Claims

[Claim 1]

A polishing pad, which comprises a polishing layer having a polishing surface,

wherein the polishing layer comprises a cured product of a composition comprising a urethane-based prepolymer, a curing agent, a silicone-based surfactant, and a foaming agent, wherein a content of the silicone-based surfactant ranges from 0.2 part by weight to 2 parts by weight based on 100 parts by weight of the urethane-based prepolymer, and wherein a content of an inorganic substance in the polishing layer is 5 ppm to 500 ppm,

wherein when polishing is carried out using a first composition having a hydrogen ion concentration (pH) of 8 to 12, the polishing surface of the polishing layer has a first surface zeta potential (PZ1), which is a value of surface zeta potential of the polishing surface derived by the following Relationship 1 for the first composition;

when polishing is carried out using a second composition having a hydrogen ion concentration (pH) of 2 to 6, the polishing surface of the polishing layer has a second surface zeta potential (PZ2), which is a value of surface zeta potential of the polishing surface derived by the following Relationship 1 for the second composition; and

at least one of the first surface zeta potentials (PZ1) and at least one of the second surface zeta potentials (PZ2) satisfy the following Relationship 2:

[Relationship 1]

Surface zeta potential = (-) zeta potential of a fixed layer + zeta potential of the composition

[Relationship 2]

$-20 \leq \frac{PZ1}{PZ2} \leq 0$,

wherein the fixed layer is a layer formed on the polishing surface by the particles in a standard composition when the standard composition having its own zeta potential is supplied on the polishing surface of the polishing pad.

[Claim 2]

The polishing pad of claim 1, wherein when polishing is carried out using a third composition having a hydrogen ion concentration (pH) of 7.5 to 9.5, the polishing

surface of the polishing layer has a third surface zeta potential (PZ3), which is a value of surface zeta potential of the polishing surface derived by the above Relationship 1 for the third composition, and

at least one of the first surface zeta potentials (PZ1) and at least one of the third surface zeta potentials (PZ3) satisfy the following Relationship 3:

[Relationship 3]

$$1 \leq \frac{PZ1}{PZ3} \leq 5.$$

[Claim 3]

The polishing pad of claim 2, wherein at least one of the first surface zeta potentials (PZ1), at least one of the second surface zeta potentials (PZ2), and at least one of the third surface zeta potentials (PZ3) satisfy the following Relationship 4:

[Relationship 4]

$$1.1 \leq \frac{PZ1 \times PZ2}{PZ3} \leq 50.$$

[Claim 4]

The polishing pad of claim 2, wherein at least one of the first surface zeta potentials (PZ1), at least one of the second surface zeta potentials (PZ2), and at least one of the third surface zeta potentials (PZ3) satisfy the following Relationship 5:

[Relationship 5]

$$1 \leq \frac{(PZ2 - PZ1)}{(PZ2 - PZ3)} \leq 5.$$

[Claim 5]

The polishing pad of claim 2, wherein the zeta potential of the fixed layer for the first composition, IZ1, is +5 mV to about +30 mV,

the zeta potential of the fixed layer for the second composition, IZ2, is -5 mV to about +15 mV, and

the zeta potential of the fixed layer for the third composition, IZ3, is -15 mV to about +10 mV.

[Claim 6]

The polishing pad of claim 2, wherein the first composition comprises silica particles having an average particle diameter of 130 nm to 160 nm and has a zeta potential of -50 mV to -30 mV,

the second composition comprises silica particles having an average particle diameter of 30 nm to 50 nm and has a zeta potential of +10 mV to +30 mV, and

the third composition comprises ceria particles having an average particle diameter of 130 nm to 170 nm and has a zeta potential of -55 mV to -35 mV.

[Claim 7]

The polishing pad of claim 1, wherein the urethane-based prepolymer has an isocyanate end group content (NCO%) of 5% by weight to 11% by weight, or

the foaming agent comprises a solid phase foaming agent having an average particle diameter of 5 μm to 200 μm, a gas phase foaming agent, or a combination thereof, or

the content of the curing agent is 18 parts by weight to 27 parts by weight based on 100 parts by weight of the urethane-based prepolymer, or

the polishing layer has a porous structure comprising pores having an average diameter of 10 μm to 40 μm.

[Claim 8]

The polishing pad of claim 2, wherein when the polishing rate of the polishing surface of the polishing layer for an oxide layer using the first composition is OR1,

when the polishing rate of the polishing surface of the polishing layer for a tungsten layer using the second composition is WR2, and

when the polishing rate of the polishing surface of the polishing layer for an oxide layer using the third composition is OR3,

OR1 is 2,750 Å/min to less than 2,955 Å/min, or

WR2 is 730 Å/min to 850 Å/min, or

OR3 is 2,200 Å/min to 2,955 Å/min.

[Claim 9]

A process for preparing a semiconductor device using a polishing pad comprising a polishing layer having a polishing surface,

wherein the polishing layer comprises a cured product of a composition comprising a urethane-based prepolymer, a curing agent, a silicone-based surfactant, and a foaming agent, wherein a content of the silicone-based surfactant ranges from 0.2 part by weight to 2 parts by weight based on 100 parts by weight of the urethane-based prepolymer, and wherein a content of an inorganic substance in the polishing layer is 5 ppm to 500 ppm; and

relatively rotating the polishing surface of the polishing layer and the surface of an object to be polished while they are in contact with each other to polish the object to be polished,

wherein the object to be polished comprises an oxide layer, a tungsten layer, or a composite layer thereof,

when polishing is carried out using a first composition having a hydrogen ion concentration (pH) of 8 to 12, the polishing surface of the polishing layer has a first surface zeta potential (PZ1), which is a value of surface zeta potential of the polishing surface derived by the following Relationship 1 for the first composition;

when polishing is carried out using a second composition having a hydrogen ion concentration (pH) of 2 to 6, the polishing surface of the polishing layer has a second surface zeta potential (PZ2), which is a value of surface zeta potential of the polishing surface derived by the following Relationship 1 for the second composition; and

at least one of the first surface zeta potentials (PZ1) and at least one of the second surface zeta potentials (PZ2) satisfy the following Relationship 2:

[Relationship 1]

Surface zeta potential = (-) zeta potential of a fixed layer + zeta potential of the composition

[Relationship 2]

$-20 \leq \frac{PZ1}{PZ2} \leq 0$,

wherein the fixed layer is a layer formed on the polishing surface by the particles

in a standard composition when the standard composition having its own zeta potential is supplied on the polishing surface of the polishing pad.