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**Datasheet for the decision
of 23 July 2013**

Case Number: T 1631/11 - 3.2.07
Application Number: 01926659.2
Publication Number: 1286808
IPC: B24B 57/02, G01N 21/41,
B01F 5/00
Language of the proceedings: EN

Title of invention:

A chemical-mechanical polishing system for the manufacture of semiconductor devices

Applicant:

Freescale Semiconductor, Inc.

Headword:

-

Relevant legal provisions:

EPC Art. 111(1), 123(2)

Keyword:

"Amendments - extension beyond the content of the application as filed (main request and replacement first and second auxiliary requests - yes, replacement third auxiliary request - no)"

"Remittal to the department of first instance (yes)"

Decisions cited:

T 1067/97, T 2619/11

Catchword:

-



Case Number: T 1631/11 - 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 23 July 2013

Appellant: Freescale Semiconductor, Inc.
(Applicant) 6501 William Cannon Drive West
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 18 February 2011
refusing European patent application
No. 01926659.2 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: H. Meinders
Members: H. Hahn
I. Beckedorf

Summary of Facts and Submissions

I. The applicant lodged an appeal against the decision of the Examining Division to refuse the European patent application No. 01 926 659.2.

II. In the present decision the following documents from the examining procedure are cited:

D1 = US-A-6 048 256

D2 = Groetsch J.G.: "Use of refractive index analyzers for improved process control", ISA TECH/EXPO Technology Update, Instrument Society of America, Salem, USA, no. 393, October 1999, pages 35-43

D3 = Bare J.P. et al.: "Evaluation of Manufacturing Handling Characteristics of Hydrogen Peroxide-Based Tungsten CMP Slurry", 23rd IEEE/CPMT International Electronics Manufacturing Technology Symposium. IEMT'98. Austin, TX, Oct. 19-21, 1998, IEEE/CPMT International Electronics Manufacturing Technology Symposium, New York, NY: IEEE, US, 19 October 1998, pages 164-171

and the following document was introduced by the Board in the appeal proceedings:

D4 = J. Gebhardt et al. "Recent Successful Fuzzy Logic Applications in Industrial Automation, published at 5th IEEE International Conference on Fuzzy Systems, New Orleans, USA, September 1996, pages 1-10

III. The Examining Division held that claim 6 of the single request dated 22 December 2010 contravenes

Article 123(2) EPC. In an *obiter dictum* the Examining Division considered that also the subject-matter of process claim 1 extends beyond the content of the application as originally filed. Furthermore, the subject-matter of the claims when seen as strictly limited to the content of the application as filed would lack inventive step over a combination of the teachings of D1 and D2, optionally in the light of D3.

IV. With a communication dated 19 February 2013 and annexed to summons for oral proceedings the Board presented its preliminary and non-binding opinion with respect to claims 1-10 of the single request underlying the impugned decision and re-filed with the statement of the grounds of appeal dated 16 June 2011.

Claims 1 and 6 appeared to contravene Article 123(2) EPC.

Claims 1, 3 and 6 additionally appeared to contravene Article 84 EPC.

With respect to a remittal to the department of first instance it should be discussed whether or not a fresh case ensues.

The Board further stated amongst others that the further search should have covered the CMP system and if a further search would actually be needed then it should be performed as an additional search by the Examining Division.

Furthermore, the Board introduced document D4 with respect to the use of fuzzy logic control systems.

Concerning the issue of inventive step the Board remarked amongst others that in case that a request would comply with Articles 123(2) and 84 EPC and it would come to the decision **not** to remit the case to the department of first instance then the issue of inventive step would be dealt with taking account of the problem-solution approach.

- V. With its letter dated 25 June 2013 the appellant submitted an amended main request and first to fifth auxiliary requests together with arguments said to take account of the remarks made by the Board in its above mentioned communication.
- VI. Oral proceedings before the Board were held on 23 July 2013. The requirements of Article 123(2) EPC in respect of claim 1 according to any of the (then valid) main request and the first to fifth auxiliary requests were discussed in particular in view of each single point referred to under points 3.1 and 3.2 of the Board's communication dated 19 February 2013, the overall disclosure of the application to the relevant skilled person, and the interaction between the broadly defined original claims and the single embodiment in the description. During this discussion an objection under Rule 106 EPC - for (a) not issuing a first communication under Rule 100(2) EPC before summoning to oral proceedings and (b) for surprising the appellant with the question to provide the Board with the information why the application in case T 1067/97 (cited by the appellant) would be comparable to the present application - was raised which was later (after a break upon the appellant's request) withdrawn by the

appellant without further discussion. Thereafter the requirements of Article 123(2) EPC were discussed in respect of claim 1 according to the replacement first to third auxiliary requests (from which the system claims were deleted), all filed during the oral proceedings, in particular in view of the feature "fuzzy logic control". The fourth and fifth auxiliary requests filed during the written proceedings were withdrawn by the appellant.

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of one of the sets of claims filed as main request with letter dated 25 June 2013 or, alternatively, as replacement first, second and third auxiliary requests, all filed during the oral proceedings.

At the end of the oral proceedings the Board announced its decision.

VII. Independent claim 1 of the **main request** reads as follows (amendments as compared to claim 1 underlying the impugned decision are underlined or in strikethrough, emphasis added by the Board):

"1. A method of chemical mechanical polishing a layer formed over a semiconductor component, the component comprising a substrate with devices formed therein, the method comprising:

providing (220) a slurry comprised of a mixture of an oxidizer and an abrasive;

using a refractometer to measure (230), in-situ, a concentration of the oxidizer in the slurry;

detecting (235) ~~the~~ a flow rate of the slurry, ~~and using a refractometer to measure (230), in-situ, a concentration of the oxidizer in the slurry;~~

using (240) the measured concentration of the oxidizer and the detected flow rate of the slurry, to determine an additional amount (250) of oxidizer to add to the slurry, to control the concentration of the oxidizer;

adding (250) the additional amount of oxidiser [should read: oxidizer]; and

applying (255) the slurry to the layer formed over the semiconductor component."

VIII. Independent claim 1 of the **replacement first auxiliary request** reads as follows (amendments as compared to claim 1 underlying the impugned decision are underlined or in strikethrough, emphasis added by the Board):

"1. A method of chemical mechanical polishing a layer formed over a semiconductor component, the component comprising a substrate with semiconductor devices formed therein, the method comprising:

mixing a slurry in a vessel (110), the

~~providing a slurry comprised of a mixture of~~ ing:

(i) an oxidizer; and

(ii) an abrasive in a liquid suspension or a liquid carrier;

~~mixing a slurry in a vessel (110);~~

adding a first additional amount of the oxidiser to the mixture at a first rate before measuring a concentration of the oxidiser;

using a refractometer to measure (230), in-situ in the vessel (110), a the concentration of the oxidizer in the slurry, the refractometer using reflection of a light beam from the interface between the slurry and a prism of the refractometer;

adding a second additional amount of the oxidiser to the mixture at a second rate, different from the first rate, after measuring the concentration;

detecting (235) ~~the~~ a flow rate of the slurry from a slurry output port, and using a refractometer to measure (230), in-situ, a concentration of the oxidizer in the slurry;

using (240) the measured concentration of the oxidizer and the detected flow rate of the slurry, to determine an additional amount (250) of oxidizer to add to the slurry, to control the concentration of the oxidizer;

adding (250) the additional amount of oxidiser; ~~and~~

applying (255) the slurry to the layer formed over the semiconductor component; and

using (260) the mixture to chemically mechanically polish the layer."

IX. Independent claim 1 of the **replacement second auxiliary request** reads as follows (amendments as compared to claim 1 underlying the impugned decision are underlined or in strikethrough, emphasis added by the Board):

"1. A method of chemical mechanical polishing a layer formed over a semiconductor component, the component comprising a substrate with semiconductor devices formed therein, the method comprising:

mixing a slurry in a vessel (110), the

~~providing a slurry comprised of a mixture of~~ ing:

(i) an oxidizer; and

(ii) an abrasive in a liquid suspension or a liquid carrier;

~~mixing a slurry in a vessel (110);~~

adding a first additional amount of the oxidiser to the mixture at a first rate before measuring a concentration of the oxidiser;

using a refractometer to measure (230), in-situ in the vessel (110), a the concentration of the oxidizer in the slurry, the refractometer using reflection of a light beam from the interface between the slurry and a prism of the refractometer;

adding a second amount of the oxidiser to the mixture at a second rate different from the first rate after measuring the concentration; comprising:

~~detecting (235) the~~ measuring by a flow sensor (160)

~~the~~ a flow rate of the slurry from a slurry output port,

~~and using a refractometer to measure (230), in-situ, a concentration of the oxidizer in the slurry;~~

~~using (240) the measured concentration of the oxidizer and the detected flow rate of the slurry, to determine an additional amount (250) of oxidizer to add to the slurry, to control the concentration of the oxidizer;~~

~~adding (250) the additional amount of oxidiser; and~~

providing by the flow rate sensor (160) a first signal to adjust the flow rate of the oxidiser, and a second signal by the refractometer to adjust the flow rate of the oxidiser

applying (255) the slurry to the layer formed over the semiconductor component; and

using (260) the mixture to chemically mechanically polish the layer."

- X. Independent claim 1 of the **replacement third auxiliary request** reads as follows (amendments as compared to claim 1 underlying the impugned decision are underlined or in strikethrough, emphasis added by the Board):

"1. A method of chemical mechanical polishing a layer formed over a semiconductor component, the component comprising a substrate with semiconductor devices formed therein, the method comprising:

mixing a slurry in a vessel (110), the

~~providing a slurry comprised of a mixture of ing:~~

(i) an oxidizer; and

(ii) an abrasive in a liquid suspension or a liquid carrier;

~~mixing the slurry in a vessel (110);~~

using a refractometer to measure (230), in-situ in the vessel (110), a concentration of the oxidizer in the slurry, the refractometer using reflection of a light beam from the interface between the slurry and a prism of the refractometer;

detecting (235) the a flow rate of the slurry from a slurry output port, ~~and using a refractometer to measure (230), in-situ, a concentration of the oxidizer in the slurry;~~

using (240) the measured concentration of the oxidizer and the detected flow rate of the slurry, to determine ~~an additional amount (250) of oxidizer to add to the slurry, to control the concentration of the oxidizer;~~ (240) fuzzy logic variables;

using (245) the fuzzy logic variables to determine an injection rate for the oxidizer, to control the concentration of the oxidizer;

adding (250) an the additional amount of oxidiser at the determined injection rate;

applying (255) the slurry to the layer formed over the semiconductor component; and

using (260) the mixture to chemically mechanically polish the layer."

XI. The appellant argued, insofar as relevant for the present decision, essentially as follows:

It has no problem to add the erroneously omitted feature "**semiconductor** devices" into the subject-matter of claim 1 of the main request, as done for the other requests.

The features mentioned in points 3.1 and 3.2 of the Board's communication as missing in the claim have not been presented as essential features in the application and would not have been considered essential by the person skilled in the art. In this context it is remarked that the specific embodiment is enabling the skilled person to carry out the invention but concerning the generalisation of essential features it is sufficient that the application as a whole describes the necessary characteristics of the invention (see Guidelines, F-IV, 4.5.3).

Claims are generalisations of one or more particular examples (see the Guidelines, F-IV, 6.2) so that the applicant cannot be forced to specify features in the independent claim that would overly restrict the claim, thereby allowing competitors to design around the invention. The underlying idea of Article 123(2) EPC is that an applicant is not allowed to improve his position by adding subject-matter not disclosed in the application as filed, which would give him an unwarranted advantage (see Guidelines, H-IV, 2.2) but the comments made in the Board's communication go significantly beyond an objective application of this principle. The key point is the statement in

point 3.2.3 concerning the alleged intermediate generalisation in claim 1 of the main request. According to decision T 1067/97 (not published in OJ EPO) an intermediate generalisation would be allowable in the absence of any clearly recognisable functional or structural relationship among the features isolated from a set of features (see Case Law of the Boards of Appeal of the European Patent Office, 6th edition 2010, section III.A.2). It is not known whether or not the description and claims of the application underlying this case T 1067/97 was comparable to the present case since this issue was not mentioned in the Board's communication. However, the Board should explain which functional relationship is present and thus requires the incorporation of these allegedly missing features.

Furthermore, decision T 2619/11 (not published in OJ EPO; see catchword and point 2.6 of the reasons) mentions that the Examining Divisions should not take an overly restrictive view of the wording in an application as filed. Therein it is stated that the examination of an application must concentrate on "what is really disclosed to the skilled person by the documents as filed as directed to a technical audience rather than a philologist or logician ...".

The feature of a Chemical-Mechanical Polishing (CMP) "slurry" can be derived from claim 2 and page 7, lines 20 to 21 of the specification as originally filed so that there exists no need to define that the abrasives are in a liquid suspension or a liquid carrier as requested by the Board. From page 7, line 23 to page 8, line 1 it can be derived that the slurry may comprise something else. It is sufficient that it is a slurry.

This passage would also allow a generalisation to measuring in a slurry as such since the place where the mixing takes place is not relevant. As derivable from page 1, lines 19 and 20 and page 2, lines 8 to 12 it is clear that the use of titration for determining the oxidiser concentration should be avoided so that measuring in premixed slurries, such as those stored in day tanks should be encompassed by the invention. Therefore it is sufficient that the daily consumption problem of such slurries is only solved and not the complete problem which may be less severe now due to this improved and new solution.

The claims as originally filed define neither that the refractometer must be in the vessel nor that a specific concentration measuring device must be used, let alone require any fuzzy logic features. In particular original claim 3 - which defines the additions of a first and second amount of the first component (oxidiser) at different rates to the mixture before and after measuring its concentration - was drafted to cover what was believed to be the invention; not every detail of the embodiment has to be incorporated into the independent claim.

It is not mandatory to use this fuzzy logic control and it is clear to the skilled person that a conventional control system can also be used (see page 9, lines 19 to 21 which matches with original claim 3 which is general in this respect). It is not necessary to have stated this as an optional feature in the application to be able to leave it out of the independent claim.

Figure 1 also does not show any fuzzy logic control system.

The person skilled in the art can be a team of persons each having the common general knowledge of the different aspects of the invention. He would read the teaching of the application and its claims and, like a third party or a possible infringer, would think about which modifications of the features, equivalents to and uses which are described in the claims and in the specific embodiment are possible and would then apply his common general knowledge to design around the invention. All thereby derivable modifications of the explicit disclosure of the application would become implicit information to the skilled person and keeping these as possible embodiments via a more general wording of the claim would not contravene Article 123(2) EPC.

In this respect it is sufficient that general features are comprised in the independent claim as long as the underlying problem is solved to a certain extent.

The additional features of the replacement first and second auxiliary requests are taken from page 6, line 22 to page 7, line 2 and claim 3 as originally filed when restricted to an oxidiser and an abrasive.

The replacement third auxiliary request is based on the former fifth auxiliary request wherein the corresponding amendments concerning the semiconductor "devices" and the mixing of the slurry in the vessel have been made.

Therefore the independent claims 1 of all these requests comply with Article 123(2) EPC.

The clarity objections raised in points 4.1 and 4.2 of the Board's communication have been overcome by the amendments made so that Article 84 EPC is also complied with.

Reasons for the Decision

1. *Allowability of amendments made in claims 1*
(Article 123(2) EPC)

Since the Board considers that process claim 1 of the main request contravenes Article 123(2) EPC, amongst others, for **not** defining that the measured concentration of the oxidiser and the detected flow rate of the slurry are used to determine **fuzzy logic variables**, which are then used for determining an injection rate for the oxidiser to control the concentration of the oxidiser (see points 1.1 to 1.7.7 below), which conclusion equally applies to the process claims 1 of the replacement first and second auxiliary requests (see point 1.8 below), there is no need to consider in this decision whether or not the amendments made in these three requests comply with Article 84 EPC.

Main request

- 1.1 The Board comes to the conclusion that process claim 1 of the main request in this respect does **not** comply with Article 123(2) EPC for the reasons that follow.

1.2 The present application as originally filed (corresponding to the published WO-A-01 89767 which in the following is quoted) comprises in total 14 pages of description consisting of the four paragraphs "Field of the Invention" (page 1, lines 6 to 9), "Background of the Invention" (page 1, line 11 to page 2, line 12), "Brief Description of the Drawings" (page 2, line 14 to page 3, line 16) and "Detailed Description of the Drawings" (page 3, line 18 to page 14, line 8. It further contains claims 1 to 10 and figures 1 to 6.

1.3 The description starts by stating that the invention relates, in general, to manufacturing semiconductor components, and more particularly, to detecting concentrations of components in mixtures used in the manufacturing of the same (see page 1, lines 6 to 9).

1.3.1 In the context of the background of invention it is described that CMP slurries can be used for planarising metal layers and that they can include a buffered solution, an oxidiser, and an abrasive. Such slurries for polishing tungsten metals require precise quantities of the oxidiser which has an extremely short useful lifetime so that new quantities must be added to the CMP slurry to maintain the necessary chemical activity of the oxidiser (see page 1, lines 12 to 18).

Prior art techniques for determining the oxidiser concentration include manual techniques such as titration which is time consuming and results in a poor process control (see page 1, lines 19 to 23).

This short useful lifetime also produces other problems in existing CMP systems which include, for example the

use of large day tanks for holding significant quantities of CMP slurry. These day tanks consume large amounts of floor space and are expensive and large amounts of oxidiser must be added periodically to the slurry stored in such day tanks. Furthermore, there may exist residence time problems with these large quantities of CMP slurry resulting in that they must be rejuvenated via chemical additions (see page 1, line 24 to page 2, line 12).

1.3.2 Subsequently the object to be solved by the invention is stated as: "Accordingly, a need exists for a method of manufacturing semiconductor components that includes a process for easily, accurately, and cost-effectively detecting and controlling a concentration of a component in a mixture. As applied to CMP processing, a need exists for a CMP system that can easily, accurately, and cost-effectively detect and control a concentration of an oxidiser or other time-sensitive chemical components in a CMP slurry" (see page 2, lines 8 to 12).

1.3.3 There is no further general description of the different parts of the invention, nor of possible alternatives for these different parts. The following paragraph deals with the single embodiment of the figures and states that "The invention will be better understood from a reading of the following detailed description, taken in conjunction with the accompanying drawing figures". Figure 1 is stated to illustrate a cross-sectional view of a portion of a CMP system in accordance with "an" embodiment of the invention, figure 2 illustrates a flow chart of a method in accordance with "an" embodiment of the invention,

figures 3 to 6 illustrate fuzzy logic graphs for the method of figure 2 in accordance with "an" embodiment of the invention.

The Board notes that the undefined article "an" in this respect does not imply more than one embodiment, since what follows is the description of only one and the same embodiment, as will be shown below.

Thereafter it is stated that for simplicity and clarity of illustration these drawing figures illustrate the general manner of construction, and elements in the drawing figures are not necessarily drawn to scale, as well as that descriptions and details of well-known features and techniques are omitted to avoid unnecessarily obscuring the invention. Moreover, the terms first, second, top, bottom, etc. "in the description and in the claims, if any, are used for distinguishing between similar elements and not necessarily for describing relative positions or a sequential or chronological order", and "that the embodiments described are capable of operation in other orientations or sequences than described or illustrated herein". Finally it is remarked in this paragraph "that the terms so used are interchangeable under appropriate circumstances" (see page 3, lines 5 to 16).

- 1.4 In the subsequent paragraph the single specific embodiment of a CMP system according to figure 1 is described which is used in the method 200 for manufacturing a semiconductor component as shown in the flowchart of figure 2 (see page 7, lines 10 and 11).

- 1.4.1 According to this specific **method** of figure 2 according to steps 205 to 215 semiconductor devices are formed in a semiconductor substrate and thereafter a layer is formed over the semiconductor substrate and the semiconductor devices (see page 7, lines 10 to 16).
- 1.4.2 According to step 220 first and second components of a mixture are provided and mixed together and in "the preferred embodiment, the mixture is a CMP slurry; the first component is an oxidiser, such as, for example, hydrogen peroxide; and the second component is an abrasive such as, for example, silica particles suspended in a liquid carrier. The mixture can also be comprised of other components known to those skilled in the art of CMP processing" (see page 7, line 20 to page 8, line 1). According to the preferred embodiment these two components are mixed or combined together within the reservoir 120 (i.e. in the vessel 110) of figure 1 (see page 8, lines 1 to 3).
- 1.4.3 Step 225 of figure 2 is then stated to be optional only but particularly useful if the oxidiser is hydrogen peroxide, since in that case the mixture has a limited lifetime due to the decomposition of the hydrogen peroxide into oxygen and water (see page 8, lines 7 to 15).
- 1.4.4 At a step 230 a concentration of the first component (i.e. the oxidiser) is optically detected or measured. As an example, refractometer 150 (figure 1) can be used to quickly perform step 230. In the preferred embodiment it is performed in-situ within reservoir 120 while dynamically mixing together the first and second components and this fast, automated, and in-situ

measurement provides a more accurate measurement of the concentration of the first component than a slow titration process (see page 8, lines 16 to 21) by measuring an index of refraction of a portion of the mixture, which preferably is comprised of a boundary layer in the CMP slurry. As an example it is comprised of the first component, or the oxidiser, and is devoid of the second component, or the abrasive particles but is also comprised of other liquid components such as, for example, the liquid carrier for the abrasive particles (see page 8, line 22 to page 9, line 4). To measure the index of refraction of this boundary layer, the refractometer shines a light through a solid material such as, for example, a prism 151 toward interface 152 between prism 151 and the CMP slurry within reservoir 120 (figure 1) and optically detects the angle of the light reflected off the interface 152 to determine the index of refraction of the liquid boundary layer surrounding the CMP slurry abrasive particles. The measured index of refraction is directly and linearly proportional to the concentration of the first component within the mixture and the determined concentration is subsequently used to determine a second injection rate for the first component of the mixture (see page 9, lines 5 to 17).

- 1.4.5 Then at a step 235 of method 200 a flow rate of the mixture is detected or measured, as an example flow rate 160 in figure 1 can be used, and is subsequently used to determine a second injection rate for the first component of the mixture. It is also stated that steps 230 and 235 can be reversed (see page 9, lines 18 to 21).

- 1.4.6 Next, at step 240 of method 200, the concentration determined in step 230 and the flow rate determined in step 235 are used to determine **fuzzy logic parameters or variables** and the details of the conversions into fuzzy logic variables is described in more detail with respect to figures 3 and 4 (see page 9, line 22 to page 10, line 8).
- 1.4.7 At a step 245 the **fuzzy logic variables** are used to determine a second injection rate for the first component of the mixture and the details of this step are explained in more detail with reference to figures 5 and 6 (see page 10, lines 9 to 12).
- 1.4.8 Next at a step 250 a second additional amount of the first component is added to the mixture at a second injection rate which most likely will be different from the first rate (see page 10, lines 13 to 15).
- 1.4.9 Then at step 255 the mixture is applied to the first layer over the semiconductor substrate and at a step 260 the mixture is used to chemically-mechanically polish the first layer (see page 10, lines 20 to 22).
- 1.4.10 After the description of the **fuzzy logic graphs** of figures 3-6 it is then stated that an improved method of manufacturing a semiconductor component and CMP system therefor is provided to overcome the disadvantages of the prior art and that the thirty second optical detection cycle is much faster and more accurate than the fifteen minute titration cycle of the prior art. The optical detection is in-line and non-intrusive and also more cost effective. Moreover, the fuzzy logic control system provides a faster and more

accurate response that will not overshoot the intended target and that will also not oscillate around the intended target (see page 13, lines 7 to 16).

1.4.11 Finally the description comprises the common statement that various changes can be made - amongst the examples the compositions of the mixture are mentioned. Further, the **fuzzy logic** can be used to adjust the pump stroke volume instead of, or in addition to, the pump stroke rate - and that "the scope of the invention shall be limited only to the extent required by the appended claims" (see page 13, line 17 to page 14, line 8).

1.5 The claims 1-10 of the application as originally filed are silent with respect to any controlling of the concentration of the first component or oxidiser as well as to the use of a fuzzy logic control system.

1.5.1 In particular, independent claim 1 defines: "A method of manufacturing a semiconductor component comprising: forming a first layer over a semiconductor substrate; providing a mixture comprised of a first component and a second component; optically detecting a concentration of the first component in the mixture; and applying the mixture to the first layer."

1.5.2 The dependent claims 2 and 3 quoted by the appellant define, respectively:

"The method of claim 1 further comprising: providing an oxidizer for the first component; and providing an abrasive for the second component." and "The method of claim 1 or 2 further comprising: adding a first additional amount of the first component to the mixture

at a first rate before optically detecting the concentration; and adding a second additional amount of the first component of the mixture at a second rate different from the first rate after optically detecting the concentration."

1.6 The Board considers that for compliance with Article 123(2) EPC, amongst others, it needs to be decided what the relevant person skilled in the art - which in the present case is a chemical engineer having common general knowledge of process control, semiconductor manufacturing including CMP processing and at least basic knowledge of the chemistry and the possible reactions of the chemicals used therein - directly and unambiguously derives from the whole specification of the application as originally filed, i.e. the description, the claims and the figures as being the control of the oxidiser in the CMP method.

Does it or not use any fuzzy logic variables?

Consequently, the Board cannot see any deviation in its reasoning from the conclusion of decision T 2619/11 (*supra*) that the disclosure of an application is directed to a technical audience and what that audience can derive from the disclosure.

1.7 First of all, the skilled person knows from his common general knowledge that hydrogen peroxide is a commonly used oxidiser in CMP processing. However, hydrogen peroxide has a short lifetime due to its decomposition into water and oxygen. If he would not be aware of the latter fact then he could derive it in any case from the present application (see page 8, lines 7 and 8).

1.7.1 Consequently, by reading the problems described in the context of CMP processing in the prior art (see point 1.3.1 above) and the statement of the object to be solved by the present application (see point 1.3.2 above) in combination with the description of the specific embodiment illustrated in accordance with figures 1 and 2 it is clear to him that titration as well as the use of day storage tanks should be avoided. The latter particularly in view of the fact that said commonly used hydrogen peroxide has a short lifetime so that the process can be made more cost-effective by not wasting this expensive oxidiser unnecessarily while at the same time further saving money for not having the investment in these day tanks. Thus it is clear to him that the CMP slurry should be made from the two components oxidiser and abrasive such that any decomposition of the oxidiser is minimized, i.e. the invention requires that the CMP slurry should be made just in time before its intended use by mixing the two components in a mixing vessel wherein also the concentration measurement takes place to be used in the control of the amount of oxidiser added to that mixing vessel.

The teaching of claims 1 to 10 as originally filed is **not** helpful in this context to the person skilled in the art for the following reasons.

1.7.2 Firstly, original claim 1 only defines "**providing a mixture** comprised of a first component and a second component" (see point 1.5.1 above) which definition can be interpreted by the skilled person as covering a premixed mixture. Taking account of his considerations in point 1.7.1 above, it is, however, clear to him that

a premixed CMP slurry - which could be read into this broad definition "providing a mixture comprising ..." of claim 1 - such as a CMP slurry comprised in a day tank according to the prior art does **not** solve the technical problem underlying the present application as specified in point 1.3.2 above.

Therefore the appellant's arguments that the skilled person would comprehend that only a part of the prior art problems need be solved in view of claims 1 and 2 as originally filed cannot hold.

1.7.3 The two components of this mixture are specified in original claim 2 as "an oxidiser" and "an abrasive", respectively (see point 1.5.2 above). It is clear to the skilled person that a mixture of e.g. a solid oxidiser and a solid abrasive, as encompassed by original claim 2, does **not** result in a CMP **slurry** since a slurry requires the presence of a liquid or solvent.

It is likewise clear to the person skilled in the art from his common general knowledge that such a liquid or solvent is also necessary to dilute the oxidiser in said mixture since it is not possible to use a liquid oxidiser, for example simply using a solution of concentrated hydrogen peroxide, as the solvent for the abrasive since its concentration would be much too high for the intended use in CMP processing. In this context the skilled person is taught by the original application that the abrasive is in a liquid carrier or in a liquid suspension (see page 7, lines 20 to 23 and page 9, lines 3 and 4). Consequently, the appellant's arguments that a slurry of an oxidiser and abrasive comprising such a liquid carrier or solvent would

represent only a preferred embodiment within an original broader disclosure cannot hold, either.

- 1.7.4 When reading the teaching of the broadly worded claims 1 to 10 as originally filed the person skilled in the art realises that their subject-matter **cannot** solve said technical problem since they are absolutely silent with respect **to controlling the concentration** of the oxidiser in the CMP process.
- 1.7.5 Thus it is clear to him that he has to derive the necessary information from the description and the figures, which give only one embodiment of the process using the apparatus of figure 1 and following the general process sequence of figure 2 in combination with the remaining figures 3-6, using his common general knowledge.
- 1.7.6 The appellant argued that the skilled person would derive from a combination of original claim 3 and the disclosures concerning measuring of the flow rate and the refractive index for determining the (second) flow rate of the first component, i.e. the oxidiser, into the vessel (see page 6, line 20 to page 7, line 2 and page 9, lines 19 to 21) that he can use a conventional control system for controlling the concentration of the oxidiser. These arguments cannot hold for the following reasons.

First of all, the flowchart of figure 2 teaches the skilled person a general process of manufacturing a semiconductor component comprising the process steps: 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255 and 260. This process is much more specific than the

respective process of original process claim 3 (which teaching correlates to process steps: 225 and 250 so that these steps of claim 3 when read together with those of claim 1 would correspond only to steps: 205, 210, 215, 225, 230, 250 and 255) but which likewise as claim 3 does not define the first and second components of the mixture.

This reading does not produce any information regarding the control of the concentration yet. The only information concerning this control relates to the use of the measured concentration of the first component in the mixture and the measured flow rate of this mixture (steps 230, 235) to determine **fuzzy logic variables** (step 240) which are subsequently used to determine a second injection rate for the first component of the mixture (step 245). From the description of figure 2 the skilled person will further derive that the process of figure 2 uses the CMP system depicted in figure 1 which includes an in-line refractometer for measuring the index of refraction of the liquid of the slurry in the vessel by detecting the light reflected off the interface between the slurry and the prism (see page 5, lines 17 to 21 and page 9, lines 5 to 10) and which also includes a flow rate sensor for measuring the flow rate of the CMP slurry out of the vessel. The use of the signal of this flow rate sensor for adjusting the flow rate of the first component is stated to be explained in more detail with reference to figures 2 to 5 (see page 6, line 19 to page 7, line 2).

In full agreement with the flowchart of figure 2 the description teaches the skilled person that the concentration determined in step 230 and the flow rate

determined in step 235 are used in step 240 **to determine fuzzy logic parameters or variables** (see points 1.4.4 to 1.4.6 above) which in step 245 are then used to determine a second injection rate or pump stroke for the first component of the mixture. He is further taught that, as an example, steps 230 to 245 can be performed within 30 seconds (see page 10, lines 9 to 12).

Hence the application as originally filed and particularly the description of the specific embodiment is silent with respect to the use of any other, let alone a conventional, control system. To the contrary, its only teaching is the use of a fuzzy logic control system. The fuzzy logic control is not described as only "optional" (or "preferred") nor that it may be replaced by a conventional control system (see point 1.7.6 above).

This view is additionally supported by page 13, lines 7 to 16 of the application where it is stated that the improved inventive method results in a thirty second optical detection cycle and due to the **fuzzy logic control system** "provides a faster and more accurate response that will not overshoot the intended target and that will also not oscillate around the target". This paragraph clearly leads the skilled person to the conclusion that the invention needs the use of a fuzzy logic control system and **not** to a conventional control system since his general knowledge of process control (see point 1.6) tells him that these disadvantages particularly concern conventional control systems which are thus to be avoided. In view of the problem to be solved (see point 1.3.2 above) the invention as

presented by the description and figures is for a fast and accurate method for controlling the oxidiser concentration in the CMP slurry, i.e. the fuzzy logic control system.

1.7.7 Consequently, the absence from the method of claim 1 of the main request of the use of fuzzy logic variables is **not** directly and unambiguously derivable from the specification as originally filed, contrary to Article 123(2) EPC.

1.7.8 Taking account of point 1.7.7 the appellant's further arguments relating to the other features missing in claim 1 as addressed by the Board, therefore need not be dealt with.

The Board nevertheless remarks that decision T 1067/97 (*supra*), which was quoted by the appellant for the first time at the oral proceedings, is not considered relevant since it actually concerns the issue of an intermediate generalisation without basis in the description due to the incorporation into the claim of a particularly preferred molar ratio (which was only disclosed in combination with other features) for the originally already claimed developer was objected to in inter-partes proceedings. In the present case there was not even a control mentioned in the original claims. As soon as a concentration control is added to the claimed method, the simple question is: which type of control is at all disclosed? That question finds its answer in point 1.7.6 above. Further, the application as originally filed underlying case T 1067/97 had a European style description comprising a counterpart to the claims and intermediate fall back positions and

thus is **not** comparable with the US style description of the present application which does not contain a counterpart to the original claims, let alone any intermediate fall back positions for the concentration control, besides the single embodiment.

Replacement first and second auxiliary requests

1.8 The above conclusion in point 1.7.7 with respect to claim 1 of the main request applies *mutatis mutandis* to the claims 1 of the replacement first and second auxiliary requests which identically do **not** contain these fuzzy logic features (see points VIII and IX above).

The Board therefore concludes that the claims 1 of the replacement first and second auxiliary requests neither comply with the requirement of Article 123(2) EPC. The replacement first and second auxiliary requests are therefore not allowable.

Replacement third auxiliary request

1.9 Claim 1 of the replacement third auxiliary request is based on the process steps 205 to 260 of figure 2 (with the acceptable omission of the optional process step 225) and page 7, lines 21 to 23. The Board is therefore satisfied that claim 1 of this request complies with Article 123(2) EPC.

1.9.1 The Board is also satisfied that by the amendments made in claims 1-4 of this auxiliary request the clarity objections concerning claims 1 and 3 of the request underlying the impugned decision, raised in points 4.1

and 4.2 of its communication, have been overcome.
Claims 1-4 of the replacement third auxiliary request are therefore considered to comply with Article 84 EPC as far as these issues are concerned.

2. *Remittal to the department of first instance
(Article 111(1) EPC)*

2.1 The Board has come to the conclusion that the subject-matter of the replacement third auxiliary request meets the formal requirements and therefore, overcomes the main reasons for refusing the present patent application (see point III above).

2.2 Process claim 1 of the replacement third auxiliary request has been considerably amended compared to the process claim 1 underlying the impugned decision by incorporating from the description further process features linked to the use of the fuzzy logic variables (see point X above) whereby a fresh case has been created so that it is not appropriate for the Board to further deal with it.

2.3 The Board therefore considers it appropriate to remit the case in accordance with Article 111(1) EPC to the department of first instance for further prosecution on the basis of the claims 1-4 of the replacement third auxiliary request so that it firstly can decide whether or not an **additional search** is necessary (the system claims have been deleted), and secondly, can proceed to the assessment of inventive step. Thereby the appellant also has the benefit of having the case examined with respect to inventive step without loss of an instance.

Furthermore, the description has not yet been adapted to the present request and therefore contains passages which are inconsistent with claim 1.

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 first instance for further prosecution on the basis of claims 1 to 4 filed as replacement third auxiliary request during the oral proceedings.

The Registrar:

The Chairman:

D. Magliano

H. Meinders