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D E C I S I O N
of 30 January 2006

Case Number: T 1009/03 - 3.4.03

Application Number: 97946280.1

Publication Number: 0946979

IPC: H01L 21/321

Language of the proceedings: EN

Title of invention:
Method for chemical-mechanical planarization of a substrate on a fixed-abrasive polishing pad

Applicant:
MICRON TECHNOLOGY, INC.

Opponent:
-

Headword:
-

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

Keyword:
"Added subject-matter (no; after amendment)"
"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1009/03 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 30 January 2006

Appellant:	MICRON TECHNOLOGY, INC. 8000 South Federal Way P.O. Box 6 M/S 507 Boise ID 83707-0006 (US)
Representative:	Hirsch, Peter Klunker Schmitt-Nilson Hirsch Winzererstrasse 106 D-80797 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted 14 April 2003 refusing European application No. 97946280.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. G. O'Connell
Members: V. L. P. Frank
P. Mühlens

Summary of Facts and Submissions

I. This is an appeal from the refusal of European patent application 97 946 280.1 on the ground of added subject-matter (Article 123(2) EPC.

II. In response to a communication from the board the appellant filed amended claims and description.

Claim 1 is now worded as follows:

"A chemical/mechanical planarization method for removing material from a surface of a semiconductor substrate, comprising:

- providing an abrasive-free planarizing solution,
- providing a fixed-abrasive pad having abrasive particles dispersed in a suspension medium, the fixed-abrasive particles being fixedly attached to the suspension medium,
- covering the planarization (sic) solution onto the fixed-abrasive pad,
- oxidizing the material of the surface layer of the substrate, wherein the material of the surface layer comprises a metal selected from the group consisting of tungsten, aluminium and copper, the planarizing solution comprises an oxidant and forms non-soluble oxides on the surface of the substrate, and the pH of the planarizing solution is controlled to oxidize the material of the surface layer without passing it into solution, and where if the metal is tungsten the oxidant is comprised of at least one of hydrogen peroxide and bromine, if the metal is aluminium the oxidant is comprised of at least one of hydrogen peroxide, potassium iodate, and ferric nitrate, if

the metal is copper, the planarizing solution has a mixture selected from the group consisting of a mixture of deionized water with 0.1% to 5.0% nitric acid and 0.1% to 10% ethanol, a mixture of deionized water with 0.1% to 5.0% nitric acid and 0.1% to 1.0% benzotriazole, a mixture of deionized water with 0.5% to 3.0% ammonium hydroxide, and a mixture of deionized water with 0.5% to 3.0% ammonium ferricyanide,

- removing the oxidized surface layer by the abrasive particles in the fixed-abrasive polishing pad, wherein the step of removing the oxidized surface layer of the substrate is performed by pressing the surface layer against the fixed-abrasive pad in the presence of the planarizing solution and moving at least one of the fixed-abrasive pad or substrate relative to the other."

Claims 2 to 16 are dependent on claim 1.

III. The following prior art documents *inter alia* were cited in the examination procedure:

D1: US 5 340 370 A

D2: WO 96/16436 A

D5: US 3 638 366 A

IV. In the decision under appeal the examining division found that the omission of the pH range of the planarizing solution in the then claimed chemical mechanical polishing (CMP) method was not a permissible amendment under Article 123(2) EPC, since it was clear

from the application that a successful polishing required specification of the metal to be polished, the oxidant and the pH of the solution. The extraction of two of these three features amounted to an undisclosed intermediate generalization, as it implied that the pH value was not an important factor in the planarization process.

The examining division found also that the then claimed method was not inventive over the combination of documents D1 and D5 or D2 and D5. Documents D1 and D2 each disclosed a CMP method using an abrasive solution comprising an oxidant and an abrasive-free polishing pad while document D5 disclosed the use of an abrasive-free solution and a fixed-abrasive polishing pad. To use an abrasive-free solution comprising an oxidant according to D1 or D2 with the fixed-abrasive polishing pad disclosed in D5 was obvious to the skilled person, as this later document disclosed the advantages of employing such polishing pads. This reasoning applied to the then claimed method, as the claim was neither limited to specific metals to be polished nor to specific oxidants of the planarizing solution.

V. The appellant argued essentially as follows:

- The present method specified that the pH of the planarizing solution was controlled to oxidize the material of the surface layer without passing it into solution. As this was the fundamental property of the pH control disclosed in the application, the requirements of Article 123(2) EPC were met.

- Document D1 and D2 disclosed slurries for CMP of thin films used in semiconductor integrated circuit manufacturing. Document D5, however, did not relate to semiconductor polishing, but to polishing of magnetic disk substrates. Such substrates had features of 6-10 microinches in size, while semiconductor substrates had submicron sized features. The process disclosed in D5, although applicable to polishing magnetic disks, was not suitable for polishing of semiconductor substrates. For these reasons, documents D1 or D2 on the one hand and D5 on the other could not be combined.

- The specific metal/oxidant combinations now claimed were not disclosed in any of the cited documents and were not obvious to the skilled person.

VI. The appellant requests that the decision under appeal be set aside and that a patent be granted with the claims, description and figures filed with the letter of 7 November 2005.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments (Article 123(2) EPC)*

Claim 1 now specifies that the planarizing solution comprises an oxidant which forms non-soluble oxides on the surface of the substrate and that the pH of the

solution is controlled to oxidize the material of the surface layer without passing it into solution (cf page 4, lines 3 to 10; page 6, line 20 to page 7, line 1 and page 10, lines 14 to 17 of the application as originally filed). The metals to be polished (tungsten, aluminium and copper) and the respective oxidants of the planarizing solution are also specified in the claim (cf page 7, line 17 to page 8, line 14). Consequently, the three features required for achieving a successful polishing are explicitly identified in the claim.

The description has been adapted to the claims.

The board is therefore satisfied that Article 123(2) EPC is not contravened.

3. *Novelty (Article 54 EPC)*

3.1 Claim 1 is directed to a chemical-mechanical planarization (CMP) method for removing metal containing layers from the surface of a semiconductor substrate. The metal is tungsten, aluminium or copper. For each metal a specific planarizing solution is specified which comprises an oxidant which forms non-soluble metal oxides.

For tungsten the oxidant comprises hydrogen peroxide or bromine; for aluminium it comprises hydrogen peroxide, potassium iodate or ferric nitrate and for copper it comprises nitric acid, ethanol, benzotriazole, ammonium hydroxide or ammonium ferricyanide (cf point II. above).

The pH of the solution is controlled so that the metal is oxidized but not dissolved. The oxides are removed from the substrate by a polishing pad which comprises abrasive particles that are fixed to it, ie a fixed-abrasive polishing pad.

3.2 Document D1 discloses a CMP method for planarizing *inter alia* tungsten or copper layers. An abrasive-free pad is used together with a polishing slurry. The slurry comprises abrasive particles, such as silica, alumina or ceria, and an oxidant, such as potassium ferricyanide, potassium dichromate, potassium iodate, potassium bromate or vanadium trioxide. Potassium ferricyanide is the preferred oxidizing agent for planarizing tungsten or copper layers (cf column 6, lines 36 to 61; column 7, lines 12 to 14).

3.3 Document D2 discloses a CMP abrasive slurry for planarizing tungsten layers which comprises a ferric salt as oxidant (cf page 1, lines 6 to 10; page 5, lines 3 to 4).

3.4 The method of claim 1 differs from the CMP methods disclosed in documents D1 and D2 by:

(a) the specific oxidants used, and

(b) the combination of a fixed-abrasive pad and a non-abrasive planarizing solution.

3.5 Although document D5 discloses the combination of a fixed-abrasive pad and a non-abrasive planarizing solution it neither discloses a planarizing solution comprising an oxidant within the meaning of the present

application nor the control of the pH of the planarizing solution (cf column 1, lines 50 to 55; column 5, lines 15 to 20).

3.6 The method of claim 1 is therefore new.

4. *Inventive step (Article 56 EPC)*

The examining division found in their decision that none of the available documents rendered obvious the selection of the specific oxidants of the planarizing solution used in the CMP methods for tungsten, aluminium or copper of claim 1. The board approves and adopts this conclusion and the reasoning on which it was based.

5. The board judges, for these reasons, that the application fulfils the requirements of the EPC.

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 with the order to grant a patent with the following documents:

   Claims: 1 to 16 of the main request;

   Description: pages 1 to 3, 3a, 3b and 4 to 12;

   Figures: sheets 1 and 2;

   all filed with the letter of 7 November 2005.

Registrar Chair

D. Meyfarth R. G. O'Connell