CHEMICAL MECHANICAL POLISHING (CMP) COMPOSITION COMPRISING A PROTEIN

Description

This invention essentially relates to a chemical mechanical polishing (CMP) composition and its use in polishing substrates of the semiconductor industry. The CMP composition according to the invention comprises a protein and shows an improved polishing performance.

In the semiconductor industry, chemical mechanical polishing (abbreviated as CMP) is a well-known technology applied in fabricating advanced photonic, microelectromechanical, and microelectronic materials and devices, such as semiconductor wafers.

During the fabrication of materials and devices used in the semiconductor industry, CMP is employed to planarize metal and/or oxide surfaces. CMP utilizes the interplay of chemical and mechanical action to achieve the planarity of the to-be-polished surfaces. Chemical action is provided by a chemical composition, also referred to as CMP composition or CMP slurry. Mechanical action is usually carried out by a polishing pad which is typically pressed onto the to-be-polished surface and mounted on a moving platen. The movement of the platen is usually linear, rotational or orbital.

In a typical CMP process step, a rotating wafer holder brings the to-be-polished wafer in contact with a polishing pad. The CMP composition is usually applied between the to-be-polished wafer and the polishing pad.

In the state of the art, CMP compositions comprising a peptide are known and described, for instance, in the following references.

EP 1 235 261 A1 discloses a polishing compound for polishing a metal layer and/or a barrier layer formed on a semiconductor substrate, which is a polishing compound for chemical mechanical polishing in a process for production of a semiconductor device and which comprises polishing abrasive grains and a peptide. The peptide is for example a member selected from the group consisting of glycylglycine (Gly-Gly), alanyl-alanine (Ala-Ala), glycylalanine (Gly-Ala), alanylglycine (Ala-Gly), glycylglycylglycine (Gly-Gly-Gly) and di- to heptamers thereof.

One of the objects of the embodiments of the present ~~invention~~disclosure was to provide a CMP composition appropriate for the CMP of surfaces of dielectric substrates and/or showing an improved polishing performance, particularly the combination of high material removal rate (MRR) of silicon dioxide and low MRR of silicon nitride or polysilicon. Furthermore, A CMP composition was sought that would result in a high step height reduction (SHR) and would be ready-to-use.

Furthermore, a respective CMP process was to be provided.

Accordingly, in a first aspect there is provided a CMP composition ~~was found~~ which comprises

(A) inorganic particles, organic particles, or a mixture or composite thereof,

(B) a protein, and

(C) an aqueous medium.

In a second aspect there is provided ~~In addition, the above-mentioned objects of the invention are achieved by~~ a process for the manufacture of a semiconductor device comprising the polishing of a substrate in the presence of said CMP composition as defined above.

~~Moreover,~~In a third aspect there is provided the use of the CMP composition ~~of the invention~~as defined above for chemical mechanical polishing of substrates which are used in the semiconductor industry ~~has been found~~, which fulfills the objects of the embodiments of the present disclosure~~invention~~.

Preferred embodiments are explained in the claims and the specification. It is understood that combinations of preferred embodiments are within the scope of the present ~~invention~~disclosure.

A semiconductor device can be manufactured by a process which comprises the CMP of a substrate in the presence of the CMP composition of the invention. Preferably, said process comprises the CMP of a dielectric substrate, that is a substrate having a dielectric constant of less than 6. Said process comprises more preferably the CMP of a substrate comprising silicon dioxide, most preferably the CMP of a substrate comprising silicon dioxide and silicon nitride or polysilicon, particularly the CMP of a silicon dioxide layer of a substrate which is a shallow trench isolation (STI) device or a part thereof, for example the CMP of a silicon dioxide layer of a substrate comprising silicon dioxide and silicon nitride or polysilicon.

If said process comprises the CMP of a substrate comprising silicon dioxide and silicon nitride, the selectivity of silicon dioxide to silicon nitride with regard to the material removal rate is preferably higher than 20:1, more preferably higher than 35:1, most preferably higher than 50:1, particularly higher than 70:1, for example higher than 90:1. This selectivity can be adjusted by the type and concentration of protein (B) and by setting other parameters such as pH value.

If said process comprises the CMP of a substrate comprising silicon dioxide and polysilicon, the selectivity of silicon dioxide to polysilicon with regard to the material removal rate is preferably higher than 20:1, more preferably higher than 35:1, most preferably higher than 50:1, particularly higher than 70:1, for example higher than 90:1. This selectivity can be adjusted by the type and concentration of protein (B) and by setting other parameters such as pH value.

The CMP composition of the invention is used for polishing any substrate used in the semiconductor industry. Said CMP composition is used preferably for polishing a dielectric substrate, that is a substrate having a dielectric constant of less than 6, more preferably for polishing a substrate comprising silicon dioxide, most preferably for polishing a substrate comprising silicon dioxide and silicon nitride or polysilicon, particularly for polishing a silicon dioxide layer of a substrate which is a shallow trench isolation (STI) device or a part thereof, and for example for pol-