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Datasheet for the decision of 3 March 2020

Case Number: T 2483/16 - 3.4.03

Application Number: 10183272.3

Publication Number: 2267762

IPC: H01L21/20, H01L21/02, C30B25/02, C30B29/52, H01L21/8238

Language of the proceedings: EN

Title of invention:
Semiconductor heterostructures having reduced dislocation pile-ups and related methods

Applicant:
Taiwan Semiconductor Manufacturing Co., Ltd.

Headword:

Relevant legal provisions:
EPC Art. 97(2)
EPC R. 103(1)(a)
EPC 1973 Art. 84, 111(1)

Keyword:
Claims - support in the description (no)

Decisions cited:
T 0127/02, T 1048/05

Catchword:

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Office européen des brevets

Beschwerdekammern

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Case Number: T 2483/16 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 3 March 2020

Appellant: (Applicant)	Taiwan Semiconductor Manufacturing Co., Ltd. No. 8, Li-Hsin Rd. 6 Science-Based Industrial Park Hsin-Chu, 300-77 (TW)
Representative:	Burton, Nick Urquhart-Dykes & Lord LLP Arena Point Merrion Way Leeds LS2 8PA (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 20 May 2016 refusing European patent application No. 10183272.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	G. Eliasson
Members:	T. M. Häusser
	C. Heath

Summary of Facts and Submissions

I. The appeal concerns the decision of the examining division refusing the European patent application No. 10183272.3 for lack of clarity (Article 84 EPC 1973) in relation to the former main request and second auxiliary request. The former first auxiliary request was not admitted into the proceedings (Rule 137(3) EPC).

II. The oral proceedings before the board took place in the absence of the appellant (applicant) of which the board had been informed beforehand. In writing the appellant had requested that the decision under appeal be set aside and a patent be granted based on a main request or a first, second or third auxiliary request, all requests filed with letter dated 3 February 2020.

III. The wording of respective claim 1 of the various requests is as follows (board's labelling "(a)", "(b)", "(c)", "(a)'", and "(c)'"):

Main request:

"1. A method of forming a relaxed graded semiconductor layer on a semiconductor substrate, the method comprising the steps of:
(a) providing a first semiconductor layer comprising a seed layer proximal to a surface of the semiconductor substrate, wherein the first semiconductor layer has a plurality of threading dislocations distributed uniformly across a surface thereof,
(b) providing a compositionally uniform cap layer over the surface of the first semiconductor layer, the cap layer being relaxed, and

(c) epitaxially growing over the compositionally uniform cap layer a relaxed graded layer comprising silicon and germanium, with increasing germanium content at a gradient exceeding 40% Ge μm^{-1} to a final composition having a germanium content ranging from greater than 0% to 100% and a threading dislocation density not exceeding 10^7 cm^{-2}, wherein the relaxed graded layer has a non-linear profile, having a step grading, having smaller regions having different local grading rates."

First auxiliary request:

Claim 1 of the first auxiliary request differs from claim 1 of the main request in that feature (c) is replaced by the following feature (marking of the changes here and below by the board):

(c)' "epitaxially growing, at a temperature ranging from 900 to 1200°C and at a rate greater than 1 $nm.s^{-1}$, over the compositionally uniform cap layer a relaxed graded layer comprising silicon and germanium, with increasing germanium content at a gradient exceeding 40% Ge μm^{-1} to a final composition having a germanium content ranging from greater than 0% to 100% and a threading dislocation density not exceeding 10^7 cm^{-2}, wherein the relaxed graded layer has a non-linear profile, having a step grading, having smaller regions having different local grading rates, and wherein the relaxed graded layer has a thickness ranging from 0.1 to 4.0 µm."

Second auxiliary request:

Claim 1 of the second auxiliary request differs from claim 1 of the main request in that feature (a) is replaced by the following feature:

(a)' "providing a first semiconductor layer comprising a seed layer proximal to a surface of the semiconductor substrate, wherein the first semiconductor layer has a plurality of threading dislocations distributed uniformly across a surface thereof, the method including growing the first semiconductor layer to several times its critical thickness at a temperature high enough to ensure equilibrium strain relaxation,"

Third auxiliary request:

Claim 1 of the third auxiliary request differs from claim 1 of the main request in that features (a) and (c) are replaced by features (a)' and (c)', respectively.

IV. The appellant argued essentially as follows:

The claimed subject-matter had a basis in the application as filed, reference being made to claim 9 of the second auxiliary request filed during the oral proceedings before the examining division.

Furthermore, a substantial procedural violation had occurred during the examination proceedings.

Reasons for the Decision

1. Procedural matters

1.1 Right to be heard

With letter dated 19 February 2020 the appellant stated that it would not be attending the oral proceedings scheduled before the board, which thus took place in the appellant's absence in accordance with Rule 71(2) EPC 1973.

According to Article 15(3) and (6) RPBA 2020, the board is not "obliged to delay any step in the proceedings, including its decision, by reason only of the absence at the oral proceedings of a party duly summoned who may then be treated as relying only on its written case" and has to "ensure that each case is ready for decision at the conclusion of the oral proceedings, unless there are special reasons to the contrary".

The appellant could expect that it would be discussed during oral proceedings whether the claims of the present requests, which had been filed one month prior to the oral proceedings, were supported by the description. By not attending the oral proceedings before the board the appellant forewent the opportunity to present its case orally, meaning that it chose to rely on its written submissions only.

The board's decision which hinges on the issue of support by the description (see below), is therefore in conformity with the requirements of Article 113(1) EPC 1973 that the decisions of the EPO may only be based on grounds or evidence on which the parties concerned have had an opportunity to present their comments.

Accordingly, the case was ready for decision at the conclusion of the oral proceedings in accordance with Article 15(6) RPBA 2020.

1.2 Alleged procedural violation

The appellant requested reimbursement of the appeal fee based on the argument that a substantial procedural violation had occurred during the examination proceedings.

According to Rule 103(1)(a) EPC it is a precondition for the reimbursement of the appeal fee that the appeal is allowable. Since in the present case none of the requests meets the requirements of the EPC (see below) this precondition is not fulfilled and hence the appeal fee may not be reimbursed. It is therefore not necessary to decide whether a substantial procedural violation had actually occurred during the first instance proceedings and whether the reimbursement of the appeal fee was equitable by reason of such a procedural violation as stipulated in Rule 103(1)(a) EPC.

2. Support by the description

2.1 According to Article 84 EPC 1973 the claims define the matter for which protection is sought and have to be, *inter alia*, supported by the description.

This requirement means that the claimed subject-matter must have an adequate basis in the description and that the scope of the claims may not go beyond what is justified by the description and the drawings. In particular, the claimed subject-matter must have technical support in the description reflecting the applicant's effective contribution to the art. However, purely formal support, e. g. a verbatim repetition in the description of a claimed feature, is not sufficient

for fulfilling this requirement (see **T 127/02**, point 3 of the Reasons; **T 1048/05**, point 11 of the Reasons).

2.2 In respective claim 1 of all requests, it is specified that
(c1) a relaxed graded layer comprising silicon and germanium is epitaxially grown over the compositionally uniform cap layer (part of features (c) and (c)', respectively, indicated under point III. above).

The question arises whether respective claim 1 of all requests is supported by the description, in particular in relation to the aspect of feature (c1).

2.3 The appellant did not specifically point to support of the claims in the description and merely cited claim 9 of the second auxiliary request filed during the oral proceedings before the examining division as a basis for feature (c1).

2.4 The description currently on file consists of pages 1-4 and 11-23 filed with letter dated 21 January 2013 and respective replacement pages 5-9 (main request and second auxiliary request) and replacement pages 5-8 (first and third auxiliary requests), all filed with letter dated 3 February 2020.

It is to be noted that none of the described embodiments disclose that the relaxed graded layer is epitaxially grown over the uniform cap layer as specified in feature (c1). This holds for all requests.

Rather, in relation to the first embodiment shown in Figure 1 it is indicated in the description of the application that the cap layer 150 is the outermost layer of a "virtual substrate" and constitutes the

layer over which the compressively strained layer 160 and/or the tensilely strained layer 170 are disposed. In particular, the compositionally uniform, relaxed cap layer 150 is disposed over the graded layer 140 (see page 11, lines 16-22 and page 13, line 26 to page 14, line 28 of the description of the application).

Furthermore, Figures 2 and 4 and the corresponding passages in the description of the application relate to the germanium concentration in the different layers of the semiconductor structure of the embodiment of Figure 1 according to two versions of this embodiment (see page 11, lines 1-3 and 6-8). Accordingly, the respective cap layer 150 and 450 of Figures 2 and 4 is disposed over the respective graded layer 140 and 440, respectively (see page 15, lines 20-24; page 19, lines 15-23).

In the embodiment of Figure 5 the cap layer 550 is also disposed over the graded layer 540 (see the paragraph bridging pages 19 and 20).

Figure 6 and the corresponding part of the description merely relate to specific devices, namely a PMOS transistor 680 and an NMOS transistor 686, using a virtual substrate structure of the embodiments described with reference to Figures 1, 2, 4, and 5 (see the paragraph bridging pages 22 and 23).

Hence, the description of the embodiments of the invention does not provide technical support of the claimed subject-matter in relation to feature (c1).

3. Claim 9 of the second auxiliary request filed during the oral proceedings before the examining division,

which was cited by the appellant as a basis for feature (c1), contains a similar wording as that feature.

The respective description pages of the various requests do not even contain a verbatim repetition of feature (c1). Merely a reference to the independent claims is contained in the part of the description setting out the invention in general terms (see respective page 7 for all requests). However, such a reference merely constitutes a purely formal support and is insufficient for fulfilling the requirement that the claims be supported by the description as indicated under point 2.1 above.

3.1 In view of the above, respective claim 1 of all requests is not supported by the description contrary to the requirements of Article 84 EPC 1973.

4. Conclusion

Since none of the requests on file meets the requirements of the EPC, the examining division's decision refusing the application is confirmed. Consequently the appeal has to be dismissed (Articles 97(2) EPC and 111(1) EPC 1973).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Sánchez Chiquero G. Eliasson

Decision electronically authenticated