A powder preparing device has a filtering device which processes CMP waste water and a vacuum dry-freezing device which dries a slurry which is concentrated to a high concentration by the filtering device. A membrane module in which at least one gel filtering film in which a gel layer is formed on a surface of a filtering membrane having a pore size of 0.25 μm is provided is placed within the filtering device. A pump sucks waste water from within the gel filtering membrane of the membrane module. The high-concentration slurry obtained by the filtering device may be supplied for various uses without further processing, or a powder may be obtained by transporting the high-concentration slurry to the vacuum dry-freezing device using a transporting pump and applying a drying process.
RELATIONSHIP BETWEEN SPECIFIC SURFACE AREA AND pH
(DRIED BY FREEZE-DRYING)

Fig. 2
pH < 4

Fig. 3

pH > 4

Fig. 4
\[ \text{pH} = 4 \]

Fig. 5
HIGH-CONCENTRATION PARTICLE CONCENTRATE, POWDER, PREPARING METHOD OF HIGH-CONCENTRATION PARTICLE CONCENTRATE, AND PREPARING METHOD OF POWDER

CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a high-concentration particle concentrate, a method of preparing a high-concentration particle concentrate, a fine particle, and a method of preparing a fine particle.

[0004] 2. Description of the Related Art

[0005] Commonly, a thin substrate such as a silicon substrate and a wafer used in a semiconductor manufacturing is polished and planarized using a CMP (Chemical Mechanical Polishing) system. In general, with a CMP system, because it is possible to completely planarize a layer to be exposed in a manufacturing process of a semiconductor device, reduce load of the exposure technology, and to stabilize yield, CMP systems have become necessary for, for example, planarizing an interlayer insulating film and a BPSG film, a shallow trench isolation, etc.

[0006] In a manufacturing process of a semiconductor device, as a CMP polisher for planarizing an inorganic insulating film layer such as a silicon oxide insulating film which is formed through plasma CVD (Chemical Vapor Deposition), a low-pressure CVD, etc., a material such as, for example, cerium oxide (ceria; CeO₂), a silica particle, an alumina particle, and a titania (titanium oxide; TiO₂) particle is used. The polishers are typically dispersed into a solvent such as water, and a chemical reaction catalyst such as potassium hydroxide and a dispersant such as an organic high polymer and a surfactant are suitably added to the dispersed solution to form a polisher slurry.

[0007] In the CMP system, a substrate (for example, a semiconductor wafer) is placed between polisher pads, which are supported and held by a carrier plate or a pressurization plate and a rotatable polisher table or platen, and is polished. A fine groove is formed on the surface of the polisher pad so that even when the substrate is in contact with the surface of the polisher pad, the polisher slurry can be supplied to the central portion of the substrate. The polisher slurry as described above is continuously supplied by a pump or the like to the polisher pad during the polishing process.

[0008] With such a CMP system, it is possible to remove unevenness on a surface of the SiO₂ insulating film and to achieve a flat surface over the entire surface of the semiconductor substrate.

[0009] Although a CMP process for an SiO₂ insulating film layer on a semiconductor substrate has been described, the target of CMP processing is not limited to an SiO₂ insulating film layer on a semiconductor substrate, and CMP processing may be applied to polishing of, for example, a wired plate having a predetermined line, an inorganic insulating film such as glass and silicon nitride, an optical glass such as a photo mask, a lens, and a prism, an inorganic conductive film such as ITO (Indium Tin Oxide), an optical integrated circuit, an optical switching element, or an optical waveguide which are made of glass and a crystalline material, the end of an optical fiber, an optical single crystal such as a scintillator, a solid-state laser single crystal, an LED sapphire substrate for blue laser, a semiconductor single crystal such as SiC, GaP, and GaAs, a glass substrate for a magnetic disk, a magnetic head, and the like.

[0010] CMP waste water which is discharged in the CMP system contains fine particles of useful metal compounds such as, I or example, ceria, silica, alumina, and titania particles which were used for the polisher and fine particles of the metal compound which was polished.

[0011] The recovery and reuse of useful metal compounds from the fine particles is also desired.

[0012] In recent years, a device has been developed which concentrates the fine particles of metal compounds contained in the CMP waste water, for example, using a filtering membrane. In this device of related art, the fine particles in the CMP waste water can be concentrated to 1000 mg/L-5000 mg/L. However, it remains difficult to use a concentrate having such a concentration for reuse of fine particles.

[0013] Recently, a filtering device known as a “Slurry Closer” (trade name) has been developed, in which a gel filtering membrane is formed on a surface of a filtering membrane having a pore size of 0.25 μm, waste water is sucked using a pump from within the filtering membrane, and the membrane surface is cleaned using a supply of generated air bubbles (for example, Japanese Patent Laid-Open Publication No. 2003-135914). With this filtering device, the fine particles can be concentrated to, for example, 10,000 mg/L-300,000 mg/L, and, thus, the concentrating efficiency can be significantly improved.

[0014] Improvement of the added value of the highly concentrated particle slurry is desired.

SUMMARY OF THE INVENTION

[0015] An advantage of the present invention is that the added value of particles recovered from, for example, waste water is increased and reusability is improved.

[0016] According to one aspect of the present invention, there is provided a high-concentration particle concentrate which is obtained by concentrating a solution containing particles in a low concentration having a pH adjusted to 3 or greater and 8 or less to a slurry containing particles in a high concentration having a concentration of 1 weight % to 50 weight %.

[0017] The high-concentration particle concentrate can be used in various fields without further processing. In addition, because the concentrate is highly concentrated, a desired powder can be obtained in a short time when the concentrate is dried (moisture is adjusted).

[0018] According to another aspect of the present invention, there is provided a method of preparing a high-concentration particle concentrate wherein a solution con-
containing particles in a low concentration having a pH adjusted to 3 or greater and 8 or less is concentrated to a slurry having the particles in a high concentration having a concentration of 1 weight % to 50 weight %.

[0019] Similar to the above, the high-concentration particle concentrate can be used in various fields without further processing. In addition, because the concentrate is highly concentrated, a desired powder can be obtained in a short time when the concentrate is dried (moisture is adjusted).

[0020] According to another aspect of the present invention, there is provided a method of preparing a powder wherein the slurry containing particles in a high concentration which is the high-concentration particle concentrate as above is further processed so that the concentration of a slurry containing the particles is adjusted during re-dispersing according to a size of powder to be obtained after drying, and then the drying process (moisture adjusting process) is applied.

[0021] Because the slurry containing particles in high concentration is further processed such that the concentration of the particle slurry is adjusted during re-dispersing according to the powder size to be obtained after drying, a desired assembly condition, that is, a powder of a desired size can be obtained at the later drying process (moisture adjusting process).

[0022] According to another aspect of the present invention, there is provided a method of preparing a powder wherein the slurry containing particles in high concentration as above is further processed so that a concentration of a slurry containing particles is adjusted during re-dispersing according to a size of powder to be obtained after drying, and then the drying process is applied.

[0023] Similar as above, because the slurry containing particles in high concentration is further processed such that the concentration of the particle slurry is adjusted during re-dispersing according to the powder size to be obtained after drying, it is possible to obtain a desired assembly condition, that is, a powder of desired size during the later drying process (moisture adjusting process).

[0024] According to another aspect of the present invention, there is provided a method of preparing a powder, wherein a powder is created by vacuum freeze-drying a slurry having a pH adjusted to 3 or greater and 8 or less and containing particles in a concentration of 20 weight % to 50 weight %.

[0025] Because a vacuum freeze-dry process is applied using a slurry containing powder in high concentration, it is possible to significantly reduce the time for powder drying, and, at the same time, a powder with a higher added value than slurry can be obtained.

[0026] According to another aspect of the present invention, it is preferable that, in the high-concentration particle concentrate as above, an average size of the particles is 50 nm to 500 nm.

[0027] According to still another aspect of the present invention, it is preferable that, in the methods of preparing high-concentration particle concentrate as above, an average size of the particles is 50 nm to 500 nm.

[0028] According to another aspect of the present invention, it is preferable that, in a high-concentration particle concentrate as above, the solution containing particles in low concentration is CMP waste water.

[0029] According to another aspect of the present invention, it is preferable that, in a method of preparing high-concentration particle concentrate as above, the solution containing particles in low concentration is CMP waste water.

[0030] According to another aspect of the present invention, it is preferable that, in a high-concentration particle concentrate as above, the particles include at least SiO₂.

[0031] According to another aspect of the present invention, it is preferable that, in a method of preparing a high-concentration particle concentrate as above, the particles include at least SiO₂.

[0032] According to another aspect of the present invention, it is preferable that, in the method of preparing powder above, the particles include at least SiO₂.

[0033] The above-mentioned compound, SiO₂, is a multipurpose material used in various fields as a reagent, and its value is enhanced by obtaining the compound in a powder form.

[0034] According to another aspect of the present invention, it is preferable that, in a high-concentration particle concentrate as above, the solution containing particles in low concentration is prepared by mixing acidic CMP waste water and basic CMP waste water so that the pH is 3 or greater and 8 or less.

[0035] According to another aspect of the present invention, it is preferable that, in the method of preparing high-concentration particle concentrate according as above, the solution containing particles in low concentration is prepared by mixing acidic CMP waste water and basic CMP waste water so that the pH is 3 or greater and 8 or less.

[0036] According to another aspect of the present invention, it is preferable that, in a high-concentration particle concentrate as above, the particles include at least one of SiO₂, ceria, alumina, titania, a metal hydroxide, an oxide, ceramic, indium, iron hydroxide, and calcium fluoride.

[0037] According to another aspect of the present invention, it is preferable that, in a high-concentration particle concentrate as above, the particles include at least one of SiO₂, ceria, alumina, titania, a metal hydroxide, an oxide, ceramic, indium, iron hydroxide, and calcium fluoride.

[0038] According to another aspect of the present invention, it is preferable that, in a method of preparing powder as above, the particles include at least one of SiO₂, ceria, alumina, titania, a metal hydroxide, an oxide, ceramic, indium, iron hydroxide, and calcium fluoride.

[0039] The above-listed particles are useful metal compounds and recovery and reuse of these compounds is desired.

[0040] According to another aspect of the present invention, it is preferable that, in a method of preparing powder as above, the particles include at least one of SiO₂, ceria, alumina, and titania.
For example, it is possible to obtain at least SiO₂, ceria, alumina, and titania which are included in the CMP waste water and a powder form of at least SiO₂, ceria, alumina, and titania are useful in a wide variety of usages and thus having a high added value.

According to another aspect of the present invention, it is preferable that, in a method of preparing powder as above, the specific surface area of the obtained powder is 10 m²/g to 400 m²/g.

It is possible to increase the specific surface area of the obtained powder by drying. In addition, it is possible to control the degree of the specific surface area of the obtained powder by adjusting the drying conditions.

According to another aspect of the present invention, it is preferable that, in a method of preparing powder as above, the average particle size of the obtained powder is 5 μm to 100 μm.

According to another aspect of the present invention, there is provided a powder which is obtained by any of the methods of preparing powder noted above.

According to the present invention, it is possible to obtain a high-concentration slurry which can be recycled and powder having a higher added value compared to the high-concentration slurry.

**BRIEF DESCRIPTION OF THE DRAWINGS**

A preferred embodiment of the present invention will be described in detail based on the following drawings, wherein:

**FIG. 1** is a diagram for explaining a structure of a powder preparing device according to a preferred embodiment of the present invention;

**FIG. 2** is a graph showing a relationship between the pH of the solution containing SiO₂ particles in a low concentration and a specific surface area of the obtained SiO₂ powder;

**FIG. 3** is a schematic diagram showing a surface condition of an SiO₂ particle in an acidic solution containing SiO₂ particles in a low concentration;

**FIG. 4** is a schematic diagram showing a surface condition of an SiO₂ particle in a basic solution containing SiO₂ particles in a low concentration;

**FIG. 5** is a schematic diagram showing a surface condition of SiO₂ particles in a solution containing SiO₂ particles in a low concentration near an isoelectric point of SiO₂.

**DESCRIPTION OF PREFERRED EMBODIMENT**

A preferred embodiment (hereinafter, referred to simply as "embodiment") of the present invention will now be described.

**FIG. 1** shows a structure of a powder preparing device used in a method of preparing powder according to a preferred embodiment of the present invention. As shown in **FIG. 1**, the powder preparing device according to the present embodiment can be viewed as a combination of a filtering device **10** for treating CMP (Chemical Mechanical Polishing) waste water as described and a vacuum freeze-drying device **20** for applying a vacuum freeze-dry process to a slurry which is concentrated to a concentration of, for example, 1 weight % to 50 weight %, more preferably, 20 weight % to 50 weight % by the filtering device **10**. As described above, a membrane module **12** is placed within the filtering device **10** in which at least one gel filtering membrane is provided in which a gel layer is formed on a surface of a filtering membrane having a pore size of 0.25 μm. A pump **14** sucks waste water from the gel filtering membrane of the membrane module **12**. As the filtering device **10**, for example, it is preferable to use a device such as the "Slurry Closer" (trade name) manufactured by Sanyo Aqua Technology Co., Ltd., in which air bubbles are lightly generated on a surface of the membrane.

Examples of the particles within the CMP waste water include, for example, a polisher used in the CMP system such as cerium oxide (ceria; CeO₂), a silica particle, an alumina particle, a titania (titanium oxide; TiO₂) particle. Although these particles of the polisher are the main composition of the CMP waste water, the CMP waste water also contains, for example, an SiO₂ particle which is a polishing waste of the SiO₂ insulating film layer of the semiconductor substrate, a metal hydroxide, an oxide, ceramic, indium, iron hydroxide, and calcium fluoride.

In particular, the CMP waste water which is generated when an SiO₂ insulating film layer of a semiconductor substrate is polished using a polisher made of a silica particle is known as a "basic CMP waste water" because the pH of the CMP waste water is around 10. In this basic CMP waste water, almost 100% of the inorganic particles within the CMP waste water is SiO₂. In addition, a percentage of the basic CMP waste water among all CMP waste water is high. The CMP waste water which contains a large amount of metals other than SiO₂, which is generated during polishing in the semiconductor field or other fields, are referred to as "acidic CMP waste water" because the pH is around 2.

An average size of the particle in such a CMP waste water is 50 nm to 500 nm, more preferably 50 nm to 200 nm, and is within a range of size for particles which are called "colloids". A normal average particle size is around 100 nm. For example, when the particle is SiO₂, the particle is in the state of colloidal silica.

A pH of a solution containing particles in a low concentration to be supplied to the filtering device **10**, in particular, the CMP waste water is preferably adjusted to 3 or greater and 8 or less. As shown in **FIG. 2**, in a solution containing particles in a low concentration in which 100% of the inorganic particles is SiO₂, a specific surface area is maximum around a pH of 4, and, thus, it can be seen that this pH is an isoelectric point. In addition, it can be seen that the pH is preferably 8 or less in order for the specific surface area of the SiO₂ powder after concentration and vacuum dry-freezing processes by the powder preparing device as described above to be 130 m²/g or greater, which is a specific surface area sufficient for allowing use as a high functionality particle. On the other hand, a pH of less than 3 for the solution containing particles in low concentration is not preferable because, not only the specific surface area is reduced, but also, there is a possibility that corrosion may occur during a concentrating process in the filtering device **10**.

A relationship between a pH of the solution containing particles in low concentration and the specific sur-
face area of the powder after the concentration and vacuum dry-freezing processes will be described in more detail referring to FIGS. 3-5 and an example solution containing particles in low concentration containing only SiO₂ particles.

As shown in FIG. 3, when the pH of the solution containing SiO₂ particles is lower than the isoelectric point pH of 4, that is, when the pH is less than 4 (this solution is hereinafter referred to as an “acidic solution”), the interparticle spacing is increased because of a repulsive force between particles caused by charging of the surface of the particles, and, as a result, the particles tend not to aggregate and the specific surface area tends to be reduced. Similarly, as shown in FIG. 4, when the pH of the solution containing SiO₂ particles is greater than the isoelectric point pH of 4, that is, when the pH exceeds 4 (this solution is hereinafter referred to as a “basic solution”), the interparticle spacing is increased because of a repulsive force between particles caused by charging of the surface of the particles, and, as a result, the particles tend not to aggregate and the specific surface area tends to be reduced. When, on the other hand, the pH of the solution containing SiO₂ particles is at the isoelectric point pH of 4 as shown in FIG. 5 (this solution is hereinafter referred to as a “neutral solution”), the particle surface is not charged, and thus, no repulsive force is created between particles. Therefore, the interparticle spacing is decreased, the particles tend to aggregate, and, as a result, the specific surface area is increased.

Methods suitable for adjusting the pH of the solution containing particles in a low concentration, include (a) to adjust the pH to a value of 3 or greater and 8 or less by suitably mixing the acid CPM waste water and the basic CPM waste water, and (b) to prepare the solution containing particles in low concentration having the pH adjusted by adding a pH adjusting agent to the acidic and/or basic CPM waste water. In the present example, as the pH adjusting agent, it is possible to use, for example, potassium hydroxide and ammonium hydroxide. Alternatively, it is also possible (c) to supply, to the filtering device 10, a solution containing particles in a low concentration in which the pH is not adjusted and to suitably adjust the pH within the filtering device 10 using the pH adjusting agent. Moreover, it is also possible (d) to supply, to the filtering device 10, a solution containing particles in a low concentration in which the pH is not adjusted, monitor the pH within the filtering device 10, and complete the concentrating process when the pH exceeds the range of 3 or greater and 8 or less, to obtain a slurry containing particles in a high concentration.

In the present embodiment, it is preferable to adjust the pH of the basic CPM waste water having a main composition of SiO₂ particles as the CPM waste water and to apply the concentrating and vacuum dry-freezing processes. Because it is thereby possible to obtain a pure SiO₂ powder having a high purity, it is possible to reuse the powder as a powder with a high added value.

It is also preferable to concentrate, using the filtering device 10, the solution containing particles in a low concentration to form a slurry having a concentration of 1 weight % to 50 weight %, and more preferably, 20 weight % to 50 weight %, In particular, by applying the vacuum dry-freezing process to the slurry concentrated to a high concentration of 20 weight % to 50 weight %, it is possible to significantly shorten the drying time. In addition, it is possible to maintain uniform particle size for the obtained powder.

In the present embodiment, it is preferable to use a vacuum freeze-drying device 20 as a drying device for drying the slurry containing particles in a high concentration. The conditions for vacuum freeze-drying are suitably selected according to the concentration of the slurry containing particles in a high concentration. For example, it is preferable that the temperature is −70°C to 0°C, more preferably −60°C to −5°C, and more preferably −10°C to −5°C (freezing temperature), and the degree of vacuum is 2 mmHg to 5 mmHg (2.7 hPa to 6.7 hPa (N/m²)). It is possible to use, for example, the TFD-550-8SP device manufactured by Takara Seikakusho as the vacuum freeze-drying device.

According to experiments by the present inventors, when a freeze-dry process was applied to a slurry which had been concentrated to 30 weight % by the filtering device 10 and had an average particle size of 18.5 μm, no grinding was necessary and the average size of the powder was 59.0 μm. On the other hand, when a heat drying process was applied to the same slurry, the particles became sintered, and therefore, were ground in a mortar. The average size of the ground powder was 120.8 μm. From these results it can be seen that, to obtain a powder with a small particle size, it is preferable to employ a vacuum freeze-dry process.

The high-concentration slurry which is a high-concentration particle concentrate obtained by the filtering device 10 can be used without any further processing as, for example, a glue of crockery, a cosmetic product, or a polish. In addition, it is also possible to suitably add an additive to the high-concentration particle concentrate according to desired use.

The average size of a powder obtained by applying the vacuum freeze-dry process under the above-described conditions using the powder-preparing device was 5 μm to 100 μm. For example, when the powder is SiO₂, a powder having an average size of approximately 30 μm, that is, a fumed silica, is obtained.

It is desirable to further adjust the concentration of the particle slurry in the slurry containing particles in high concentration obtained by the filtering device 10 during re-distribution according to powder size to be obtained after the drying process and to apply the drying process.

In the drying process, for example, in the vacuum freeze-drying process, it is possible to control the particle size of the dried powder by suitably adjusting the state of vacuum and drying temperature. In this manner, it is possible to refine a powder having a desired particle size according to the intended use of the obtained powder.

The specific surface area of the powder obtained in the drying process is 10 m²/g to 40 m²/g.

It is possible to increase the specific surface area of the obtained powder by applying a drying process. In addition, it is possible to control a degree of the specific surface area of the powder to be obtained by adjusting the drying conditions.

The powder obtained by the powder-preparing device and method of preparing powder as described above
can be used, for example, as a porous material, a cosmetic product, an adsorbent, ceramic, a filtering assisting agent, a hydrophilic processing agent, a filler for analysis equipment (for example, filler for gas chromatography or the like), and an additive of toner for printing.

[0073] The use of the high-concentration slurry may be suitably selected according to the type of powder contained in the slurry and may include, for example, a crockery or ceramic glaze, a cosmetic product, or a polisher.

[0074] In addition, the powder may be used in any field as long as the powder obtained by drying a CMP waste water can be used, and, for example, may be preferably used as a porous material, a cosmetic product, an adsorbent, ceramic, a filter assisting agent, a hydrophilic processing agent, a filler of an analysis equipment (for example, filler in gas chromatography or the like), or an additive to a toner used for printing.

What is claimed is:

1. A high-concentration particle concentrate obtained by concentrating a solution containing particles in a low concentration having a pH adjusted to 3 or greater and 8 or less to a slurry containing particles in a high concentration having a concentration of 1 weight % to 50 weight %.

2. A method of preparing a high-concentration particle concentrate wherein

   a solution containing particles in a low concentration having a pH adjusted to 3 or greater and 8 or less is concentrated to form a slurry containing particles in a high concentration having a concentration of 1 weight % to 50 weight %.

3. A method of preparing a powder, wherein

   the slurry containing particles in high concentration which is the high-concentration particle concentrate according to claim 1 is further processed so that a concentration of a slurry containing particles is adjusted during re-dispersing according to a size of powder to be obtained after the drying process, and then the drying process is applied.

4. A method of preparing a powder, wherein

   the slurry containing particles in high concentration according to claim 2 is further processed so that a concentration of a slurry containing particles is adjusted during re-dispersing according to a size of powder to be obtained after drying, and then the drying process is applied.

5. A method of preparing powder, wherein

   a powder is created by vacuum freeze-drying a slurry having a pH adjusted to 3 or greater and 8 or less and containing particles in a concentration of 20 weight % to 50 weight %.

6. A high-concentration particle concentrate according to claim 1, wherein

   the average particle size of the particle concentrate is 50 nm to 500 nm.

7. A method of preparing high-concentration particle concentrate according to claim 2, wherein

   an average particle size of the particle concentrate is 50 nm to 500 nm.

8. A method of preparing powder according to claim 3, wherein

   an average particle size of the particle concentrate is 50 nm to 500 nm.

9. A method of preparing powder according to claim 4, wherein

   an average particle size of the particle concentrate is 50 nm to 500 nm.

10. A method of preparing powder according to claim 5, wherein

    an average size of the particles in a slurry is 50 nm to 500 nm.

11. A high-concentration particle concentrate according to claim 1, wherein

    the solution containing particles in low concentration is CMP waste water.

12. A method of preparing a high-concentration particle concentrate according to claim 2, wherein

    the solution containing particles in low concentration is CMP waste water.

13. A high-concentration particle concentrate according to claim 1, wherein

    the particles include at least SiO₂.

14. A method of preparing high-concentration particle concentrate according to claim 2, wherein

    the particles include at least SiO₂.

15. A method of preparing powder according to claim 3, wherein

    the particles include at least SiO₂.

16. A method of preparing powder according to claim 4, wherein

    the particles include at least SiO₂.

17. A method of preparing powder according to claim 5, wherein

    the particles include at least SiO₂.

18. A high-concentration particle concentrate according to claim 1, wherein

    the solution containing particles in low concentration is prepared by mixing acidic CMP waste water and basic CMP waste water so that the pH is 3 or greater and 8 or less.

19. A method of preparing high-concentration particle concentrate according to claim 2, wherein

    the solution containing particles in low concentration is prepared by mixing acidic CMP waste water and basic CMP waste water so that the pH is 3 or greater and 8 or less.

20. A high-concentration particle concentrate according to claim 1, wherein

    the particles include at least one of SiO₂, ceria, alumina, titania, a metal hydroxide, an oxide, ceramic, indium, iron hydroxide, and calcium fluoride.

21. A method of preparing high-concentration particle concentrate according to claim 2, wherein

    the particles include at least one of SiO₂, ceria, alumina, titania, a metal hydroxide, an oxide, ceramic, indium, iron hydroxide, and calcium fluoride.

22. A method of preparing powder according to claim 3, wherein
the particles include at least one of SiO₂, ceria, alumina, titania, a metal hydroxide, anoxide, ceramic, indium, iron hydroxide, and calcium fluoride.

23. A method of preparing powder according to claim 4, wherein
   the particles include at least one of SiO₂, ceria, alumina, titania, a metal hydroxide, anoxide, ceramic, indium, iron hydroxide, and calcium fluoride.

24. A method of preparing powder according to claim 5, wherein
   the particles include at least one of SiO₂, ceria, alumina, and titania.

25. A method of preparing powder according to claim 3, wherein
   the specific surface area of the obtained powder is 10⁻³ m²/g to 400 m²/g.

26. A method of preparing powder according to claim 4, wherein
   the specific surface area of the obtained powder is 10⁻³ m²/g to 400 m²/g.

27. A method of preparing powder according to claim 5, wherein
   the specific surface area of the obtained powder is 10⁻³ m²/g to 400 m²/g.

28. A powder obtained by a method of preparing powder according to claim 5, wherein
   an average size of the obtained powder is 5 μm to 100 μm.

29. A glaze containing a high-concentration particle concentrate according to claim 1.

30. A polisher containing a high-concentration particulate concentrate according to claim 1.

31. A cosmetic product containing a high-concentration particle concentrate according to claim 1.

32. A powder obtained by the method of preparing powder according to claim 5.

33. A powder obtained by the method of preparing powder according to claim 4.

34. A porous material made of a powder obtained by the method of preparing powder according to claim 5.

35. A cosmetic product containing a powder obtained by the method of preparing powder according to claim 5.

36. An adsorbent containing a powder obtained by a method of preparing powder according to claim 5.

37. A ceramic containing a powder obtained by the method of preparing powder according to claim 5.

38. A filtering assisting agent containing a powder obtained by the method of preparing powder according to claim 5.

39. A hydrophilic processing agent containing a powder obtained by the method of preparing powder according to claim 5.

40. A filler for an analysis equipment, the filler containing a powder obtained by the method of preparing powder according to claim 5.

41. An additive of a toner for printing, the additive containing a powder obtained by the method of preparing powder according to claim 5.

42. A porous material made of a powder obtained by the method of preparing powder according to claim 3.

43. A cosmetic product containing a powder obtained by the method of preparing powder according to claim 3.

44. An adsorbent containing a powder obtained by the method of preparing powder according to claim 3.

45. A ceramic containing a powder obtained by the method of preparing powder according to claim 3.

46. A filtering assisting agent containing a powder obtained by the method of preparing powder according to claim 3.

47. A hydrophilic processing agent containing a powder obtained by the method of preparing powder according to claim 3.

48. A filler for an analysis equipment, the filler containing a powder obtained by the method of preparing powder according to claim 3.

49. An additive of a toner for printing, the additive containing a powder obtained by the method of preparing powder according to claim 3.

50. A porous material made of a powder obtained by the method of preparing powder according to claim 4.

51. A cosmetic product containing a powder obtained by the method of preparing powder according to claim 4.

52. An adsorbent containing a powder obtained by the method of preparing powder according to claim 4.

53. A ceramic containing powder obtained by the method of preparing powder according to claim 4.

54. A filtering assisting agent containing a powder obtained by the method of preparing powder according to claim 4.

55. A hydrophilic processing agent containing a powder obtained by the method of preparing powder according to claim 4.

56. A filler for an analysis equipment, the filler containing a powder obtained by the method of preparing powder according to claim 4.

57. An additive of a toner for printing, the additive containing a powder obtained by the method of preparing powder according to claim 4.

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