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Datasheet for the decision of 21 June 2010

Case Number: T 1542/07 - 3.4.03

Application Number: 00991365.8

Publication Number: 1243020

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Language of the proceedings: EN

Title of invention:
Method and apparatus for the treatment of substrates

Applicant:
ASM INTERNATIONAL N.V.

Opponent:
-

Headword:
-

Relevant legal provisions:
-

Relevant legal provisions (EPC 1973):
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1542/07 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 21 June 2010

Appellant: ASM INTERNATIONAL N.V.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 2 May 2007 refusing European application No. 00991365.8 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: G. Eliasson
Members: R. Q. Bekkering
T. Karamanli

Summary of Facts and Submissions

I. This is an appeal against the refusal of application No. 00 991 365 for lack of clarity, Article 84 EPC 1973, and added subject-matter, Article 123(2) EPC, as well as lack of inventive step, Article 56 EPC 1973, over document

D1: WO 98 01890 A.

II. The appellant applicant requested, as main request, that the decision under appeal be set aside and a patent granted on the basis of the following documents:

Claims:	Claims 1 to 9 filed as main request with letter dated 24 August 2007;
Description:	Pages 2, 4 and 5 as published; Pages 1 and 3 filed with letter of 2 May 2006;
Drawings:	Sheets 1/3 to 3/3 as published.

In the alternative, the grant of a patent was requested according to a first, second and third auxiliary request, all filed with letter dated 24 August 2007.

III. Claim 1 of the main request reads:

"*Method for the thermal treatment of a substrate, such as a wafer, comprising the introduction thereof in a heat treatment apparatus, wherein the heat treatment apparatus comprises two substantially flat parts parallel to the introduction position of the wafer,*

between which the wafer is received, wherein the first part is heated and is at a first high temperature and during at least part of the treatment time on each of the two sides of the wafer a gas flow is supplied to implement the heat treatment, characterised in that the second part is actively cooled with the help of cooling means and is at a second lower temperature wherein the second temperature is lower than 70 °C and in that, during the treatment, the heat conductance between the wafer and each of those parts is controlled by controlling the properties of the supplied gas flows in such a way that, during a determined time, the heat conduction between the wafer and the first part is at a comparatively high value while the heat conduction between the wafer and the second part is at a comparatively low value so that the wafer takes on a temperature that is comparatively closer to the first high temperature and then the heat conduction between the wafer and the first part is at a comparatively low value while the heat conduction between the wafer and the second part is at a comparatively high value so that the wafer takes on a temperature which is comparatively closer to the second lower temperature."

IV. Reference is also made to the following prior art documents:

D4: US 5 927 077 A

D5: US 5 431 700 A.

V. The appellant essentially argued as follows:

The Examining Division set particular high requirements to the persons skilled in the art. First of all the related person should conclude that starting from day one it was obvious to provide one of the side sections with cooling means and actively cooling such side section to a temperature lower than 70°C. Furthermore Dl did not disclose changing of the heat conduction between the wafer and each of the side sections intentionally during heat treatment to effect a change in wafer temperature during treatment. Dl did disclose (for example on page 4) that adjustment of the temperature of a wafer could be effected by flowing gasses on both sides of the wafer having different thermal conduction properties. However it was not indicated to make several changes in the gas composition in order to actively run a temperature cycle.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 *Amendments*

Claim 1 is based on claims 1 and 2 as originally filed and on the description as originally filed (page 2, lines 1 to 25).

Dependent claim 2 corresponds to original claim 4.

Dependent claim 3 is based on the original description (cf page 4, lines 22 to 25).
Dependent claim 4 corresponds to original claim 3.
Dependent claim 5 is based on the original description (cf page 4, lines 26 to 27).
Dependent claims 6 to 9 corresponds to original claims 5 to 8, respectively.

The amendments, thus, comply with Article 123(2) EPC.

2.2 It is noted that the objections for lack of clarity, Article 84 EPC 1973, and added subject-matter, Article 123(2) EPC, in the decision under appeal concerned the apparatus claim (claim 10 then on file) which is not maintained in the present main request.

2.3 *Novelty*

2.3.1 *Document D1*

Document D1, cited in the application as originally filed as prior art (cf application, page 1, second paragraph), discloses a method for the thermal treatment of a substrate, such as a wafer (cf D1, page 6, line 18 to page 9, line 24; figures 1 and 2).

In particular, the method comprises, using the terminology of claim 1 of the main request, the introduction of the substrate (3) in a heat treatment apparatus, wherein the heat treatment apparatus comprises two substantially flat parts (6, 7) parallel to the introduction position of the wafer, between which the wafer is received, wherein the first part (6) is heated and is at a first high temperature (eg 1100 K)

and during at least part of the treatment time on each of the two sides of the wafer a gas flow is supplied to implement the heat treatment (eg silane in a deposition process) (cf page 8, lines 13 to 36).

2.3.2 According to D1, in case of a deposition process, the second part (7) is kept at a lower temperature (eg 700 K) than the first part so as to avoid any deposition of material from the deposition gas on the second part which would otherwise become contaminated and clogged. If the first and second heated parts are equidistant from the wafer and the same gas is present on both sides, the substrate will assume a temperature which is the average of the values of the temperatures of the two parts (cf page 3, line 20 to page 4, line 13; page 8, lines 28 to 31). If different types of gas are used, that is to say gases having different thermal conduction properties, a change in temperature will likewise take place. For example, when argon is used on one side and hydrogen is used on the other side it has been found that transfer between the relevant side section and the wafer is ten times better on the side where hydrogen is supplied. Consequently, by means of a suitable choice of the temperatures concerned, it is possible to provide the side section from which the process gas is emitted with a temperature such that no deposition takes place on such side section, whilst the wafer is at a temperature which is so much higher that deposition does take place on such wafer (cf page 4, lines 17 to 29).

2.3.3 Thus, in D1 the second part is not actively cooled with the help of cooling means to a second lower temperature,

which is lower than 70 °C, as per the first feature of the characterising portion of claim 1.

In fact, according to D1, when the treatment at the elevated temperature is complete, the first and second parts (6, 7) are moved away from one another and the wafer is removed. Cooling takes place equally as rapidly as heating without any damage over the entire extent of the wafer (cf page 9, lines 21 to 24).

Neither does document D1 disclose the second feature of the characterising portion of claim 1 that, "*during the treatment, the heat conductance between the wafer and each of those parts is controlled by controlling the properties of the supplied gas flows in such a way that, during a determined time, the heat conduction between the wafer and the first part is at a comparatively high value while the heat conduction between the wafer and the second part is at a comparatively low value so that the wafer takes on a temperature that is comparatively closer to the first high temperature and then the heat conduction between the wafer and the first part is at a comparatively low value while the heat conduction between the wafer and the second part is at a comparatively high value so that the wafer takes on a temperature which is comparatively closer to the second lower temperature*".

The subject-matter of claim 1 is, thus, new over document D1 (Articles 54(1) and (2) EPC 1973).

2.3.4 The subject-matter of claim 1 is also new over the remaining cited prior art which is more remote.

2.4 *Inventive step*

2.4.1 The closest prior art is considered to be provided by document D1 which, as discussed above, discloses a method for the thermal treatment of a substrate according to the pre-characterising portion of claim 1.

The features of the characterising portion of claim 1 result in substance in the substrate being heated during a determined amount of time so that it takes on a temperature that is comparatively closer to the first high temperature of the first part and then the wafer being cooled so that it takes on a temperature which is comparatively closer to the second lower temperature, which is lower than 70 °C.

As discussed above, in D1 the wafer is cooled after the treatment at the elevated temperature by moving away the first and second parts and removing the wafer. As noted in the application as originally filed, such a cooling step is not quick and controllable (cf page 1, lines 15 to 24).

Accordingly, the objective problem to be solved relative to D1 is to provide a more rapid and accurately controlled cooling step.

2.4.2 In the decision under appeal (point 4.2) it is argued that the objective problem to be solved by the present invention may be regarded as to provide a more accurate control of the wafer temperature, which is also mentioned in document D1 (see page 2, lines 17-20).

The cited passage of D1 however merely states that the aim of the invention is to provide a method with which contactless heating of semiconductor substrates to relatively high temperature within a relatively short time is possible. Still document D1 does mention cooling of the wafer, as discussed above, and the board agrees that it is generally known to the person skilled in the art working in the field of semiconductor processing to first heat and then cool wafers depending on the desired wafer processing.

However, the contention in the decision under appeal (point 4.2, last paragraph) that it would be a normal procedure option for the skilled person depending on the desired wafer processing first to heat and secondly to cool the substrate via altering the type of gases having a distinct thermal conductance, is not supported by any fact or argument.

It is generally agreed that the skilled person would select the type of gas present during the thermal treatment based on its thermal conductance so as to provide thermal coupling between the wafer and the adjacent heated parts of the apparatus, as this is taught in D1. In fact, as discussed above, in D1 a thermal coupling of a wafer to two parts at different (high) temperatures by means of the same or different types of gases on either side of the wafer is provided.

There is however nothing in D1, let alone for cooling the wafer down to temperatures close to 70 °C, suggesting controlling the properties of the supplied gas flows in such a way that:

- in a first step, during a determined time, the heat conduction between the wafer and the first part is at a comparatively high value while the heat conduction between the wafer and the second part is at a comparatively low value so that the wafer takes on a temperature that is comparatively closer to the first high temperature,

- and then in a second step the heat conduction between the wafer and the first part is at a comparatively low value while the heat conduction between the wafer and the second part is at a comparatively high value so that the wafer takes on a temperature which is comparatively closer to the second lower temperature.

In fact, the above second step would rather be against the teaching of D1 as according to D1 the lower temperature of the second part is selected so as to avoid any deposition on the second part (see point 2.3.2 above). Bringing the wafer to a temperature close to that of the second part would prevent any deposition to take place on the wafer.

Neither can the above steps fairly be held to be common general knowledge of the skilled person. Although the underlying basic principle based on thermal conduction by means of a gas may be considered so, the application of this principle in a two-step process for heating and cooling a wafer as claimed is not.

2.4.3 No further prior art documents which could render the claimed solution obvious were considered in the decision under appeal.

Document D4, cited in the course of the examination procedure, discloses a thermal processing apparatus with a cooling part which is actively cooled to a temperature of about 70 °C. The cooling part, however, consists of eg a Peltier element which, together with a heater section, is disposed on the lower surface of the substrate supporting plate (cf figure 2 and corresponding description). There is no mention of parts at different temperatures and different gas flows at either side of the wafer as claimed in the present application.

In the board's judgement, of the remaining available prior art documents, only document D5 is of some relevance as it addresses the particular issue of cooling the wafer after heat treatment using an actively cooled part.

Document D5 in fact discloses a method for the thermal treatment of a substrate in an apparatus having a heated part (bake plate) and an actively cooled part (chill plate), respectively, at either side of the wafer. For the heat treatment the wafer is moved by a lift into close proximity of the heated part. After heat treatment the wafer is cooled by moving it by means of the lift into close proximity of the actively cooled part (cf column 3, line 18 to column 5, line 20; figures 1 and 2).

Incidentally it is noted that moving the wafer into proximity of the heated/cooled part is proposed as an auxiliary measure in the application (see claims 8 and 9).

Document D5, however, does not mention different gas flows at either side of the wafer to thermally couple/decouple the wafer to the heated or cooled parts as claimed in the present application.

2.4.4 Accordingly, the subject-matter of claim 1, having regard to the available state of the art, is not considered to be obvious to the person skilled in the art and, thus, involves an inventive step (Article 56 EPC 1973).

2.5 Claims 2 to 9 are dependent on claim 1, providing further limitations. The subject-matter of these claims, therefore, also involves an inventive step.

2.6 The patent application as amended also meets the remaining requirements of the EPC, so that a patent can be granted on the basis of these documents.

3. As the main request is allowable there is no reason to go into any of the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of the first instance with the order to grant a patent in the following version:

Claims:	Claims 1 to 9 filed as main request with letter dated 24 August 2007;
Description:	Pages 2, 4 and 5 as published; Pages 1 and 3 as filed with letter of 2 May 2006;
Drawings:	Sheets 1/3 to 3/3 as published.

Registrar:	Chair:
S. Sánchez Chiquero	G. Eliasson