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D E C I S I O N
of 23 November 2000

Case Number: T 0551/97 - 3.2.2

Application Number: 86109893.7

Publication Number: 0209150

IPC: C30B 25/08

Language of the proceedings: EN

Title of invention:

Apparatus of metal organic vapor deposition for growing epitaxial layer of compound semiconductor

Patentee:

FUJITSU LIMITED

Opponent:

Aixtron GmbH

Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 56

Keyword:

"Relevance of late-filed documents (no)"

"Remittal to first instance (no)"

"Apportionment of costs (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0551/97 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 23 November 2000

Appellant: Aixtron GmbH
(Opponent) Kackertstrasse 15-17
D-52072 Aachen (DE)

Representative: München, Wilhelm, Dr.
Dr. München & Kollegen
Anwaltskanzlei
Wilhelm-Mayr-Str. 11
D-80689 München (DE)

Respondent: FUJITSU LIMITED
(Proprietor of the patent) 1015, Kamikodanaka
Nakahara-ku
Kawasaki-shi
Kanagawa 211 (JP)

Representative: Schmidt-Evers, Jürgen, Dipl.-Ing.
Patentanwälte
Mitscherlich & Partner
Postfach 33 06 09
D-80066 München (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 11 March 1997
rejecting the opposition filed against European
patent No. 0 209 150 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: W. D. Weiß
Members: S. S. Chowdhury
J. C. M. De Preter
D. Valle
R. T. Menapace

Summary of Facts and Submissions

I. The Appellant (opponent) lodged an appeal against the decision of the opposition division to reject the opposition against patent No. 0 209 150. The decision was dispatched on 11 March 1997.

The appeal was filed and the fee for the appeal was paid on 12 May 1997. The statement setting out the grounds of appeal was received on 21 July 1997.

The opposition was filed against the whole patent and based on Article 100(a) EPC (lack of inventive step).

The opposition division had decided that the claims of the patent as granted met the requirements of Article 52(1) EPC.

The following prior art documents were cited during the appeal proceedings:

B1: Handschuhboxen und Gasreinigungssysteme - Das technische Konzept, Firmendruckschrift der Fa. MBraun, München;

B2: Handschuhboxen Typenreihe MB 200-B, Prospekt der Fa. MBraun, München;

B3: DE-A-3 425 267;

E1: Drawing from the opponent dated 30 May 1985 and entitled "Gasmischsystem Glovebox / Steuerung".

The documents B1 and B2 were filed after the expiration of the time limit for opposition and not admitted into

the procedure by the opposition division under Article 114(2) EPC as being late filed, and the document B3 was cited for the first time with the grounds of appeal. The opposition division had decided that Document E1 had not been made available to the public before the priority date (19 July 1985) of the patent in suit.

The respondent (patent proprietor) doubted that the documents B1 and B2 were prior published, argued that they should not be admitted into the appeal procedure, and submitted arguments that they do not endanger the patent under Article 52(1) EPC.

II. Oral proceedings took place on 23 November 2000, at the end of which the following requests were put forward:

The appellant requested that:

- the decision under appeal be set aside and that the patent be revoked, or
- the decision under appeal be set aside and the case be remitted to the first instance for further prosecution (auxiliary request).

The respondent requested that:

- the appeal be rejected as inadmissible, or
- the appeal be dismissed (first auxiliary request), or
- the case be remitted to the first instance for further prosecution and that its costs for the

appeal procedure be imposed on the appellant
(second auxiliary request).

III. Independent claims 1 and 3 of the patent in suit read as follows (the claims have been subdivided into the features (a), (b), (c), etc. and (A), (B), (C), etc. to facilitate their comparison with the prior art):

1. "A metal organic chemical vapor deposition MOCVD process for growing at least one epitaxial layer of compound semiconductor on wafers, said process comprising the following steps:
 - (a) introducing said wafers into a load lock chamber,
 - (b) evacuating said load lock chamber and filling it with inert gas,
 - (c) continuously filling inert gas into a transfer chamber and continuously draining said inert gas from said transfer chamber while keeping the gas pressure in said transfer chamber at essentially atmospheric pressure,
 - (d) opening closing means between said load lock chamber and said transfer chamber,
 - (e) transferring said wafers from said load lock chamber into said transfer chamber,
 - (f) closing said closing means between said load lock chamber and said transfer chamber,
 - (g) filling inert gas into a reaction chamber and draining said inert gas from said reaction chamber,
 - (h) opening closing means between said transfer chamber and said reaction chamber,
 - (i) transferring said wafers from said transfer chamber to said reaction chamber,
 - (j) closing said closing means between said transfer chamber and said reaction chamber,
 - (k) filling respective MOCVD processing gases into said

reaction chamber and draining said gases from said reaction chamber whereby at least one epitaxial layer of compound semiconductor is growing on said wafers."

3. "Apparatus of metal organic chemical vapor deposition (MOCVD) for growing an epitaxial layer of compound semiconductor on a wafer (37), **characterized in,**

- (A) a supporting means comprising
- (B) a susceptor (17) for receiving the wafer (37) on it,
- (C) a connecting rod (16), one end of which is connected to said susceptor (17), and
- (D) a lid (15) connected to another end of said connecting rod (16);
- (E) a reaction chamber (13) for effecting said MOCVD process therein comprising
- (F) a first gas inlet (13b) for introducing gases for MOCVD processing into said reaction chamber (13), and
- (G) a first gas outlet (13c) for draining said gases;
- (H) a load lock chamber (12) for loading and unloading the wafer (37) into and from said reaction chamber (13), said load lock chamber (12) comprising
- (I) a second gas inlet (12b) for introducing an inert gas into said load lock chamber (12),
- (J) a second gas outlet (21) for evacuating said load lock chamber (12),
- (K) an evacuation pump (22) for evacuating said load lock chamber (12) through said second gas outlet (21),
- (L) a door (12a) leading to the open-air area, through said door (12a) the wafer (37) being inputted from the open air area into said load lock chamber (12) as well as outputted therefrom, said door (12a) capable of being vacuum-sealed as well as opened, and
- (M) said load lock chamber being capable of being

evacuated; and

(N) a transfer chamber (11) provided between said reaction chamber (13) and said load lock chamber (12) comprising

(O) a third gas inlet (11a) for introducing an inert gas into said transfer chamber (11);

(P) a third gas outlet (11b) for draining gas therein,

(Q) a first opening (12d) for connecting said transfer chamber (11) to said load lock chamber (12), through said first opening (12d) the wafer (37) being inputted into said transfer chamber (11) from said load lock chamber (12) as well as outputted from said transfer chamber (11) to said load lock chamber (12),

(R) said opening (12d) being capable of being opened as well as vacuum-sealed by said lid (15) while said load lock chamber (12) is evacuated as well as while said door (12a) is open,

(S) a second opening (13d) for connecting said transfer chamber (11) to said reaction chamber (13), through said second opening (13d) the wafer (37) being inputted from said transfer chamber (11) into said reaction chamber (13) as well as outputted from said reaction chamber (13) into said transfer chamber (11),

(T) said second opening (13d) being capable of being opened as well as vacuum-sealed, and

(U) transfer means for transferring said supporting means from said load lock chamber (12) into said reaction chamber (13) as well as from said reaction chamber (13) into said load lock chamber (12),

(V) a liner tube (14), one end of which is detachably attached to said lid (15), said liner tube (14) being capable of being inserted into said load lock chamber (12) as well as said reaction chamber (13), said liner tube (14) being transferable between said load lock chamber (12) and said reaction chamber (13) by said

transfer means together with said supporting means, and said liner tube (14) enclosing said susceptor (17) and said wafer (37) on it, such that the inner surface of said reaction chamber (13) is protected from deposition of materials caused by said MOCVD reaction."

IV. The appellant submitted the following arguments:

The documents B1 and B2 both referred to the series MB 200-B glove box from the firm MBraun, which could be used for handling semiconductor materials and for the study of organo-metallic compounds. The glove box had modular add-on units including a vacuum lock of the type SCH with a manual operating device SCHA-E on one side of the glove box, and a vacuum oven of the type OH-550 on the other side, as shown in the figure on page 11 of document B1. Both the vacuum lock and the oven had a door to the glove box, together with means for introducing a gas and means for evacuation.

In use the vacuum lock and the vacuum oven would both be evacuated, and in order to be able to open isolating doors between them and the glove box, they would have to be filled with inert gas in order to equalise the pressure on either side of the respective door. The glove box itself was continuously purged with inert gas. The only feature of claim 1 of the patent in suit not disclosed in these documents was the use of an MOCVD reactor, but the person skilled in the art would not be hindered from exchanging the oven for such a reactor, given the reference on page 3 of document B1 to organo-metallic compounds. Moreover, no step of claim 1 except the last step related in any way to a MOCVD process.

The apparatus of claim 3 was simply the apparatus for carrying out the process of claim 1, with an automatic transfer means for transporting semiconductor wafers from one chamber to the next, and means for protecting the reaction chamber from deposition of materials from the MOCVD reaction. Such automatic transfer means were disclosed in document B3, and its use in the glove box of documents B1/B2 was obvious. Similarly, the use of means for protection against unwanted deposition of materials on apparatus parts was also known from the document B3.

V. The respondent submitted the following arguments:

Apart from the doubt about the publication dates of the documents B1 and B2, these documents were also not relevant. They failed to disclose features (b), (g), (h), (j), and (k) of claim 1 and features (A), (B), (C), (D), (F), (G), (I), (T), and (V) of claim 3. Moreover, the apparatus of these documents was not an MOCVD apparatus, and these documents disclosed studying materials, not manufacturing a semiconductor wafer device. There was also considerable doubt as to exactly which features these documents actually disclosed.

Reasons for the Decision

1. Admissibility of the appeal.

The respondent has challenged the admissibility of the appeal on the ground that the appeal was based exclusively on late filed documents (B1 and B2) which, owing to their lack of relevance, had been disregarded by the opposition division on the ground of

Article 114(2) EPC, and on a document (B3) which was first cited with the grounds of appeal.

According to the jurisprudence of the Boards of Appeal an appeal may be inadmissible, if it does not specify the legal or factual reasons on which the case for setting aside the decision is based.

The decision under appeal does not mention the documents B1 and B2 on which the grounds of appeal are based at all, but is exclusively founded on other oral and written evidence which were found not to prejudice the maintenance of the patent unamended. This explicit reasoning of the opposition division has, in fact, not been challenged in the grounds of appeal. The minutes of the oral proceedings on 11 March 1997 state, however, that two leaflets, copies of which are annexed to the minutes in the file, were presented in the course of the oral proceedings. On page 2, second paragraph, of the minutes is stated: "The Chairman declared that at the present time the leaflets would not be introduced into the procedure since they did not go beyond the original submissions." This statement must be considered as an intermediate decision by the opposition division negatively affecting the appellant, which should also have been dealt with in the final decision, and must be regarded as belonging to its implicit content. The decision under appeal is defective in this respect.

Since, therefore, the letter of 21 July 1997 specifies the reasons on which the case for setting aside the decision under appeal is based, this letter constitutes "a written statement setting out the grounds of appeal" in the meaning of Article 108, last sentence,

EPC.

Since the other requirements of Articles 106 to 108, as well as Rules 64 and 65 EPC are also met, the appeal is admissible.

2. In view of the appellant's objections in its grounds of appeal, the primary issue to be examined by the Board is, therefore, whether the documents B1 and B2, as regards their substantive merits, are of such minor relevance that the opposition division was justified in not admitting them into the procedure. It will then have to be examined, whether the additional consideration of document B3, which was first cited at the appeal stage, enhances the relevancy of these two documents. In order to do this, it is necessary to consider the invention as represented by the subject-matter of the independent claims 1 and 3 and then to analyse these documents.

3. *The invention claimed in claim 1*

3.1 The opposed patent relates to a process and an apparatus for Metal Organic Chemical Vapor Deposition (MOCVD) for the epitaxial growth of compound semiconductor wafers, which growth is adversely influenced by undesirable foreign gases. Aluminum antimony, indium and gallium, etc. used in the process are susceptible of oxidation, so extreme care should be taken to avoid the invasion of foreign gases containing oxygen or water vapor into the apparatus.

Prior art efforts to prevent foreign gas invasion have involved employing a load lock chamber through which nitrogen gas flows, for loading as well as unloading

the semiconductor wafers into and from the reaction chamber. Such an apparatus is described with reference to Figure 1 of the patent in suit.

The load lock chamber is purged to some degree by a nitrogen gas flow, but there still remain foreign gases which are adsorbed on the wafers, the tools or the walls of the load lock chamber and they may then invade the reaction chamber. If more perfect removal of the remaining foreign gases is required, the load lock chamber must be evacuated to a much higher degree of vacuum or baked at an elevated temperature, requiring more operation time and more sophisticated apparatus.

3.2 The problem

Starting from this prior art the technical problem to be solved is defined in column 3 of the patent in suit as follows: "It is an object of the present invention to provide a process and means for loading semiconductor wafers into the MOCVD reaction chamber in order to perfectly prevent an invasion of undesirable foreign gases into the reaction chamber from the outside."

3.3 The solution

The features defined in claim 1 are directed to this problem. Notable amongst these features are the following: The load lock chamber is evacuated and filled with an inert gas thereafter, and the transfer chamber is continuously filled with an inert gas which is drained away. For preventing a gas flow into the reaction chamber from the transfer chamber, whose gases are not as pure and clean as those of the reaction

chamber, the opening therebetween is sealed while an inert gas is kept flowing in the reaction chamber. The opening is unsealed to transfer the semiconductor wafer from the transfer chamber to the reaction chamber, after which the opening is re-sealed and the gas flow in the reaction chamber is changed from the inert gas to the MOCVD reaction gas.

The final steps of claim 1 ensure that foreign gases which are adsorbed on the wafers cannot pass from the transfer chamber to the reaction chamber.

4. *The disclosure of documents B1 and B2*

- 4.1. These documents both relate to the same glove box apparatus of the series MB200-B of the firm MBraun, and those features that are clearly disclosed in these documents will be discussed first. Page 11 of document B1 shows that a load lock chamber (Vacuumschleuse) and an oven may be attached on either side of a glove box. According to page 10, the load lock chamber SCH-E having a mechanism for evacuating and purging it may be used, and the oven may be a vacuum oven, and on page 4 it is stated that the glove box may be purged continuously with inert gas ("The circulation method") or the boxes are put under pressure slightly above normal ("Method 1"). The originals of the documents B1 and B2 show a door between the glove box and the oven and between the glove box and the load lock chamber. According to page 2 of document B1 the uses of the glove box include "handling of semiconductor materials" or "the study of organo-metallic compounds".

Although these documents disclose mainly an apparatus and not a method, a method of operating the apparatus,

which may reasonably be deduced from the documents, and which comes closest to the method of claim 1 of the patent in suit is as follows:

A method of handling of semiconductor materials or studying organo-metallic compounds comprising the following steps: introducing the materials or compounds into the load lock chamber, evacuating the load lock chamber and filling it with inert gas, continuously filling inert gas into the glove box and continuously draining the inert gas from the box, opening the door between the load lock chamber and the glove box, transferring the materials or compounds from the load lock chamber into the glove box, closing the door, evacuating the oven and filling it with inert gas, opening the door between the glove box and the oven, transferring the materials or compounds from the glove box to the oven, and closing this door.

In the above it is presumed that the load lock chamber and the oven are filled with an inert gas after evacuation in order to equalise the pressure therein with that in the glove box to enable the respective door to open.

- 4.2 The Board is satisfied that the following features of claim 1 of the patent in suit are not disclosed in these documents: There is no disclosure of a MOCVD process for semiconductor wafers, or of draining inert gas from the oven, or of filling a MOCVD processing gases into the oven to grow an epitaxial layer of a compound semiconductor on the wafers. Also, while it is assumed that the oven is filled with an inert gas, this is for the purposes of equalising pressure and not for the purpose of keeping out unwanted gases from the

transfer chamber.

4.3 Consequently, the apparatus of documents B1 and B2 is obviously not adapted to be used in a MOCVD process and there is no imperative to provide for utmost cleanliness of the gas in the oven, which means that there is no need to supply gas to the oven and to drain this gas in order that foreign gases which are adsorbed on the wafers cannot pass from the glove box to the oven, see point 3.3 above.

4.4 Therefore, the appellant has not proved that the apparatus of documents B1 and B2 is adapted to carry out the claimed method or that it is able to solve the problem of the patent in suit.

The appellant has argued that the oven disclosed in connection with this apparatus **could** have been replaced by a well known MOCVD reactor to perform the method of claim 1. Even if this were true, there is no indication that a person skilled in the art would have done so.

4.5 For the above reasons the documents B1 and B2 are not considered relevant to the method of claim 1 of the patent in suit.

4.6 The opposition division had decided that although the document E1 did not belong to the prior art, a certain concept of an MOCVD reactor **within** a glove box (as shown in document E1) was prior art, whose features are set out on page 6 of its decision. The appellant was not able to establish that an MOCVD reactor was used, or the use was suggested by the documents B1 and B2 in association with a glove box but outside and adjacent the glove box, such that the apparatus would be used

according to the process of claim 1.

- 4.7 The apparatus of claim 3 includes all the features necessary for carrying out the method of claim 1, and includes additional features for transferring a semiconductor wafer between the chambers and for protecting the reaction chamber from deposition of materials from the MOCVD reaction, which are also not disclosed in documents B1 and B2. Therefore, the same considerations apply to the apparatus claim, and the documents B1 and B2 are again not closer prior art for the apparatus than that already considered by the opposition division.
- 4.8 The documents B1 and B2, therefore, are not more relevant than the item of prior art identified by the opposition division on page 6 of its decision, and against which it found the subject-matter of the claims of the patent in suit to meet the requirements of Article 52(1) EPC. Therefore, the opposition division was correct in not admitting them into the opposition procedure. In view of this the publication date of the documents B1 and B2, on which the respondent threw doubt, need not be investigated.
5. Document B3 was cited against claim 3, in connection with the documents B1 and B2. This document discloses an automatic transfer mechanism for an apparatus for vacuum coating semiconductor wafers and the use of sputter shields for protection against unwanted deposition of sputter gases on apparatus parts. This document is equally irrelevant for the purposes of assessing the inventive merit of the claimed apparatus since it relates neither to the above problem nor proposes a solution therefor.

6. The main request of the appellant was that the patent be revoked exclusively because of the documents B1, B2, and B3. Since these have been found to be not relevant the main request cannot be allowed.

Auxiliary requests

Since the documents B1 to B3 have been found to be not relevant, there is no need to remit the case to the first instance for its further consideration. Since the request for apportionment of costs is conditional on a remittal to the first instance, it has no further basis. The auxiliary requests to remit the case to the first instance and for the apportionment of costs need not be considered, accordingly.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

V. Commare

W. D. Weiß