(A) at least one compound comprising at least one thiol (–SH), thioether (–SR^1) or thiocarbonyl (>C=S) group, wherein R^1 is alkyl, aryl, alkylaryl or arylalkyl,

(B) at least one sugar alcohol which contains at least three hydroxyl (–OH) groups and does not comprise any carboxylic acid (–COOH) or carboxylate ($–COO^-$) groups, and

(C) an aqueous medium

was found.

In a first aspect, there is provided a post chemical-mechanical-polishing (post-CMP) cleaning composition comprising:

(A) at least one compound comprising at least one thiol (–SH), thioether (–SR^1) or thiocarbonyl (>C=S) group, wherein R^1 is alkyl, aryl, alkylaryl or arylalkyl,

(B) erythritol, threitol, or a stereoisomer thereof, or a mixture thereof,

(C) water, and

(E) amphiphilic nonionic, water-soluble or water-dispersible surfactants

wherein the post-CMP cleaning composition has a pH-value in the range of from 4 to not more than 7.

This post-CMP cleaning composition of the disclosure is referred to as (Q1) or composition (Q1) in the following.

According to an embodiment disclosed herein, a post-CMP cleaning composition comprising:

(A) at least one compound comprising at least one thiol (–SH), thioether (–SR^1) or thiocarbonyl (>C=S) group, wherein R^1 is alkyl, aryl, alkylaryl or arylalkyl,

(L) at least one oligomeric or polymeric polycarboxylic acid, and

(C) an aqueous medium

was found.

In an aspect, there is provided the use of the post-CMP cleaning composition as defined above for removing residues and contaminants from the surface of semi-conductor substrates useful for manufacturing microelectronic devices.

In another aspect, there is provided a process for manufacturing microelectronic devices from semiconductor substrates comprising the step of removing residues and contaminants from the surface of the semiconductor substrates by contacting them a least once with the post-CMP cleaning composition as defined above.

In an embodiment, there is provided a post chemical-mechanical-polishing (post-CMP) cleaning composition comprising:

(D) is cysteine, glutathione, N-acetylcysteine, thiourea or a derivative thereof,

(L) at least one oligomeric or polymeric polycarboxylic acid, and

(C) an aqueous medium.

Claims:

1. A post chemical-mechanical-polishing (post-CMP) cleaning composition comprising:
   (A) at least one compound comprising at least one thiol (–SH), thioether (–SR^1) or thiocarbonyl (>C=S) group, wherein R^1 is alkyl, aryl, alkylaryl or arylalkyl,
   (B) is erythritol, threitol, or a stereoisomer thereof, or a mixture thereof,
   (C) water, and
   (E) amphiphilic nonionic, water-soluble or water-dispersible surfactants,
   wherein the post-CMP cleaning composition has a pH-value in the range of from 4 to not more than 7.

2. A composition according to claim 1, wherein the compound (A) is a compound comprising at least one thiol (–SH), thioether (–SR^1), or thiocarbonyl (>C=S) group and at least one amino (–NH_2, –NHR^2, or –NR^3R^4) group and wherein R^1, R^2, R^3 and R^4 is – independently from each other – alkyl, aryl, alkylaryl or arylalkyl.

3. A composition according to claim 2, wherein the compound (A) is thiourea or a derivative thereof.

4. A composition according to claim 2, wherein compound (A) is an amino acid comprising at least one thiol (–SH) or thioether (–SR^1) group, or a derivative of this amino acid,
   wherein R^1 is alkyl, aryl, alkylaryl or arylalkyl.

5. A composition according to claim 4, wherein the compound (A) is cysteine, cystine, glutathione, N-acetylcysteine, or a derivative thereof.

6. A composition according to anyone of the claims 1 to 5, wherein the composition further comprises (D) at least one metal chelating agent.

7. A composition according to anyone of the claims 1 to 5, wherein the composition further comprises at least one metal chelating agent (D) which is selected from the group consisting of propane-1,2,3-tricarboxylic acid, citric acid, butane-1,2,3,4-tetracarboxylic acid, pentane-1,2,3,4,5-pentacarboxylic acid, trimellitic acid, trimesinic acid, pyromellitic acid, mellitic acid and oligomeric and polymeric polycarboxylic acids.

8. A composition according to anyone of the claims 1 to 7, wherein (E) amphiphilic nonionic, water-soluble or water-dispersible surfactants is selected from the group consisting of:

(E1) amphiphilic nonionic, water-soluble or water-dispersible surfactants having

(e11) at least one hydrophobic group selected from the group consisting of branched alkyl groups having 5 to 20 carbon atoms; and
(e12) at least one hydrophilic group consisting of oxyethylene monomer units;

(E2) amphiphilic nonionic, water-soluble or water-dispersible surfactants having

(e21) at least one hydrophobic group selected from the group consisting of branched alkyl groups having 5 to 20 carbon atoms; and
(e22) at least one hydrophilic group selected from the group consisting of polyoxyalkylene groups comprising

(e221) oxyethylene monomer units and
(e222) at least one type of substituted oxyalkylene monomer units wherein the substituents are selected from the group consisting of alkyl, cycloalkyl, aryl, alkyl-cycloalkyl, alkyl-aryl, cycloalkyl-aryl and alkyl-cycloalkyl-aryl groups;

the said polyoxyalkylene group of (e22) containing the monomer units (e221) and (e222) in random, alternating, gradient and/or blocklike distribution; and

(E3) amphiphilic nonionic, water-soluble or water-dispersible alkyl polyglucoside surfactants.

9. The use of the post-CMP cleaning composition as defined in anyone of the claims 1 to 8 for removing residues and contaminants from the surface of semiconductor substrates useful for manufacturing microelectronic devices.

10. The use according to claim 9, wherein the residues and contaminants comprise benzotriazole or a derivative thereof and wherein the surface is a copper-containing surface.

11. The use according to claim 9, wherein the cleaning composition is used for removing residues and contaminants from the surface of semiconductor substrates comprising
    - electrically conductive layers containing or consisting of copper,
    - electrically insulating dielectric layers consisting of low-k or ultra-low-k dielectric materials, and
    - barrier layers containing or consisting of tantalum, tantalum nitride, titanium nitride, cobalt, nickel, manganese, ruthenium, ruthenium-nitride, ruthenium-carbide, or ruthenium tungsten nitride

    after chemical mechanical polishing.

12. A process for manufacturing microelectronic devices from semiconductor substrates comprising the step of removing residues and contaminants from the surface of the semiconductor substrates by contacting them at least once with the post-CMP cleaning composition as defined in anyone of the claims 1 to 8.

13. A process according to claim 12, wherein the residues and contaminants comprise benzotriazole or a derivative thereof and wherein the surface is a copper-containing surface.

14. A process according to claim 12, wherein the semiconductor substrates comprise
    - electrically conductive layers containing or consisting of copper,
    - electrically insulating dielectric layers consisting of low-k or ultra-low-k dielectric materials, and
    - barrier layers containing or consisting of tantalum, tantalum nitride, titanium nitride, cobalt, nickel, manganese, ruthenium, ruthenium-nitride, ruthenium-carbide, or ruthenium tungsten nitride.