(Al), niobium (Nb), nickel (Ni), chromium (Cr), molybdenum (Mo), tantalum (Ta), ruthenium (Ru), tungsten (W), neodymium (Nd), rubidium (Rb), gold (Au), and platinum (Pt).

The inorganic oxide film may include at least one of fluorine doped tin oxide (FTO, SnO_2 : F), indium tin oxide (ITO), indium zinc oxide (IZO), indium gallium zinc oxide (IGZO), Al-doped ZnO (AZO), aluminum gallium zinc oxide (AGZO), indium zinc tin oxide (IZTO), indium aluminum zinc oxide (IAZO), indium gallium tin oxide (IGTO), antimony tin oxide (ATO), gallium zinc oxide (GZO), IZO nitride (IZON), SnO_2, ZnO, IrOx, RuOx, and NiO.

A target film may be polished using the polishing slurry composition at a speed of greater than or equal to 100 Å/min.

A degree of planarization of a surface of a target film after the target film is polished using the slurry composition may be less than or equal to 5 %.

A transparency of a device after a target film is polished using the slurry composition may increase by 5 % or more when compared to that before the target film is polished.

An oxide film may be polished using the polishing slurry composition at a polishing rate of 100 Å/min to 200 Å/min.

The metal oxide monomolecular complexing agent may have a pKa greater than 1.0 and less than or equal to 4.5.

The metal oxide monomolecular complexing agent may be an acidic compound having 2 to 5 carbon atoms, and include at least one functional group of a hydroxyl group (-OH), a carbonyl group (C=O), and carboxylic acid (-COOH), wherein the number of each of the at least one functional group may be greater than or equal to 2.

The metal oxide monomolecular complexing agent may be included in the polishing slurry composition in an amount of 0.1 parts by weight to 1.0 parts by weight.

The metal oxide monomolecular complexing agent may include at least one of malonic acid, tartaric acid, glyoxylic acid, oxalic acid, lactic acid, and glutaric acid.

An amount of the colloidal silica abrasive particles may be 1 part by weight to 10 parts

are different in size may have different polishing characteristics depending on the particle size, and provide an enhanced action effect by suitably mixing the primary particles and the secondary particles.

The primary particles and the secondary particles may be self-assembled using a preferable method of controlling the ensemble structure and the properties of the abrasive particles, and the primary particles may be aggregated with each other to form the secondary particles.

When the colloidal silica abrasive particles have a specific surface area within a range of 10 m^2/g to 150 m^2/g, the colloidal silica abrasive particles may have a relatively low porosity, and thus the polishing efficiency may improve.

The specific surface area of the colloidal silica abrasive particles may be measured by titration using NaOH.

The metal oxide monomolecular complexing agent may interact with the oxidizer, thereby improving a polishing result. The metal oxide monomolecular complexing agent may combine metal ions that may affect the surface roughness with a complex compound through surface complexation, thereby improving the surface roughness. Further, the metal oxide monomolecular complexing agent may be applied as a chelating agent.

The metal oxide monomolecular complexing agent may have a pKa greater than 1.0 and less than or equal to 4.5. The metal oxide monomolecular complexing agent may satisfy a pKa value of greater than 1.0 and less than or equal to 4.5, and simultaneously satisfy a carbon number of 2 to 5, and/or a polishing rate of greater than 100 Å/min with respect to an inorganic film.

The metal oxide monomolecular complexing agent may be an acidic compound having 2 to 5 carbon atoms, and include at least one functional group of a hydroxyl group (-OH), a carbonyl group (C=O), and carboxylic acid (-COOH), wherein the number of each of the at least one functional group may be greater than or equal to 2.

The metal oxide monomolecular complexing agent may interact with the oxidizer, thereby improving a polishing result.

The metal oxide monomolecular complexing agent may be an acidic compound, preferably, having a pKa greater than 1.0 and less than or equal to 4.5, and more preferably, having a pKa greater than 1.25 and less than or equal to 4.3 and simultaneously having 2 to 5 carbon atoms and a polishing rate greater than 100 Å/min with respect to an inorganic film.

The metal oxide monomolecular complexing agent satisfying all the conditions for the pKa, the carbon number, and the polishing rate with respect to the inorganic film may combine metal ions that may affect the surface roughness with a complex compound through surface complexation, thereby improving the surface roughness.

The metal oxide monomolecular complexing agent may exhibit a relatively high current density value when a potentiodynamic polarization curve is drawn with respect to an amount of the oxidizer through an electrochemical analysis. This may be construed that polishing by oxidization occurs actively since a corrosion speed increases when the current density value increases.

The metal oxide monomolecular complexing agent may include at least one functional group of a hydroxyl group (-OH), a carbonyl group (C=O), and carboxylic acid (-COOH), wherein the number of each of the at least one functional group may be greater than or equal to 2, and wherein the functional group has an acidity since oxygen having a high electronegativity attracts electrons.

When the metal oxide monomolecular complexing agent is used, CMP polishing may be continued and continuously chelate metal oxides that are continuously generated, whereby readsorption of the metal oxides to a metal layer to be polished again may be continuously prevented.

The metal oxide monomolecular complexing agent may include at least one of glyoxylic acid, citric acid, malic acid, maleic acid, malonic acid, oxalic acid, succinic acid,

substrate including at least one of glass, silicon, SiC, SiGe, Ge, GaN, GaP, GaAs, sapphire, and plastic.

The film to be polished may be polished using the polishing slurry composition at a speed of greater than or equal to 100 Å/min, greater than or equal to 500 Å/min, or greater than or equal to 1000 Å/min. For example, an oxide film may be polished using the polishing slurry composition at a polishing rate of 100 Å/min to 200 Å/min.

The polishing rate may be determined by measuring a thickness of the oxide film with a polished wafer thin film coating thickness gauge. The polishing rate may be a value obtained by measuring [thickness of wafer before polishing - thickness of wafer after polishing] / 1 min. When the polishing rate is less than 100 Å/min, a sufficient polishing rate and a selectivity thus achieved may not be supported, and a quality deterioration may occur. When the polishing rate exceeds Å/min, there is a possibility of overetching.

A degree of planarization of a surface of the film to be polished after polishing is performed using the slurry composition may be less than or equal to 5 %.

After the film to be polished is polished using the polishing slurry composition, a peak to valley (PV) value of the surface thereof may be less than or equal to 100 nm, and a roughness of the surface thereof may be less than or equal to 10 nm. The PV value and a degree of the roughness may be measured using a scanning probe microscopy.

A transparency of a device after the film to be polished is polished using the slurry composition may increase by 5 % or more.

Hereinafter, the example embodiments will be described in detail with reference to the following examples and comparative example. However, the technical idea of the present invention is not limited thereto.

Example 1: Polishing slurry composition including colloidal silica abrasive particles

A polishing slurry composition of pH 2.5 was prepared by adding 4 wt% of colloidal silica abrasive particles, 0.5 wt% of hydrogen peroxide as an oxidizer, 0.1 wt% of malonic acid

Example 1	- 21.5	- 18.2	Stable
Comparative Example 1	+ 1.5	+ 0.2	Aggregated

Referring to Table 1, it may be verified that the colloidal silica abrasive particles exhibited a high zeta potential absolute value even after 10 days and thus, have a high dispersion stability when compared to the abrasive particles of Comparative Example 1.

(2) Evaluation of polishing characteristics

An ITO film containing substrate was polished using the polishing slurry compositions of the examples and the comparative example under the polishing conditions as described below.

[Polishing Conditions]

1. Polishing device: CETR CP-4 of Bruker
2. Wafer: 6 cm X 6 cm ITO film transparent substrate
3. Platen pressure: 3 psi
4. Spindle speed: 69 rpm
5. Platen speed: 70 rpm
6. Flow rate: 100 ml/min

To evaluate the polishing characteristics, polishing speeds and degrees of planarization after the ITO film substrate was polished using the polishing slurry compositions of the examples and the comparative example were compared. Table 2 shows the polishing speeds and the degrees of planarization after the ITO film substrate was polished using the polishing slurry compositions of the examples and the comparative example.

[Table 2]

	Abrasive particles type	Abrasive particles content (wt%)	Metal oxide monomolecular complexing agent content	Polishing speed (Å/min)	Degree of planarization (%)	Transparency change (After polishing/ Before polishing)

complexing agents used in Examples 5 through 10 and Comparative Examples 2 through 4 is shown in Table 3.

[Table 3]

Item	Chemical	pKa	C number	ITO RR (Å/min)
Example 5	Malonic acid	2.8	3	133
Example 6	Tartaric acid	2.9	4	140
Example 7	Glyoxylic acid	3.18	2	142
Example 8	Oxalic acid	1.25	2	138
Example 9	Lactic acid	3.83	2	146
Example 10	Glutaric acid	4.3	5	128
Comparative Example 2	-	-	-	17
Comparative Example 3	Citric acid	3.13	6	68
Comparative Example 4	Isonicotinic acid	4.96	6	14

It may be verified that the slurry compositions prepared in Examples 5 to 10 exhibited improved polishing rates since the metal oxide monomolecular complexing agent added in an appropriate amount interacted with the oxidizer.

A number of example embodiments have been described above. Nevertheless, it should be understood that various modifications may be made to these example embodiments. For example, suitable results may be achieved if the described techniques are performed in a different order and/or if components in a described system, architecture, device, or circuit are combined in a different manner and/or replaced or supplemented by other components or their equivalents. Accordingly, other implementations are within the scope of the following claims.