

In EP 1 844 122 B1 an adjuvant for use in simultaneous polishing of a cationically charged material like silicon nitride and an anionically charged material like silicon dioxide is disclosed. It is assumed that said adjuvant forms an adsorption layer on the cationically charged material in order to increase the polishing selectivity of the anionically charged material over the cationically charged material. The adjuvant comprises a polyelectrolyte salt containing: (a) a graft type polyelectrolyte that has a weight average molecular weight of 1,000 to 20,000 and comprises a backbone and a side chain having a specific structure as defined in EP 1 844 122 B1; and (b) a basic material. Said adjuvant shall also minimize agglomeration of abrasive particles. However, the examples of EP 1 844 122 B1 show that said objects are not always achieved with the proposed adjuvants. In some cases the material removal selectivity of silicon dioxide over silicon nitride is not increased, compared to CMP compositions with prior art adjuvants. Furthermore, in the CMP compositions comprising an adjuvant according to EP 1 844 122 B1 the average agglomerated particle size of the ceria particles is higher than 500 nm which is not acceptable for a plurality of CMP applications. The influence of said adjuvant on the zeta potential of the ceria particles is not discussed in EP 1 844 122 B1.

US 7,381,251 B2 discloses a liquid composition comprising a mixture of a liquid medium, a colloidal dispersion of mineral particles and a phosphonate terminated poly(oxyalkene) polymer.

One of the objects of the ~~present invention~~ embodiments disclosed herein is to provide a chemical mechanical polishing (CMP) composition and a CMP process showing an improved polishing performance especially for dielectric substrates. More specifically it is an object of the ~~present invention~~ embodiments disclosed herein to provide a chemical mechanical polishing (CMP) composition and a CMP process showing

- (i) a high material removal rate (MRR) of silicon dioxide, or
- (ii) an adjustable selectivity between silicon dioxide and silicon nitride, or
- (iii) an adjustable selectivity between silicon dioxide and polycrystalline silicon,
- (iv) a high surface quality of the polished surfaces
- (v) preferably the combination of (i), (ii), (iii) and (iv).

It is a further object of the ~~present invention~~ embodiments disclosed herein to provide a chemical mechanical polishing (CMP) composition comprising ceria particles wherein agglomeration of the ceria particles at a pH value of 6 and higher, preferably up to a pH value of 10, is suppressed.

It is a further object of the ~~present invention~~ embodiments disclosed herein to provide a chemical mechanical polishing (CMP) composition comprising ceria particles wherein the ceria particles carry low charges, i.e. have a low zeta potential.

According to an ~~first~~ aspect of the present ~~invention~~ disclosure, a chemical-mechanical polishing (CMP) composition is provided comprising the following components:

(A) abrasive particles containing ceria

(B) one or more polymers, wherein each macromolecule of said polymers (B) comprises

(i) one or more anionic functional groups

and

(ii) one or more structure units $-(AO)_a-R$

wherein in each structure unit $-(AO)_a-R$ independently from each other structure unit $-(AO)_a-R$

A is C_xH_{2x} wherein for each A in said structure units $-(AO)_a-R$, x is (independently from each other x) selected from the range of integers from 2 to 4, wherein x is preferably 2 or 3, further preferably $x=2$

wherein within each structure unit $-(AO)_a-R$ the groups A are the same or different

a is an integer selected from the range of from 5 to 200, preferably 8 to 150, most preferably 20 to 135,

R is hydrogen or a branched or linear alkyl group having 1 to 4 carbon atoms,

wherein in said polymer (B) the sum of the molar masses of all structure units (ii) is at least 50 % of the molar mass of said polymer (B).

In another aspect, there is provided a process for the manufacture of a semiconductor device comprising chemical mechanical polishing of a substrate in the presence of a chemical mechanical polishing (CMP) composition as defined above.

In another aspect, there is provided the use of a polymer (B) as defined above for suppressing the agglomeration of ceria containing particles dispersed in aqueous medium and/or for adjusting the zeta potential of ceria containing particles.

In another aspect, there is provided a process for suppressing the agglomeration and/or adjusting the zeta potential of ceria containing particles dispersed in aqueous medium, said process comprising the step of adding an effective amount of one or more polymers (B) as defined above to said aqueous medium wherein the ceria containing particles are dispersed.

Further details, modifications and advantages of the present invention are explained in the following detailed description and the examples.

(A) Abrasive particles containing ceria

The CMP composition according to the present invention comprises as component (A) abrasive particles containing ceria. In the CMP process, said ceria particles act (A) as an abrasive towards the surface to be polished.

Preferably, the abrasive particles (A) consist of ceria. Preferably, a chemical-mechanical polishing (CMP) composition according to the present invention does not contain other abrasive particles than (A) abrasive particles containing ceria or consisting of ceria.

5 Within the CMP composition of the present invention, the ceria particles are typically dispersed in a colloidal state.

Suitable ceria containing abrasive particles (A) are commercially available, for instance under the trade name Rhodia.