a)", "(b)", "(b)'" and "(b)''"):

Main request:

"1. A method, comprising:

performing a processing run of semiconductor devices (105) on a semiconductor wafer, wherein the processing run comprises a photolithography process for forming a pattern on the semiconductor wafer;

using a scatterometer (240), measuring a light intensity pattern from at least two different portions of said semiconductor wafer;

providing the measurements as metrology data for said processed semiconductor devices (105);

(a) analyzing said metrology data, including determining a measurement difference between the at least two portions of said semiconductor wafer, wherein a difference indicates a non-conformity in line width variation of the pattern on the semiconductor wafer, and calculating adjustment data for each of said portions;

determining whether said measurement difference merits modification to said processing of semiconductor devices (105); and

(b) performing at least one of a feedback modification of said processing of semiconductor devices (105) or a feed-forward modification of a subsequent processing step based upon said adjustment data in response to said determination that said error data merits modification to said processing of semiconductor devices (105)."

1st auxiliary request:

Claim 1 of the first auxiliary request differs from claim 1 of the main request in that "at least one of" is deleted in feature (b), i. e. in that feature (b) is replaced by the following feature (b)':

(b)' "performing a feedback modification of said processing of semiconductor devices (105) or a feed-forward modification of a subsequent processing step based upon said adjustment data in response to said determination that said error data merits modification to said processing of semiconductor devices (105)."

2nd auxiliary request:

"1. A method, comprising:

performing a photolithography process on one or more semiconductor devices (105) on a semiconductor wafer, wherein the photolithography process forms a pattern on the semiconductor wafer;

using a scatterometer (240), measuring a light intensity pattern from at least two different, separately illuminated portions of said semiconductor wafer;

providing the measurements as metrology data for said processed semiconductor devices (105);

(a) analyzing said metrology data, including determining a measurement difference between the at least two portions of said semiconductor wafer, wherein a difference indicates a non-conformity in line width variation of the pattern on the semiconductor wafer, and calculating adjustment data for each of said portions;

determining whether said measurement difference merits modification to said photolithography process on one or more semiconductor devices (105); and

(b)' ' performing a feedback modification of said photolithography process on one or more semiconductor devices (105) or a feed-forward modification of a subsequent processing step based upon said adjustment data in

response to said determination that said error data merits modification to said photolithography process on one or more semiconductor devices (105)."

VI. Concerning the basis for the amendments the appellant argued essentially as follows:

Main request:

The examining division used the wrong standard for assessing compliance with Article 123(2) EPC when requiring verbatim support in the original application documents for the claim amendments. The correct standard was that an amendment was unallowable if the overall change in the content of the application resulted in the skilled person being presented with information which was not directly and unambiguously derivable from the application as filed.

In particular, a person of skill in the art could directly and unambiguously derive from the specification on page 5, line 21 to page 5, line 8, that analysing the metrology data included determining a measurement difference between the at least two portions of said semiconductor wafer, wherein a difference indicated a non-conformity in properties of the pattern on the semiconductor wafer, and calculating adjustment data for each of said portions.

Furthermore, the person of skill in the art could directly and unambiguously derive from the specification on page 4, lines 16 to 41 the performing of at least one of a feedback and a feed-forward modification from a controller capable of performing feedback and feed-forward modifications. The specification described how feedback might be used to correct a photolithography

process and how feed-forward might be used to alter subsequent processes such as etch or spacer deposition processes. In particular, line-width adjustments using photo exposure dosages or exposure focus modifications were disclosed. Moreover, modifications of the control input on the line 120 could also be performed on etch processes, such as etch line shape adjustments using etch recipe modifications, see page 4, lines 29 to 37 and page 7, lines 17 to 29.

1st and 2nd auxiliary requests:

The same arguments applied also in relation to claim 1 of the 1st and 2nd auxiliary requests.

Reasons for the Decision

1. Main request - amendments

- 1.1 The appellant argued that the examining division used the wrong standard for assessing the compliance of the amendments with the requirements of Article 123(2) EPC.

According to Article 123(2) EPC a European patent application may not be amended in such a way that it contains subject-matter which extends beyond the application as filed. It is established jurisprudence of the Boards of Appeal that an amendment should be regarded as introducing subject-matter which extends beyond the application as filed, if the overall change in the content of the application results in the skilled person being presented with information which is not directly and unambiguously derivable from that previously presented by the application, even when account is taken of matter which is implicit to the

skilled person (Case Law of the Boards of Appeal of the EPO, 7th edition 2013, section II.E.1). This has been referred to as the "gold standard" for assessing the compliance of an amendment with the requirements of Article 123(2) EPC (see the decision G 2/10 of the Enlarged Board of Appeal, Reasons 4.3).

The board does not share the appellant's view that the examining division applied another standard for examining compliance with Article 123(2) EPC. Indeed, in point 1.3 of the Reasons of the decision the examining division refers to the established jurisprudence mentioned above and to the relevant parts of the Guidelines, namely section C-VI, 5.3.1 in the version of April 2010.

- 1.2 In the decision under appeal the examining division held that claim 1 of the former main request contravened Article 123(2) EPC. In particular, this claim comprised the step of determining a measurement difference between at least two portions of the wafer. This feature had only been disclosed in the description of the application (page 5, line 21 to page 6, line 13) in the context of a feedback modification which involved adjusting the recipe of the stepper such that exposure sites with smaller line widths received either an increased energy exposure or a longer duration exposure. However, claim 1 of the former main request did not comprise the step of adjusting the stepper while specifying the alternative of a feed-forward modification of the device processing (see points 1.1 and 1.3 of the Reasons).

Claim 1 of the present main request also comprises the features objected to by the examining division, i. e. the combination of the following features:

- determining a measurement difference between at least two portions of the semiconductor wafer indicating a non-conformity in line width variation of the pattern on the semiconductor wafer, and calculating adjustment data for each of said portions (see point V. above, feature (a)), and
- performing at least one of a feedback modification of said processing of semiconductor devices or a feed-forward modification of a subsequent processing step based upon said adjustment data (see point V. above, feature (b)).

Hence the examining division's objections are still relevant for determining whether claim 1 of the main request contains added subject-matter or not.

1.3 The appellant referred to page 4, lines 16 to 41 and page 7, lines 17 to 29 as a basis for the amendments to features (a) and (b) of claim 1 of the main request.

These passages describe the invention at a general level, namely performing - on the basis of metrology data - feedback and feedforward modifications of the input signals for controlling the processing tools, as set out in feature (b) of claim 1. Examples of specific feedback and feedforward modifications are also described.

The above passages do not provide a basis for feature (a). The board agrees with the examining division that the only disclosure in the application of the claimed steps of determining a difference between two portions of the wafer indicating a non-conformity in line width variation of the pattern on the wafer and calculating adjustment data for each portion is found in the

specific embodiment described on page 5, line 21 to page 6, line 13.

However, an amendment resulting from the introduction into a claim of selected process steps merely disclosed in a specific embodiment can only be considered permissible in the absence of any clearly recognisable functional or structural relationship among the features of the specific embodiment (Case Law of the Boards of Appeal of the EPO, 7th edition 2013, section II.E.1.2).

- 1.4 In relation to the specific embodiment mentioned above it is described in the application that, in order to correct the line width variation, the recipe of the stepper is changed such that the exposure sites with smaller line widths receive either an increased energy exposure or a longer duration exposure (page 6, lines 6-8).

In this way the differences in line widths detected across a semiconductor wafer can be corrected in the processing of a subsequent wafer by using exposures of different energy or duration for different portions of the subsequent wafer as the latter is moved from one shot location to another under the lens of the stepper.

The detection of the line width variation across a wafer is considered to be intimately linked to the proposed method of correcting the processing of subsequent wafers by means of providing a feedback modification using the adjustment of the recipe of the stepper, especially as both are related to the variation of the line width across a semiconductor wafer.

By omitting in claim 1 of the main request the fact that the feedback modification involves the adjustment of the stepper and furthermore by specifying that a feed-forward modification may be performed of a subsequent processing step based on the adjustment data calculated for each of the portions of the wafer the skilled person is presented with information which is not directly and unambiguously derivable from the original application documents.

Therefore, the subject-matter of claim 1 of the main request contains subject-matter which extends beyond the application as filed, contrary to the provisions of Article 123(2) EPC.

2. 1st and 2nd auxiliary requests - amendments

Claim 1 of the 1st auxiliary request and claim 1 of the 2nd auxiliary request correspond essentially to claim 1 of the main request in that they both include feature (a) and the step of performing a feedback or feed-forward modification of the processing (point V. above, features (b)' and (b)''', respectively). Therefore, the objection mentioned above under points 1.2 to 1.4 applies to these claims as well.

Consequently, the subject-matter of claim 1 of the 1st auxiliary request and claim 1 of the 2nd auxiliary request contains subject-matter which extends beyond the application as filed, contrary to the provisions of Article 123(2) EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



S. Sánchez Chiquero

G. Eliasson

Decision electronically authenticated