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# Datasheet for the decision of 25 March 2021

**Case Number:** T 0386/17 - 3.4.03

**Application Number:** 07017348.9

**Publication Number:** 1898450

**IPC:** H01L21/20

**Language of the proceedings:** EN

**Title of invention:**
Epitaxial silicon wafer and fabrication method thereof

**Applicant:**
SUMCO CORPORATION

**Headword:**

**Relevant legal provisions:**
EPC 1973 Art. 54

**Keyword:**
Novelty - (no)

**Decisions cited:**
T 0594/01

**Catchword:**

A claimed feature that an angle has a magnitude of "more than 0 degrees" does not establish novelty over a prior art disclosure in which the corresponding angle is equal to 0 degrees, since the feature encompasses values closer to 0 degrees than the finite error margin to which the determination of the magnitude of the angle would always be subject, and such values would, in practice, be indistinguishable from 0 degrees (see Reasons, point 2.8, confirming T 594/01).

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**Case Number: T 0386/17 - 3.4.03**

# D E C I S I O N
# of Technical Board of Appeal 3.4.03
# of 25 March 2021

| | |
|---|---|
| **Appellant:** (Applicant) | SUMCO CORPORATION<br>2-1, Shibaura 1-chome<br>Minato-ku,<br>Tokyo (JP) |
| **Representative:** | Adam, Holger<br>Kraus & Weisert<br>Patentanwälte PartGmbB<br>Thomas-Wimmer-Ring 15<br>80539 München (DE) |
| **Decision under appeal:** | **Decision of the Examining Division of the European Patent Office posted on 28 July 2016 refusing European patent application No. 07017348.9 pursuant to Article 97(2) EPC.** |

**Composition of the Board:**

| | |
|---|---|
| **Chairman** | G. Eliasson |
| **Members:** | S. Ward |
| | T. Bokor |

## Summary of Facts and Submissions

I. The appeal is against the decision of the Examining Division to refuse European patent application No. 07 017 348 on the grounds that the subject-matter of the main request and the first auxiliary request was not new within the meaning of Article 54 EPC, and the subject-matter of the second auxiliary request did not meet (at least) the requirements of Article 84 EPC.

II. At the end of the oral proceedings held before the Board the appellant confirmed its request that the decision under appeal be set aside, and a patent be granted on the basis of claims 1 and 2 of the sole request filed with letter dated 24 February 2021.

III. The following document is referred to:

D1: EP 1 592 045 A1

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

*"An epitaxial silicon wafer comprising: a silicon wafer; and an epitaxial layer provided on the silicon wafer,*
*characterized in that the epitaxial silicon wafer further comprising:*
*a main surface inclined from a {110} plane,*
*wherein, with respect to the main surface, an inclination angle azimuth (ψ) of the {110} plane is in a range of more than 0 degrees and 20 degrees or less as measured from a <100> orientation that is parallel to the {110} plane toward a <110> direction, and*

*wherein, with respect to the main surface, an inclination angle (ξ) of the {110} plane is in a range of more than 0 degrees and not more than 10 degrees."*

V. Following the summons to oral proceedings, the Board sent the appellant a communication under Article 15(1) RPBA setting out its provisional views. The Board noted that D1 disclosed an arrangement in which the inclination angle azimuth was aligned with the [001] and [00-1] directions, which, translated into the terminology of the present application, meant that the angle ψ was equal to 0 degrees, whereas the claimed range for ψ had a lower limit of "more than 0 degrees".

The Board cited the decision T 594/01of 30 March 2004 and provisionally approved the approach taken therein to the question of novelty. If applied to the present case, this approach would appear to lead to the conclusion that the claimed subject-matter lacked novelty in view of D1.

VI. The appellant's arguments, insofar as they are relevant to the present decision, may be summarised as follows:

D1 provided a general teaching to tilt the main surface towards the [001] direction, hence with an inclination angle azimuth (ψ) equal to zero. The teaching of the claimed invention was not to choose this direction (claim 1 defined ψ to be in a range of more than 0 degrees and 20 degrees or less). This was a clear difference over D1.

The case was not comparable to the case underlying the decision cited by the Board (T 594/01), in which the relevant prior art disclosure was merely one of several examples. In the present case, D1 provided a general

teaching of inclining the main surface towards the [001] direction (0 degree for the inclination angle azimuth). The invention defined a departure from this general teaching.

At the time of invention, when the inclination angle azimuth (ψ) was 0 degrees, the epitaxial silicon wafer sometimes did not exhibit characteristics desirable for an electronics device. Therefore, the inventor of the present invention set a preferable range of the inclination angle azimuth (ψ) which did not include 0 degrees. This range of the inclination angle azimuth (ψ) was an advantageous range, which indicated the presence of an inventive step, in that an epitaxial silicon wafer was formed having good characteristics in the flow direction of the carriers of an electronics device, since the effects of surface roughness and haze decreased.

## Reasons for the Decision

1. The appeal is admissible.

2. *Novelty*

2.1 The invention according to claim 1 concerns an "epitaxial silicon wafer comprising: a silicon wafer; and an epitaxial layer, provided on the silicon wafer", the main surface of the wafer being inclined from a {110} plane. Claim 1 further defines *inter alia* the following feature:

*"wherein, with respect to the main surface, an inclination angle azimuth (ψ) of the {110} plane is in*

*a range of more than 0 degrees and 20 degrees or less as measured from a <100> orientation that is parallel to the {110} plane toward a <110> direction".*

2.2 Document D1 also discloses a silicon wafer having an epitaxial layer, the main surface of the wafer being inclined from a {110} plane (see e.g. claim 3). In D1 the inclination of the main surface with respect to the (110) plane is aligned with the [001] and [00-1] directions (see D1, paragraph [0039]; Figs. 7 and 8).

The appellant accepts that the arrangement of D1 has, in the terminology of the present application, an inclination angle azimuth (ψ) of 0 degrees. Since the claimed range for ψ has a lower limit of "more than 0 degrees", the appellant argues that the claimed invention is novel over D1.

2.3 At oral proceedings the appellant confirmed that this feature was seen as the sole difference over D1, and hence, in relation to the question of novelty, the task of the Board is to decide whether a lower limit for the claimed parameter ψ defined as "more than 0 degrees" is sufficient to establish that the invention is new within the meaning of Article 54(1) EPC 1973 when the corresponding parameter in the state of the art is 0 degrees.

2.4 In its communication pursuant to Article 15(1) RPBA, the Board cited the decision T 594/01. The case concerned a "process for the preparation of ethylene glycols", and claim 1 of the main request and the first auxiliary request included *inter alia* the feature that "the process is performed with less than 0.1 wt% of carbon dioxide in the reaction mixture" (Summary of Facts and Submissions, point VI).

2.5 The prior art ("document (1)") disclosed (in "Example No. 4") a similar process for the preparation of ethylene glycols in which the carbon dioxide concentration was *equal to* 0.1 wt%, and the deciding Board noted that, in relation to the question of novelty, it was "not disputed that the sole issue to be decided is whether there is an overlap between the carbon dioxide concentration ranges defined in any of the requests at issue and the carbon dioxide concentration values disclosed in document (1)" (Reasons, points 4.1.1 and 4.1.2).

2.6 In point 4.1.5 of the Reasons, the Board found as follows:

*"Furthermore, although the Board concurs with the Appellant that only an unambiguous disclosure may be considered in assessing novelty, it remains the case that any technical information is addressed to a skilled reader. In that context, it must be pointed out that it is common general knowledge, as shown by document (10) on page 46, that every experimental measurement in quantitative analytical chemistry as well as any result of any physical measurement cannot be dissociated from the margin of uncertainty attached to the measurement. Normally, the uncertainty of a measured experimental value is irrelevant for the assessment of novelty. However, when a specific experimental value is disclosed in an example of the prior art, seeking to distinguish the claimed subject-matter therefrom only in terms of an upper limit required to be 'lower than' the experimental value must fail as the claimed subject-matter is still not distinguishable from the prior art within the margin of experimental error."*

As a result, the Board found that the subject-matter of claim 1 of the main and first auxiliary requests lacked novelty over document (1) (Reasons, point 4.1.7).

2.7 In the present case, there was a disagreement between the applicant and the Examining Division on the question whether D1 explicitly disclosed an error margin for the inclination angle azimuth (Reasons, point 14.1). The Board does not regard this question as having any importance, since, in any laboratory or industrial operation, it is impossible to measure an angle or align a direction with infinite accuracy, and such operations will always be subject to a small but finite error. This includes (whether explicitly disclosed or not) the alignment of the inclination azimuth with the [001] and [00-1] directions in D1 (or, in the terminology of the present application, the operation of setting $\psi = 0$).

2.8 A claimed feature that an angle has a magnitude of "more than 0 degrees" does not establish novelty over a prior art disclosure in which the corresponding angle is equal to 0 degrees, since the feature encompasses values closer to 0 degrees than the finite error margin to which the determination of the magnitude of the angle would always be subject, and such values would, in practice, be indistinguishable from 0 degrees.

2.9 The appellant argued that, in the prior art cited in T 594/01, a carbon dioxide concentration equal to 0.1 wt% was disclosed only in one particular example amongst others. The present case was different, as it was the clear general teaching of D1 to align the inclination of the main surface with the [001]/[00-1] direction (i.e. to set $\psi = 0$), whereas claim 1 of the

present application specifically defined *not* to choose this direction.

2.10 It is not entirely clear to the Board why the appellant considers this distinction to be important. Article 54 EPC 1973 refers to "the state of the art", and makes no distinction between a "general teaching" and a "specific example". The Board can only understand the appellant's argument in the following sense: where multiple examples are disclosed in the prior art, a skilled person would regard any one of them (e.g. a carbon dioxide concentration equal to 0.1 wt%) as merely a possibility, whereas, when a disclosure is given in the form of a general teaching (e.g. to set $\psi = 0$), it would not occur to the skilled person to depart from that teaching (e.g. to set $\psi > 0$, as claimed).

2.11 While such an argument might possibly have relevance for the question of inventive step, the Board cannot see how it could be relevant for the assessment of novelty. The question at issue is not whether a skilled person would consider departing from what is disclosed in the prior art, but rather (briefly summarised) whether a feature in the form $\psi > 0$ is sufficient to distinguish the claimed subject-matter from the condition $\psi = 0$ disclosed in the prior art.

2.12 Since the formulation of claim 1 fails to exclude embodiments which would, in practice, be indistinguishable from the prior art, the Board judges that the subject-matter of claim 1 is not new within the meaning of Article 54 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