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Datasheet for the decision of 18 December 2012

Case Number: T 1731/07 - 3.3.09

Application Number: 99103676.5

Publication Number: 939344

IPC: G03F 7/42

Language of the proceedings: EN

Title of invention:
Use of a liquid composition for stripping photoresists

Patent Proprietor:
Kanto Kagaku Kabushiki Kaisha

Opponents:
FUJI FILM ELECTRONIC MATERIALS USA INC
Rohm and Haas Company

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 83, 114(2), 123

Keyword:
"Main request (not allowable - novelty - no)"
"Auxiliary request (allowable)"

Decisions cited:
T 1002/92

Catchword:
-

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It can be changed at any time and without notice.

Case Number: T 1731/07 - 3.3.09

D E C I S I O N
of the Technical Board of Appeal 3.3.09
of 18 December 2012

Appellant: (Patent Proprietor)	Kanto Kagaku Kabushiki Kaisha 2-8, Nihonbashihoncho 3-chome Chuo-ku Tokyo 103 (JP)
Representative:	Vossius, Volker Dr. Volker Vossius Patent- und Rechtsanwaltskanzlei Geibelstraße 6 D-81679 München (DE)
Respondent I: (Opponent 1)	FUJI FILM ELECTRONIC MATERIALS USA INC 200 Massasoit Avenue E Providence RI 02914 (US)
Representative:	Bawden, Peter Charles Bawden & Associates 4 The Gatehouse 2 High Street Harpenden Hertfordshire AL5 2TH (GB)
Respondent II: (Opponent 2)	Rohm and Haas Company 100 Independence Mall West Philadelphia, PA 19106-2399 (US)
Representative:	Buckley, Guy Julian Patent Outsourcing Limited 1 King Street Bakewell Derbyshire DE45 1DZ (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted 3 August 2007 concerning maintenance of the European patent No. 939344 in amended form.**

Composition of the Board:

Chairman: W. Sieber
Members: N. Perakis
R. Menapace

Summary of Facts and Submissions

I. Mention of the grant of European patent No. 0 939 344 in the name of Kanto Kagaku Kabushiki Kaisha was published on 28 April 2004 (Bulletin 2004/18). The patent was granted with 8 claims, independent claim 1 reading as follows:

"1. The use of a stripping liquid composition, for stripping photoresists, wherein the composition comprises as an active component, one or more polycarboxylic acids and/or salts thereof selected from the group consisting of aliphatic polycarboxylic acids and salts thereof as well as aminopolycarboxylic acids and salts thereof, with the proviso that

(i) in the case the photoresist stripping liquid composition comprises a combination of

(a) one or more ethylenediaminetetraacetic acid and/or salt thereof and
(b) an amine or an alkanolamine, then the concentration of ethylenediaminetetraacetic acid and/or salt is not in the range of 1-50 wt%,

(ii) the solvent is water and the liquid composition comprises no fluorine-containing compound."

II. Oppositions were filed by Fuji Film Electronic Materials USA Inc. (opponent 1) and Rohm and Haas Company (opponent 2) requesting revocation of the patent in its entirety on the grounds of Article 100(a) EPC (lack of novelty and lack of inventive step) and Article 100(b) and (c) EPC.

III. The opponents filed *inter alia* the following documents:

D1: WO 98/45399 A1;
D2: WO 98/00244 A1;
D3: WO 99/15345 A1;
D4: WO 98/36045 A1;
D5: EP 0 812 011 A2;
D6: EP 0 678 571 A2;
D7: WO 99/15609 A1;
D8: US 5 672 577 A;
D9: JP 10-55993 A;
D9a: EP 0 827 188 A2 (patent family member of D9);
D9b: priority document of D9a (English translation).

IV. By its interlocutory decision announced orally on 6 July 2007 and issued in writing on 3 August 2007, the opposition division held that the patent in amended form on the basis of claims 1 to 3 of auxiliary request VI filed during the oral proceedings met the requirements of the EPC. Claim 1 read as follows:

"1. The use of a stripping liquid composition, for stripping photoresist residues, consisting of (i) oxalic acid, (ii) ethylenediaminetetraacetic acid, and (iii) water."

Regarding the main request (claims 1 to 5 filed with letter dated 3 May 2007), the opposition division decided that it did not meet the requirements of Article 123(2) EPC *inter alia* with respect to claim 1, which read as follows:

"1. The use of a stripping liquid composition, for stripping photoresist residues, consisting of one or more polycarboxylic acids and/or salts thereof selected from the group consisting of oxalic acid, malonic acid, tartaric acid, malic acid, succinic acid, citric acid, ethylenediaminetetraacetic acid, N-(2-hydroxyethyl)-N,N',N'-ethylenediamine-triacetic acid and ammonium salts thereof, and water."

The opposition division held that there was no support in the application as filed for any ammonium salt of ethylenediaminetetraacetic acid and N-(2-hydroxyethyl)-N,N',N'-ethylenediamine-triacetic acid.

V. On 2 October 2007 the patent proprietor (hereinafter: the appellant) filed an appeal against the decision of the opposition division and paid the appeal fee on the same day.

VI. The statement setting out the grounds of appeal was filed on 12 December 2007, including a new main request (claims 1 to 5) and auxiliary requests I to IV. The appellant requested that the decision under appeal be set aside and the patent be maintained on the basis of the main request or, alternatively, on the basis of one of auxiliary requests I to IV.

For the purposes of this decision only the new main request is of relevance. Claim 1 of this request reads as follows:

"1. The use of a stripping liquid composition, for stripping photoresist residues remaining after dry etching, consisting of one or more polycarboxylic acids

and/or salts thereof and water, wherein said one or more polycarboxylic acids and/or salts thereof are selected from the group consisting of (a) oxalic acid, malonic acid, succinic acid, tartaric acid, malic acid, citric acid and ammonium salts thereof, and (b) ethylenediaminetetraacetic acid (EDTA), ethylenediaminetetraacetic acid diammonium salt, trans-1,2-cyclohexanediaminetetraacetic acid (CyDTA), nitrilotriacetic acid (NTA), diethylenetriaminepentaacetic acid (DTPA), and N-(2-hydroxyethyl)-N,N',N'-ethylenediaminetriacetic acid (EDTA-OH)."

VII. With letter dated 21 April 2008 opponent 1 (hereinafter: respondent 1) filed its reply to the statement setting out the grounds of appeal together with a new document, namely

D11: WO 98/10050 A1.

VIII. Following the summons to oral proceedings opponent 2 (hereinafter: respondent 2) indicated in its letter dated 21 June 20012 that it would not be represented at the oral proceedings scheduled for 18 December 2012. Thereafter it took no active part in these appeal proceedings.

IX. By letter dated 12 November 2012 the appellant filed new auxiliary requests I to IX in replacement of the auxiliary requests on file. The appellant provided arguments against the objections raised by respondent 1 regarding the patentability of the main request. The appellant also requested that document D11 not be admitted into the proceedings.

For the purposes of this decision only auxiliary request I is of relevance. Claim 1 of this request reads as follows:

"1. The use of a stripping liquid composition, for stripping photoresist residues remaining on wiring material made of Al-Si-Cu or ferroelectrics made of lead zirconium titanate (PZT) after dry etching, consisting of one or more polycarboxylic acids and/or salts thereof and water, wherein said one or more polycarboxylic acids and/or salts thereof are selected from the group consisting of (a) oxalic acid, malonic acid, succinic acid, tartaric acid, malic acid, citric acid and ammonium salts thereof, and (b) ethylenediaminetetraacetic acid (EDTA), ethylenediaminetetraacetic acid diammonium salt, trans-1,2-cyclohexanediaminetetraacetic acid (CyDTA), nitrilotriacetic acid (NTA), diethylenetriaminepentaacetic acid (DTPA), and N-(2-hydroxyethyl)-N,N',N'-ethylenediaminetriacetic acid (EDTA-OH)."

X. By its letter dated 15 November 2012 respondent 1 too indicated that it would not be represented at the oral proceedings.

XI. On 18 December 2012 oral proceedings were held before the board, where, as announced, respondents 1 and 2 were not represented. During the oral proceedings the appellant submitted a new auxiliary request I (claim 1 and dependent claim 2). It differed from previous auxiliary request I (see point IX *supra*) only in that dependent claims 3-6 had been deleted. These dependent

claims were objected to by the board during the oral proceedings under Rule 80 EPC.

The appellant also filed a description adapted to the claims of new auxiliary request I.

XII. The relevant arguments put forward by the appellant in its written submissions and during the oral proceedings may be summarised as follows:

- The claims of the main and auxiliary request I fulfilled the requirements of Article 123(2) EPC. The skilled person would directly and unambiguously derive the claimed subject-matter from the content of the originally filed application.

- Moreover, as the subject-matter of these requests was more restricted than the subject-matter of the granted claims, it also fulfilled the requirements of Article 123(3) EPC.

- The inventions according to the main request and auxiliary request I were disclosed in a manner sufficiently clear and complete for them to be carried out by a person skilled in the art. Therefore also the requirements of Article 83 EPC were fulfilled.

- The subject-matter of both requests was novel over the cited prior art. None of the cited documents D1 to D9 disclosed a composition consisting of water and one or more of polycarboxylic acids

and/or salts used for stripping photoresist residue remaining after dry etching.

- In particular regarding D3, it disclosed a "rinse" solution which had a different function than the stripping liquid composition of claim 1. A rinse solution was used for rinsing (removing) residual solvents left on the substrate after the photoresist stripping process in order to avoid possible corrosion of the metal layer of the substrate.

- D11 should not be admitted into the proceedings. It was late-filed and no adequate excuse had been provided for its late filing. Moreover, its disclosure was not more relevant than that of the other documents in file.

- The subject-matter of the claims of auxiliary request I involved an inventive step. D2 was the closest state of the art, and disclosed stripping compositions of either two or three constituents. D2 did not contain any hint towards the claimed composition and the skilled person would not find such a motivation in the cited prior art (D5, D6, D8, D9).

XIII. The relevant arguments put forward by respondent 1 in writing may be summarised as follows:

- The subject-matter of the opposed patent extended beyond the content of the application as filed, in particular in view of the introduction of the term "consisting of" into the claims. The application

as filed used the term "comprising" and there was no suggestion that all other materials should be excluded from the liquid composition.

- The opposed patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

- The claims lacked novelty in view of documents D1 to D7, D9 and D11. In particular, D3 disclosed a process for removing residues (including post-etch residues) from a semiconductor substrate. The aqueous rinse solution comprised water and a water soluble corrosion inhibitor, which could be, *inter alia*, oxalic acid, malonic acid, citric acid or tartaric acid. The passage at lines 25 to 27 of page 9 clearly showed that the rinse solutions of D3 were useful for the removal of plasma etch residues. D11, despite requiring the presence of the amine or the quaternary ammonium hydroxide, disclosed the use of hydroxylammonium oxalate or hydroxylammonium citrate in aqueous systems for the removal of etch residues. D11 thus destroyed the novelty of the claimed subject-matter.

- The claims lacked an inventive step. On the one hand the object of the invention was not achieved over the entire scope. On the other hand it lacked an inventive step in relation to D2.

XIV. The appellant (patent proprietor) requested that the decision under appeal be set aside and that the patent be maintained on the basis of claims 1-5 of the main request filed with letter of 12 December 2007, or on

the basis of claims 1 and 2 according to auxiliary request I and description pages 2, 3, 3A and 4-7, both filed during the oral proceedings before the board.

XV. Respondent 1 (opponent 1) requested that the appeal be dismissed.
Respondent 2 (opponent 2) did not file any request.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. Amendments - Article 123 EPC

2.1 The use of a stripping liquid composition as defined in claim 1 of the main request is based on claim 1 as filed, where the one or more polycarboxylic acids and/or their salts had to be selected from the group consisting of aliphatic polycarboxylic acids and their salts as well as aminocarboxylic acids and their salts. The further limitation of the aliphatic polycarboxylic component to the acids now listed in group (a) is disclosed on page 5, lines 20 to 27. This passage also discloses that the salts of the aliphatic polycarboxylic acids are typically ammonium salts, since metallic salts are not desirable in the manufacture of semiconductor devices. Thus there is also a basis in the application as filed for the ammonium salts of the now specified aliphatic polycarboxylic acids. The limitation of the aminocarboxylic component to the compounds listed in

group (b) is disclosed on page 5, line 20 to page 6, line 5.

The use of the liquid composition for removing photoresist residues "remaining after dry etching" is disclosed, for example, on page 7, lines 9 to 11. This passage reads as follows:

"The stripping liquids of the present invention, whose object is the removal of the residues remaining after dry etching, are basically used as an aqueous solution."

It is also apparent from this passage that water is a component of the stripping liquid composition.

2.2 Claim 1 now requires that the stripping agent **consists of** one or more of the specified polycarboxylic acids and water. According to respondent 1 the introduction of the term "consisting of" into the claim contravenes Article 123(2) EPC. In the application as filed the term "comprising" was used and there was no suggestion that all other materials should be excluded.

The board concedes that there is no explicit support for the term "consisting of" in the application as filed. However, the lack of literal support in the application as filed for the term objected to does not necessarily mean that the amendment is not allowable under Article 123(2) EPC. It has been repeatedly emphasised in the case law of the boards of appeal that an amendment should be regarded as introducing subject-matter which extends beyond the content of the application as filed only if the overall change in the

content of the application results in the skilled person being presented with information which was not directly and unambiguously derivable from that previously presented by the originally filed application. In the present case, it can be inferred from the above-cited passage on page 7, lines 9 to 11 that the stripping liquid is basically used as an aqueous composition. The immediately following sentence allows the presence of water-soluble organic solvents in the stripping liquid. However, it is explicitly stated in that paragraph that "in consideration of the environment and also from the point of view of the removing properties, it is preferred not to include organic solvents" (page 7, lines 16-19). Thus, it is evident from this passage that a stripping liquid composition consisting of water and one or more polycarboxylic acids and/or their salts is actually a preferred embodiment of the invention. This is corroborated by the fact that the stripping liquid compositions of examples 1 to 9 and 12 to 16 only consist of water and one or more polycarboxylic acids and/or their salts. Thus the limitation to a stripping liquid composition consisting of the constituents now required in claim 1 can be directly and unambiguously derived from the application as filed.

2.3 The protection conferred by claim 1 of the main request is narrower than the protection conferred by claim 1 of the patent as granted due to the "consisting language" used in claim 1 of the main request and the restriction of the granted polycarboxylic acids and/or salts thereof to particular polycarboxylic acids and certain ammonium salts thereof. As regards the provisos in claim 1 as granted, these embodiments are equally

excluded from claim 1 of the main request. Due to the wording "consisting of", the stripping liquid composition of claim 1 of the main request cannot contain a combination of EDTA and an amine or an alkanolamine (proviso (i) of claim 1 as granted) and it cannot comprise a fluorine-containing compound (proviso (ii) of claim 1 as granted). Consequently claim 1 of the main request fulfils the requirements of Article 123(3) EPC.

3. Sufficiency - Article 100(b) EPC

3.1 The respondent addressed this issue rather briefly in its reply to the statement of grounds of appeal. In fact, the board finds it difficult to identify a tangible objection. Also, no evidence was filed in this context.

3.2 The board observes that the patent in suit (tables 3 and 6) discloses several examples of stripping liquid compositions falling within the scope of claim 1 of the main request, as well as their successful performance in removing photoresist residues remaining after dry etching without corroding the wiring material or adversely affecting the environment. Thus the patent in suit gives the skilled person the necessary instructions as to how to put the claimed invention into practice without undue burden. Consequently the requirements of sufficiency of disclosure are fulfilled.

4. Novelty - Article 54 EPC

4.1 The subject-matter of claim 1 relates to the use of a specific liquid composition for stripping photoresist

residues remaining after dry etching. Such photoresist residues are mainly oxides produced during ashing by oxygen plasma treatment of the reaction products which are produced during etching between the wiring material and the gas (paragraph [0024] of the patent specification).

The liquid composition consists of water and at least one or more polycarboxylic acids and/or salts thereof as specified in claim 1. It is observed that the functional definition of the liquid composition as a "stripping" liquid composition corresponds merely to the intended use of this composition, which is actually the subject of the use claim.

4.2 The subject-matter of claim 1 lacks novelty in view of document D3, a document to be considered under Article 54(3) EPC. D3 discloses a process for removing residues from a substrate bearing said residues, wherein said residues comprise photoresist residues, post-etch residues, remover-solution residues and combinations thereof, comprising treating the residue-bearing substrate with a rinse solution comprising water and an effective corrosion-inhibiting amount of at least one water-soluble corrosion inhibitor (claim 1). The water-soluble corrosion inhibitor can be at least one water-soluble organic acid (claim 4).

4.2.1 The "at least one water-soluble organic acid" of the aqueous rinse solution of D3 can be *inter alia* oxalic acid, malonic acid, succinic acid, tartaric acid or citric acid (page 7, lines 19-25; claim 5), which means that the aqueous rinse solution of D3 has the same

components as the stripping liquid composition of claim 1 of the main request.

4.2.2 Regarding the definition of the "post-etch residues", D3 refers to residues that remain on a substrate after plasma etching operation, including sidewall polymer residues such as metal oxide residues, metal halide residues, fluorinated hydrocarbon polymers and the like (page 5, lines 5-10). This definition is in line with the definition provided in paragraph [0024] of the patent in suit for photoresist residues remaining after dry etching.

4.2.3 Regarding the use of the aqueous rinse solution of D3 "for stripping photoresist residues remaining after dry etching", this is also disclosed in D3. Reference is made to page 9, lines 22-27 where it is stated:

"The oxide film on the substrate surface is selectively etched with the patterned photoresist layer as a mask and then the patterned photoresist layer is completely dissolved away from the substrate surface by chemical stripping or plasma etching. Any remaining chemical stripper or plasma etch residue is removed by a rinsing step using the composition of the invention".

This passage discloses that the rinse solution can indeed act in the same way as the stripping liquid composition of claim 1 of the main request: it removes plasma etch residues. Thus, for exactly that reason even a different name for the very same solution, namely "rinse solution" in D3 and "stripping liquid composition" in claim 1 of the main request, cannot provide a novelty-distinguishing feature.

4.3 The appellant argued that, when considering the entire disclosure of D3, it would be evident to a person skilled in the art that the rinse solution of D3 had a different function from the stripping liquid composition of claim 1 of the main request, *i.e.* rinsing as opposed to stripping. However, this argument is not convincing, because, as explained above, it is explicitly disclosed in D3 that the rinse solution can also remove plasma-etch residues. It appears that the appellant's interpretation of D3 is based on a preferred embodiment of D3 according to which a "remover solution" including photoresist stripping solutions and cleaner solutions is used in a first step in order to remove post-etch residues, this being followed by a subsequent step in which a rinse composition is used in order to remove the residual solvents from the first step (page 4 lines 20 to 32). The disclosure of D3 is, however, not restricted to this embodiment.

4.4 In view of the above considerations, claim 1 of the main request lacks novelty over D3. Consequently this request is not allowable.

Auxiliary request I

5. Amendments - Article 123 EPC

5.1 Claim 1 of auxiliary request I is based on claim 1 of the main request, with the additional feature that the photoresist residues to be stripped are those remaining on wiring material made of Al-Si-Cu or ferroelectrics made of lead zirconium titanate (PZT). The additional

feature is disclosed, for example, in claim 5 as filed. As regards the other features of claim 1 of auxiliary request I the same arguments apply as for the main request. Consequently, this claim fulfils the requirements of Article 123(2) EPC.

5.2 Claim 1 of auxiliary request I is even more restricted than claim 1 of the main request (see point 2.2 *supra*) and fulfils *mutatis mutandis* the requirements of Article 123(3) EPC.

5.3 Dependent claim 2 of auxiliary request I concerns a preferred embodiment of claim 1 according to which the specific liquid composition consists of an aqueous solution of oxalic acid, an aqueous solution of ammonium oxalate or an aqueous solution of a combination of ethylenediaminetetraacetic acid and oxalic acid. This embodiment is supported by the passages on page 5, lines 20 to 24 and page 7, lines 4 to 8 of the application as filed. Therefore claim 2 of auxiliary request I fulfils the requirements of Article 123(2) EPC.

5.4 In view of its dependency on claim 1, claim 2 of auxiliary request I fulfils also the requirements of Article 123(3) EPC.

6. Sufficiency - Article 83 EPC

The board observes that the patent in suit (see tables 3 and 6) discloses several examples of stripping liquid compositions as specified in claim 1 and their performance in removing photoresist residues remaining on wiring material made of Al-Si-Cu or ferroelectrics

made of lead zirconium titanate (PZT). The considerations set out in point 3 above regarding the main request apply *mutatis mutandis* to the invention of auxiliary request I. Therefore the requirements of Article 83 EPC are fulfilled.

7. Novelty - Article 54 EPC

7.1 As set out above, claim 1 of auxiliary request I differs from claim 1 of the main request in that it specifies that the stripping concerns photoresist residues remaining on wiring material made of Al-Si-Cu or ferroelectrics made of lead zirconium titanate (PZT).

7.2 The subject-matter of claim 1 is novel over D3 - prior art under Article 54(3) EPC - which does not disclose the removal of photoresist residues from this particular wiring material or from ferroelectrics using an aqueous solution containing an organic acid among those of the claimed subject-matter. Page 10, lines 25 to 29 of D3 discloses substrates such as silicon, silicon dioxide, aluminium, aluminium alloys, copper and copper alloys. However, this rather general disclosure does not anticipate the specific wiring material made of Al-Si-Cu or ferroelectrics made of PZT as specified in claim 1 of auxiliary request I.

Although example 1 of D3 discloses a silicon wafer having a multi-layer of Al-Si-Cu/SiO_2/Si, the wafer is first immersed in a commercially available stripper solution of EKC 265 (available from EKC Technology Inc.) in order to remove the photoresist residue, then removed from the stripper solution bath and immersed in an aqueous solution of hydroxylammonium nitrate, *i.e.* a

rinse solution not falling within the scope of claim 1 of auxiliary request I.

Since, furthermore, there is also no hint towards a rinse solution in combination with a substrate as defined in claim 1 of auxiliary request I in the remaining disclosure of D3, the subject-matter of auxiliary request I is novel over D3.

7.3 The remaining prior-art documents D1, D2, D4 to D9 are also not relevant for the issue of novelty.

7.3.1 D1, which is prior art under Article 54(3) EPC, describes a cleaning composition for removing photoresist residues comprising EDTA or a mono-, di-, tri- or tetraammonium salt thereof and water or a polar organic solvent (claim 1). However, D1 does not disclose that this solution has been used for stripping photoresist residues remaining on wiring material made of Al-Si-Cu or ferroelectrics made of lead zirconium titanate (PZT). Therefore the subject-matter of claim 1 of auxiliary request I is novel over D1.

7.3.2 D2 describes semiconductor wafer cleaning formulations for use in post-plasma-ashing semiconductor fabrication. According to D2, the general formulation has two or three components that are present in the following ranges (page 3, lines 3 to 7):

Organic chelating agent	1-15% by weight
Water	25-99% by weight
Polar organic solvent	0-60% by weight.

However, those formulations described in D2, which consist of an organic chelating agent and water, contain catechol as the chelating agent (see page 3, lines 14 to 17). The remaining formulations described in D2 are formulations containing three components, *i.e.* a chelating agent, water and an organic solvent. By contrast, the stripping composition specified in claim 1 of auxiliary request I consists of water and one or more particular polycarboxylic acids and/or salts thereof, and thus does not contain any organic solvent or catechol. Therefore the subject-matter of claim 1 of auxiliary request I is novel over D2.

7.3.3 D4, which also is prior art under Article 54(3) EPC, discloses a post-clean treatment solution which is employed - instead of water rinse, isopropyl alcohol rinse or methylpyrrolidone rinse - after removal of photoresist and etch residues in order to rinse debris and remaining chemicals from the etched substrate. Thus it is evident that the use of the post-clean treatment solution described in D4 is completely different to the use of a stripping liquid composition for stripping photoresist residues remaining after dry etching, as required by claim 1 of auxiliary request I. Therefore the subject-matter of claim 1 of auxiliary request I is novel over D4.

7.3.4 D5 discloses a cleaning agent for semiconductor substrate surfaces comprising an organic acid having at least one carboxyl group and a complexing agent having chelating ability (page 3, lines 17-19 and 24-49). However, this cleaning agent is used for removing metallic contaminants that are absorbed and adhered on the semiconductor substrate surface. It is not used for

stripping photoresist residues after dry etching as required by claim 1 of auxiliary request I. Therefore the subject-matter of claim 1 of auxiliary request I is novel over D5.

7.3.5 D6 discloses alkaline cleaner compositions containing (i) an aqueous metal ion free base, (ii) a nonionic surfactant and (iii) a sufficient amount of a component to control or reduce the pH of the resulting cleaning solution (page 2, lines 49-53). All three components are required to produce an effective wafer cleaner action. However, the stripping liquid composition specified in claim 1 of auxiliary request I does not contain a nonionic surfactant. Therefore the subject-matter of claim 1 of auxiliary request I is novel over D6.

7.3.6 D7, which is prior art under Article 54(3) EPC, discloses an aqueous post-strip rinsing composition comprising water, at least one water-soluble organic acid and at least one water-soluble surface-active agent. Again, the stripping liquid composition specified in claim 1 of auxiliary request I does not contain a water-soluble surface-active agent. Therefore the subject-matter of claim 1 of auxiliary request I is novel over D7.

7.3.7 D8 discloses stripping and cleaning compositions comprising hydroxylamine and at least one alkanolamine. When utilised as a stripping composition, the composition can optionally contain one or more polar solvents (column 3, lines 57 to 63). However, the stripping liquid composition specified in claim 1 of auxiliary request I contains neither hydroxylamine nor

an alkanolamine. Therefore the subject-matter of claim 1 of auxiliary request I is novel over D8.

7.3.8 Regarding the disclosure of D9 (a Japanese patent application) reference is made to D9a (a European patent application of the same patent family) and to D9b (the English translation of the priority document of D9a). Both D9a and D9b disclose a cleaning liquid composition comprising a quaternary ammonium salt, a fluorine-containing compound, a water-soluble or water-miscible organic solvent, and an inorganic acid and/or an organic acid (see claim 1). In contrast, the stripping liquid composition specified in claim 1 of auxiliary request I consists of water and one or more polycarboxylic acids and/or salts thereof as defined in said claim and does not contain a fluorine-containing compound, or a water-soluble or water-miscible organic solvent. Therefore the subject-matter of claim 1 of auxiliary request I is novel over D9.

7.4 In its response to the statement of grounds of appeal, respondent 1 filed document D11, prior art under Article 54(3) EPC. The appellant requested that this document not be admitted into the proceedings.

D11 was submitted after the expiry of the nine-month period under Article 99(1) EPC and thus is filed late. It is therefore at the board's discretion to admit D11 into the proceedings (Article 114(2) EPC).

Firstly, the board notes that no adequate excuse was provided by respondent 1 as to why D11 was filed so late. Secondly, D11 is no more relevant than the documents already on file. D11 relates to a non-

corrosive cleaning composition for removing plasma-etching residues comprising a hydroxylammonium compound as a mandatory component, which is excluded from the composition used in claim 1. Since, however, one criterion for admitting late-filed documents into the proceedings is their relevance (see T 1002/92; OJ EPO 1995, point 3.4 of the reasons), this document is not admitted into the appeal proceedings (Article 114(2) EPC).

7.5 The subject-matter of dependent claim 2 is *mutatis mutandis* novel.

8. Inventive step - Article 56 EPC

8.1 Closest state of the art

The board agrees with the parties that D2 represents the closest state of the art, since it belongs to the field of cleaning formulations for use in post-plasma semiconductor fabrication (page 1, lines 12 to 18) and seeks to effectively remove inorganic residues (metal halides and metal oxides) remaining on a semiconductor wafer following a plasma ashing step (page 2, lines 6 to 12 and 17-24). D2 achieves this goal D2 by using specific liquid compositions.

As already set out in point 7.3.2 above, the subject-matter of claim 1 differs from the disclosure of D2 as far as the components of the liquid compositions are concerned.

8.2 Technical problem

8.2.1 The patent in suit (paragraph [0017]) discloses that:

"Through the present invention, it has been possible to provide the use of a photoresist stripping liquid composition which is far more effective for removing photoresist residues remaining after dry etching than the stripping liquids of the prior art, does not corrode metallic materials and does not have an impact on the environment caused by organic solvents."

8.2.2 Nevertheless, D2 already discloses liquid compositions with no organic solvents, namely formulations consisting of catechol and water (page 3, lines 13 to 16) which apparently do not have any impact on the environment.

Furthermore, the technical evidence submitted by the appellant with letters of 24 October 2000 and 3 May 2007 shows that the liquid compositions of D2 do not corrode the metallic materials during stripping of the photoresist residues. Finally, no improvement has been shown over D2 regarding the removal of photoresist residues, except in the case of a stripping aqueous composition of oxalic acid (see appellant's letters of 24 October 2000 and 3 May 2007).

8.2.3 Therefore the objective technical problem in view of D2 can only be seen in the provision of an alternative liquid composition to be used for stripping photoresist residues remaining on wiring material made of Al-Si-Cu or ferroelectrics made of lead zirconium titanate (PZT) after dry etching, and which does not corrode metallic

materials and does not have an impact on the environment like that caused by organic solvents.

8.2.4 The board is satisfied that the experimental part of the patent in suit (tables 1-6) provides the necessary technical evidence that the technical problem is solved.

8.3 Obviousness

8.3.1 The skilled person starting from the disclosure of D2 and faced with the objective technical problem identified above does not find any hint in D2 itself to use compositions according to claim 1 of auxiliary request I. The only formulations disclosed in this document which do not contain an organic solvent and are therefore environmentally friendly are those containing catechol as the chelating agent. Furthermore, D2 discloses at page 4, lines 19 to 22 that:

"... it would be expected that chelating agents related to catechol and other polar organic solvents may also be utilized with comparable results. Catechol-related chelating agents would include derivatives of benzene, naphthalene, and aromatic heterocyclic compounds having at least two hydroxyl (OH) groups on adjacent carbon atoms."

Thus D2 does not suggest the use of one or more of the particular aliphatic polycarboxylic acids and/or salts specified in claim 1 of auxiliary request I in the formulations described in D2.

8.3.2 The board does not concur with respondent 1 that the passage in D2 (bridging pages 4 and 5) gives the

skilled person a clear direction to use a mixture of malonic acid or oxalic acid with water as the only solvent. The relevant passage states:

"Additional formulations have been developed for stripping wafer residues which originate from plasma metal etching followed by ashing. The additional formulations utilize the following components (percent by weight):
A chelating agent compound 2-98%
water and/or polar organic solvent 2-98%"

Twelve chelating agents are then listed on page 5, including malonic acid and oxalic acid. The solvent is preferably selected from a list of five constituents comprising water, ethylene glycol, N-methylpyrrolidone (NMP), gamma butyrolactone (BLO) and butyl carbitol, the preferred solvent formulations being mixtures of NMP and water and BLO and water (page 5, lines 17 to 25). Contrary to the assertions of respondent 1, this disclosure does not provide any hint towards a cleaning formulation consisting of malonic acid and water or oxalic acid and water, respectively. It appears that the argument of respondent 1 is based on hindsight.

8.3.3 Moreover, all exemplified formulations of D2 which comprise oxalic acid or malonic acid (page 6, lines 9-11, 17-23) contain three components, i.e. water, oxalic acid and NMP or BLO as an organic solvent. The organic solvent is present in these formulations in an amount of at least 50% by weight and obviously has an essential function. Therefore the omission of the

organic solvent in these formulations does not seem obvious to the skilled person.

8.3.4 Finally, the necessary hint cannot be found in the other prior-art documents available under Article 54(2) EPC, (D5, D6, D8 and D9).

The compositions of D5 are used for removing metallic contaminants absorbed or adhered on the semiconductor substrate surface but not for stripping photoresist residues. Moreover, nothing is provided in D5 from which the skilled person would have reasonably expected that the cleaning agents described therein are effective in stripping photoresist residues.

D6, D8 and D9 disclose compositions which contain essential components for their stripping activity which cannot be present in the composition defined in claim 1. None of these documents provides any motivation for the skilled person to exclude these essential components from the disclosed compositions in order to arrive at the stripping liquid composition according to claim 1 of auxiliary request I.

To summarise, D5, D6, D8 and D9 do not provide the technical teaching which is missing from D2 to arrive at the subject-matter of claim 1 of auxiliary request I.

8.4 Consequently the subject-matter of claim 1 of auxiliary request I involves an inventive step.

8.5 Respondent 1 argued that the examples of the patent in suit showed that the object of the invention was not achieved over the entire scope of the claim and, thus,

the claim did not involve an inventive step. In particular, respondent 1 pointed out that:

(i) when using malonic acid, ammonium oxalate or low levels of oxalic acid, there was no removal of resists at a temperature up to 30°C, and

(ii) when using succinic acid, malic acid or citric acid, there was no removal of resists at a temperature up to 50°C.

Firstly, even if a problem is not solved over the entire scope of the claim, this in itself is not yet a reason to deny the presence of an inventive step. In the problem-solution approach one would normally have to formulate the objective problem in a less ambitious way. Secondly, as set out in point 8.2.3 above, the objective technical problem has to be seen in the provision of an alternative liquid composition to be effectively used for stripping photoresist residues remaining on wiring material made of Al-Si-Cu or ferroelectrics made of lead zirconium titanate (PZT) after dry etching, and which does not corrode metallic materials and does not have an impact on the environment like that caused by organic solvents. In this respect it is emphasised that this technical problem does not include the requirement that the stripping liquid composition has to be effective at any temperature. The person skilled in the art would know from his common general knowledge that stripping formulations are normally applied at high temperatures. Consequently, this objection is rejected.

8.6 The use of claim 2, which is a specific embodiment of the use of claim 1, involves an inventive step *mutatis mutandis*.

9. In view of the above considerations, claims 1 and 2 of auxiliary request I fulfil the requirements of the EPC and this request is allowable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent with:
   - claims 1 and 2 filed as auxiliary request 1 during the oral proceedings before the board;
   - description pages 2, 3, 3A and 4-7 filed during the oral proceedings before the board.

The Registrar: The Chairman:

M. Cañueto Carbajo W. Sieber