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Datasheet for the decision of 13 September 2012

Case Number: T 0599/08 - 3.4.03

Application Number: 01902094.0

Publication Number: 1275144

IPC: H01L 21/66

Language of the proceedings: EN

Title of invention:
Method and apparatus for control of critical dimension using feedback etch control

Applicant:
ADVANCED MICRO DEVICES, INC.

Headword:
-

Relevant legal provisions:
EPC Art. 113(1), 123(2)
RPBA Art. 13(1), 15(3)

Relevant legal provisions (EPC 1973):
EPC Art. 56, 83, 84

Keyword:
"Added subject-matter (yes)"
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0599/08 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 13 September 2012

Appellant: (Applicant)
ADVANCED MICRO DEVICES, INC.
One AMD Place
Mail Stop 68
P.O. Box 3453
Sunnyvale CA 94088-3453 (US)

Representative:
Picker, Madeline Margaret
Brookes Batchellor LLP
102-108 Clerkenwell Road
London EC1M 5SA (GB)

Decision under appeal:
Decision of the Examining Division of the European Patent Office posted 9 October 2007 refusing European patent application No. 01902094.0 pursuant to Article 97(1) EPC 1973.

Composition of the Board:

Chairman: T. Bokor
Members: R. Q. Bekkering
T. Häusser

Summary of Facts and Submissions

I. This is an appeal against the refusal of application 01 902 094 for added subject-matter, Article 123(2) EPC, and for lack of novelty, Article 54(1) EPC 1973 over documents

D3: EP 0 656 573 A and

D4: US 6 027 842 A.

II. Summons to oral proceedings before the board requested by the appellant were issued on 13 March 2012 with an annex containing objections against the main and auxiliary request on file.

The appellant applicant then requested in writing that the decision under appeal be set aside and a patent granted on the basis of a new main request or auxiliary request, both filed with letter of 6 August 2012. Moreover, the board was informed that the appellant would not be represented at the oral proceedings.

Oral proceedings before the board took place in the absence of the appellant.

III. Claim 1 of the main request reads as follows:

"A method for controlling critical dimensions, comprising:
performing a standard process on a semiconductor device using a standard etch processing tool (440);
performing a critical dimension measurement upon said processed semiconductor device;

performing an analysis of said critical dimension measurement (250); and
performing a secondary process upon said semiconductor device using a secondary etch processing tool (475) in response to said critical dimension analysis (250), wherein performing said secondary process comprises selectively implementing a process of the same type as said standard process."

Claims 10 and 12 are directed at apparatuses for controlling critical dimensions.

IV. Claim 1 of the auxiliary request corresponds to claim 1 of the main request with the last feature being replaced by the following:

"*performing a secondary process upon said semiconductor device using a secondary etch processing tool (475) in response to said critical dimension analysis (250), wherein performing said secondary process comprises selectively implementing a process of the same type as said standard process, and wherein the standard process is an etch process and is performed intentionally undershooting or broadening the critical dimensions; and*
the secondary process is an etch process for fine tuning the critical dimensions."

V. Reference is also made to the following document:

D5: JP 09 283 491 A with corresponding Patent Abstracts of Japan and English computer translation.

VI. The appellant submitted in substance the following arguments:

The original description stating "*the secondary etch process is a selective etch process*" fully supported the claimed feature "*...selectively implementing a process...*".

Moreover, the claim's novelty and non-obviousness were readily apparent given the silence of the prior art. In particular, no basis was provided for the assertion that using a secondary processing device for the secondary process would have been obvious at the time of filing the application.

Reasons for the Decision

1. The appeal is admissible.

2. *Procedural issues*

The appellant's main and auxiliary requests for the grant of a patent on the basis of amended claims were filed after oral proceedings before the board were arranged.

Any such request entails inter alia an assessment by the board as to the conformity of the request with procedural requirements, the request being filed after the statement setting out the grounds of appeal have been submitted and thus its admission and consideration being subject to the board's discretion (Article 13(1) RPBA), as well as an assessment as to the conformity of

the claimed subject-matter with the requirements of the EPC, notably clarity, added subject-matter, novelty and inventive step, as a result of which grounds for a decision adversely affecting the appellant may arise. An appellant submitting such a request should, therefore, expect such grounds to be advanced.

An appellant renouncing to come to oral proceedings before the board to which it was duly summoned must be taken to waive its right to present comments on any such grounds (Article 113(1) EPC 1973).

It is, moreover, noted that a different conclusion, ie that the appellant should be given the opportunity to comment, specifically on his request being held inadmissible or not allowable, would make a continuation of the proceedings in writing necessary and thus oblige the board to delay its decision in the proceedings by reason only of the absence at the oral proceedings of the party, contrary to Article 15(3) RPBA.

In view of the fact that the requests were filed in advance of the oral proceedings, constitute an attempt to overcome the objections raised and are provided with reasons in support thereof, and as the board is satisfied that it is able to deal with the requests in substance, it exercises its discretionary powers under Article 13(1) RPBA so as to admit the requests into the proceedings.

3. *Main request*

3.1 *Amendments*

Amended claim 1 contains the feature "*wherein performing said secondary process comprises selectively implementing a process of the same type as said standard process*".

As pointed out in the annex to the summons to oral proceedings, however, no basis is found in the application as originally filed for "*selectively*" implementing a process. The amendment, thus, introduces subject-matter which extends beyond the content of the application as filed, contrary to the requirement of Article 123(2) EPC.

The appellant has referred in this respect to the original description at page 6, lines 15-16, which states "*the secondary etch process is a selective etch process*", arguing that this fully supported the claimed feature "*...selectively implementing a process...*".

However, selectively implementing a process differs from implementing a selective process, in the former definition the selectivity being a qualifier of the implementation of the process, in the latter of the process itself. The selective etch process disclosed in the application description is used to remove the sidewalls of the polysilicon gates structures on the semiconductor wafer while not removing the underlying gate-oxide or the overlying anti-reflective coating (page 6, lines 15 to 18). Selectively implementing a process on the other hand does not require the process

itself to be selective, but encompasses, for example, applying a non-selective etch process to selected wafers or areas of a wafer.

Moreover, claim 1 as amended contains the method steps "*performing a standard process on a semiconductor device using a standard etch processing tool*" and "*performing a secondary process upon said semiconductor device using a secondary etch processing tool*".

In the application as originally filed, however, no basis is found for performing anything other than an etch process on both the standard and secondary etch process tool. This amendment too, thus, introduces subject-matter, which extends beyond the content of the application as filed, contrary to the requirement of Article 123(2) EPC.

3.2 *Inventive step*

Moreover, the subject-matter of claim 1 also lacks an inventive step (Article 56 EPC 1973).

As argued in the annex to the summons to oral proceedings, document D3 discloses, in the terms of claim 1, a method for controlling critical dimensions, comprising:
performing a standard (etch) process on a semiconductor device using a standard etch processing tool (12)(cf figure 3, step 40);
performing a critical dimension measurement upon said processed semiconductor device (cf figure 3, step 32);
performing an analysis of said critical dimension measurement (cf figure 3, step 34); and

performing a secondary (etch) process upon said semiconductor device in response to said critical dimension analysis (cf figure 3, step 40), wherein performing said secondary process comprises selectively implementing a (selective) process of substantially the same type as said standard process.

Reference is in particular made to the feedback loop from step 40 to step 32 in figure 3 and to column 3, lines 31 to 37, where it is stated "*If desired, after material has been removed from the surface of the substrate, the thickness profile may be measured and compared again with the predetermined thickness profile. Accordingly, the method of the present invention may be repeated until the desired profile is achieved*".

The subject-matter of claim 1 of the main request differs from D3 in that the secondary process is performed "*using a secondary etch processing tool*".

Reference is also made to document D5.

Document D5 discloses, in the terms of claim 1, a method for controlling critical dimensions, comprising:
performing a standard (etch) process on a semiconductor device using a standard etch processing tool (cf figure 2B);
performing a critical dimension measurement upon said processed semiconductor device (cf figure 3B);
performing an analysis of said critical dimension measurement; and
performing a secondary (etch) process upon said semiconductor device in response to said critical dimension analysis, wherein performing said secondary

process comprises selectively implementing a (selective) process of substantially the same type as said standard process (cf abstract).

The subject-matter of claim 1 of the main request differs from D5 in that the secondary process is performed "*using a secondary etch processing tool*".

As would be readily apparent to a person skilled in the art, using the same tool for both the initial and the additional etch process would require changing the process parameters, which is inconvenient.

The problem to be solved relative to both D3 and D5 thus may be formulated as obviating the need for changing the process parameters of the process tool.

It would readily occur to a person skilled in the art entrusted with solving this problem to perform the additional etch in an additional tool instead.

The appellant's argument that the claim's novelty and non-obviousness were readily apparent given the silence of the prior art is not convincing, as the skilled person is considered to arrive at the claimed subject-matter based on straightforward considerations within the ambit of his common general knowledge.

Accordingly, the subject-matter of claim 1 of the main request does not involve an inventive step (Article 56 EPC 1973).

The above applies mutatis mutandis to claim 12, which is directed at a corresponding apparatus.

Claim 10 contains in addition to the features of claim 12, a photolithography process tool and metrology tool controlled by a control algorithm.

Photolithography process and metrology tools are, however, commonly used for photo mask generation, so that it would be obvious to a person skilled in the art to provide these tools for forming the photo mask in document D5.

Furthermore, it is known to use photolithography metrology data to correct the pattern dimension in the subsequent etching process (see eg document D4, column 20, lines 29 to 45). The subject-matter of claim 10 is, thus, obvious to a person skilled in the art (Article 56 EPC 1973).

3.3 Accordingly, the appellant's main request is not allowable.

4. *Auxiliary request*

4.1 *Amendments*

Amended claim 1 of the auxiliary request also contains the feature "*wherein performing said secondary process comprises selectively implementing a process of the same type as said standard process*".

As for the main request, however, no basis is found in the application as originally filed for "*selectively*" implementing a process. The amendment, thus, introduces subject-matter, which extends beyond the content of the

application as filed, contrary to the requirement of Article 123(2) EPC.

4.2 *Inventive step*

According to claim 1 of the auxiliary request as amended, "*the standard process is an etch process and is performed intentionally undershooting or broadening the critical dimensions, and the secondary process is an etch process for fine tuning the critical dimensions*".

In the method according to document D5 the initial etch process is performed intentionally yielding a structure width broader than the target critical dimension, ie "*broadening the critical dimensions*" as claimed.

Accordingly, the subject-matter of claim 1 of the auxiliary request does not involve an inventive step either (Article 56 EPC 1973).

4.3 As to the claimed alternative of performing the standard etch process "*intentionally undershooting the critical dimensions*", it is noted that it is unclear how a semiconductor device with the critical dimension can be obtained in this case.

According to the application description, the method is used in particular for controlling the width of the polysilicon gate structure of a semiconductor device as a critical dimension. As indicated in the description, control of polysilicon gate critical dimensions affects the production quality of semiconductor products, such as microprocessors, memory, and the like. In many cases,

the critical dimensions correlate directly to the performance of semiconductor devices. For example, the critical dimension of a semiconductor device affects the speed of the functionality of the semiconductor device. As a result, excessive variation in critical dimension control can result in unacceptably slow semiconductor devices (ie having a gate width larger than the target critical dimension), high revenue fast parts, and a large number of high leakage products from unacceptably fast semiconductor devices (ie having a gate width smaller than the target critical dimension) (cf page 3, lines 22 to 30).

Intentionally undershooting the critical dimension in the standard etch process as now claimed results in a gate structure having a width smaller than the target critical dimension. It is unclear how this can be corrected by a subsequent secondary etch process for fine tuning the critical dimensions, which, as would be commonly understood, can only further reduce the width of the gate structure.

Accordingly, claim 1 of the auxiliary request as amended moreover lacks clarity, contrary to the requirement of Article 84 EPC 1973, and in fact in this respect the application as a whole is not considered to disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, contrary to the requirement of Article 83 EPC 1973.

4.4 The appellant's auxiliary request is, therefore, not allowable either.

Order

For these reasons it is decided that:

The appeal is dismissed.

Registrar Chair

S. Sánchez Chiquero T. Bokor