Spherical silver powder and method for producing same

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Abstract
A spherical silver powder has a good dispersibility and is capable of obtaining a good degree of sintering even if used for forming a paste to be fired at a low temperature of 600°C or less to form a conductor. An aqueous solution containing a reducing agent is added to a water reaction system containing silver ions, to deposit silver particles by reduction, to produce a spherical silver powder wherein a ratio (Dx/BET) of a crystallite diameter Dx (nm) to a BET specific surface area (m²/g) is in the range of from 5 to 200 and which has a crystallite diameter of not greater than 40 nm, a mean particle size of not greater than 5 μm, a tap density of not less than 2 g/cm³, and a BET specific surface area of not greater than 5 m²/g.
SPHERICAL SILVER POWDER AND METHOD FOR PRODUCING SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention generally relates to a spherical silver powder and a method for producing the same. More specifically, the invention relates to a spherical silver powder used for forming terminal electrodes of electronic parts, patterns of circuit boards and so forth, and a method for producing the same.

[0003] 2. Description of the Prior Art

[0004] In order to form electrodes and circuits of electronic parts and so forth, there has been used a conductive paste wherein a silver powder is dispersed in an organic component. Conductive pastes are generally classified into cermet type pastes (or pastes of a type to be fired) and polymer type pastes (or resin type pastes). The cermet type pastes have different uses and components from those of polymer type pastes.

[0005] A typical cermet type paste includes a silver powder, a vehicle containing ethyl cellulose or acrylic resin dissolved in an organic solvent, a glass frit, an inorganic oxide, an organic solvent, a dispersing agent and so forth as components. The cermet type paste is formed by dipping or printing so as to have a predetermined pattern, and then, fired to form a conductor. Such a cermet type paste is used for forming electrodes of hybrid ICs, multilayer ceramic capacitors, chip resistors and so forth.

[0006] The firing temperature of the cermet type paste varies in accordance with the use thereof. There are cases where a cermet type paste is fired at a high temperature on a heat resistant ceramic substrate, such as an alumina substrate or glass-ceramic substrate for use in a hybrid IC, to form a conductor, and cases where a cermet type paste is fired at a low temperature on a substrate having a low heat resistance.

[0007] The value of resistance of the sintered body of silver lowers if the paste is fired at a temperature as high as possible below the melting point of silver which is 960°C. However, various problems are caused unless a silver powder suitable for the firing temperature is used, for example, if the paste is fired at a high temperature on a ceramic substrate, there are some cases where cracks and delamination are caused by a difference in shrinkage between the sintered body of silver and the ceramic substrate. In order to solve such problems, a high crystalline silver powder is proposed (see, e.g., Japanese Patent Laid-Open Nos. 2000-1706 and 2000-1707).

[0008] On the other hand, a typical polymer type paste is used as a wiring material, such as a through-hole or a membrane, a conductive adhesive or the like. Such a polymer type paste includes a silver powder, a thermosetting resin, such as an epoxy resin or urethane resin, a curing agent, an organic solvent, a dispersing agent and so forth as components. The polymer type paste is formed by dispensing or printing so as to have a predetermined conductive pattern, and then, cured at a temperature ranging from a room temperature to about 250°C., to obtain conductivity by causing silver particles to contact each other by the curing and shrinkage of the remaining resin. Therefore, in order to increase the contact area of silver particles contacting each other, there is generally used a flake-shaped silver powder which is obtained by mechanically working a silver powder in a scale shape. Furthermore, the resin is deteriorated to deteriorate the resistance and bond strength of the conductor at a temperature above 300°C.

[0009] However, for example, in the case of a plasma display panel (PDP) substrate, a glass being the material of the substrate has a low heat resistance, so that the paste can not be fired at a high temperature of about 750 to 900°C. unlike the case of the ceramic substrate. Therefore, it is required to fire the paste at a lower temperature, and it is required to form the conductor by firing the paste at a temperature of 600°C or less in view of the heat resistance of the substrate, and at a low temperature of 500 to 600°C. in fact. Thus, it is difficult to lower the value of resistance of the conductor.

[0010] When the paste is fired at a low temperature, if a glass frit having a lower softening point than the firing temperature is added to promote sintering, it is possible to lower the value of resistance of the conductor. However, in the case of a PDP substrate formed by repeatedly carrying out firing, it is undesirable to use a glass frit having an excessively low softening point since the variation in value of resistance of the conductor is caused.

[0011] In addition, when a silver powder is used for forming a photosensitive paste, if the silver powder has an undecidied shape or a flake shape, the scattering and/or reflection of ultraviolet rays is caused, so that defective patterning is caused.

[0012] Moreover, when a conductive pattern is formed by another method, e.g., a printing or transferring method, if the silver powder has an undecidied shape or a flake shape, it is not possible to form a good conductive pattern in view of the readability from a screen plate and transferability.

SUMMARY OF THE INVENTION

[0013] It is therefore an object of the present invention to eliminate the aforementioned problems and to provide a spherical silver powder which is capable of obtaining a good degree of sintering even if it is used for forming a paste to be fired at a low temperature of 600°C or less to form a conductor, and a method for producing the same. It is another object to provide a spherical silver powder having a good dispersibility, and a method for producing the same.

[0014] In order to accomplish the aforementioned and other objects, the inventors have diligently studied and found that, if a spherical silver powder wherein a ratio (Dx/BET) of a crystallite diameter Dx (nm) to a BET specific surface area (m²/g) is in the range of from 5 to 200, and preferably which has a crystallite diameter of not greater than 40 nm and a mean particle size of not greater than 5 μm, is used for forming a paste to be fired to form a conductor, it is possible to obtain a good degree of sintering even if the firing temperature is a low temperature of 600°C or less, and it is possible to obtain a good conductive pattern by a photosensitive paste method, a printing method or a transferring method, from a paste using a spherical silver powder which has a good dispersibility, a tap density of not less than 2 g/cm³ and a BET specific surface area of not greater than 5 m²/g. Thus, the inventors have made the present invention.
According one aspect of the present invention, there is provided a spherical silver powder wherein a ratio (Dx/BET) of a crystallite diameter Dx (nm) to a BET specific surface area (m²/g) is in the range of from 5 to 200. This spherical silver powder preferably has a crystallite diameter of not greater than 40 nm and a mean particle size of not greater than 5 μm. More preferably, the spherical silver powder has a tap density of not less than 2 g/cm³ and a BET specific surface area of not greater than 5 m²/g.

According to another aspect of the present invention, there is provided a method for producing the above described spherical silver powder, wherein an aqueous solution containing a reducing agent is added to a water reaction system containing silver ions, to deposit silver particles by reduction to produce the spherical silver powder. In this method, a dispersing agent is preferably added to a slurry-like reaction system before or after the deposition of silver particles to form a paste. The dispersing agent is preferably added at a rate of not less than 1 equivalent/min with respect to the content of silver in the water reaction system containing silver ions. In addition, the surface of the spherical silver powder is preferably modified by a surface smoothing process which mechanically causes particles to collide with each other. Moreover, silver agglomerates are preferably removed by a classification after the surface smoothing process.

According to the present invention, it is possible to produce a spherical silver powder which has a good dispersibility and which is capable of obtaining a good degree of sintering even if it is used for forming a paste to be fired at a low temperature of 600°C or less to form a conductor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In a preferred embodiment of a spherical silver powder according to the present invention, the ratio (Dx/BET) of a crystallite diameter Dx (nm) of the silver powder to a BET specific surface area (m²/g) thereof is in the range of from 5 to 200, and preferably, the crystallite diameter of the silver powder is not greater than 40 nm and the mean particle diameter thereof is not greater than 5 μm. Such a silver powder can obtain a good degree of sintering even if it is used for forming a paste to be fired at a low temperature of 600°C or less, so that it is possible to lower the value of resistance of a conductor thus formed.

If the silver powder has a spherical shape, it can be suitably used for carrying out a photosensitive paste method. If the silver powder has an undeciduous shape or a flake shape, there is a disadvantage in that the photosensitive characteristics of the silver powder are not good since the irregular reflection and/or scattering of ultraviolet rays is caused. However, if the silver powder has a spherical shape, it is also suitably used for carrying out a printing or transferring method.

A preferred embodiment of a spherical silver powder according to the present invention has a tap density of 2 g/cm³ or more, and a BET specific surface area of 5 m²/g or less. If the tap density is less than 2 g/cm³, the aggregation of particles of the silver powder is violently caused, so that it is difficult to form a fine line even if any one of the above described methods is used. If the BET specific surface area is greater than 5 m²/g, the viscosity of the paste is too high, so that workability is not good.

In a preferred embodiment of a method for producing a spherical silver powder according to the present invention, an aqueous solution containing a reducing agent is added to a water reaction system containing silver ions, to deposit silver particles by reduction. A dispersing agent is preferably added to a slurry-like reaction system before or after the deposition of silver particles based on reduction.

As the water reaction system containing silver ions, an aqueous solution or slurry containing silver nitrate, a silver salt complex or a silver intermediate may be used. The silver salt complex may be produced by adding aqueous ammonia, an ammonia salt, a chelate compound or the like. The silver intermediate may be produced by adding sodium hydroxide, sodium chloride, sodium carbonate or the like. Among them, an ammine complex obtained by adding aqueous ammonia to an aqueous silver nitrate solution is preferably used so that the silver powder has an appropriate particle diameter and a spherical shape. Since the coordination number of the ammine complex is 2, 2 mol or more of ammonia per 1 mol of silver is added.

The reducing agent may be selected from ascorbic acid, sulfites, alkane amine, aqueous hydrogen peroxide, formic acid, ammonium formate, sodium formate, glyoxal, tartaric acid, sodium hypophosphate, sodium borohydride, hydrazine, hydrazine compounds, hydroquinone, pyrogallol, glucose, gallate, formalin, exsicciated sodium sulfate, and rongalite. Among them, the reducing agent is preferably one or more selected from the group consisting of ascorbic acid, alkane amine, hydroquinone, hydrazine and formalin. If these reducing agents are used, it is possible to obtain silver particles having appropriate crystalline and appropriate particle diameters.

The reducing agent is preferably added at a rate of 1 equivalent/min or more in order to prevent the aggregation of the silver powder. Although the reason for this is not clear, it is considered that, if the reducing agent is added in a short time, the deposition of silver particles by reduction is caused all at once to complete reduction in a short time, so that it is difficult to cause the aggregation of produced nuclei, thereby improving dispersibility. When reduction is carried out, the solution to be reacted is preferably agitated so as to complete the reaction in a shorter time.

The dispersing agent is preferably one or more selected from the group consisting of fatty acids, fatty acid salts, surface active agents, organic metals, chelating agents and protective colloids. Examples of fatty acids include propionic acid, caprylic acid, lauric acid, myristic acid, palmitic acid, stearic acid, behenic acid, acrylic acid, oleic acid, linoleic acid, and arachidonic acid. Examples of fatty acid salts include salts formed by fatty acids and metals, such as lithium, sodium, potassium, barium, magnesium, calcium, aluminum, iron, cobalt, manganese, lead, zinc, tin, strontium, zirconium, silver and copper. Examples of surface active agents include: anionic surface active agents, such as alkyl benzene sulfonates and polyoxyethylene alkyl
ether phosphates; cationic surface active agents, such as aliphatic quaternary ammonium salts; amphoteric surface active agents, such as imidazolinium betaines; and nonionic surface active agents, such as polyoxyethylene alkyl ethers and polyoxyethylene fatty acid esters. Examples of organic metals include acetylacetone tributoxyzirconium, magnes-
ium citrate, diethyliazine, dibutylin oxide, dimethylzinc, tetra-o-butoxyzirconium, triethyl indium, triethyl gallium, trimethyl indium, trimethyl gallium, monobutyl tin oxide, tetrasiocyanate silane, tetramethyl silane, tetrachloro-
silane, polymethoxy siloxane, monomethyl triisocyanate silane, silane coupling agent, titanate coupling agents, and aluminum coupling agents. Examples of chelating agents include imidazole, oxazole, thiazole, selanazole, pyrazole, isoxazole, isothiazole, 1H-1,2,3-triazole, 2H-1,2,3-triazole, 1H-1,2,4-triazole, 4H-1,2,4-triazole, 1,2,3-oxadiazole, 1,2,4-oxadiazole, 1,2,5-oxadiazole, 1,3,4-oxadiazole, 1,2,3-
thiadiazole, 1,2,4-thiadiazole, 1,2,5-thiadiazole, 1,3,4-thia-
diazole, 1H-1,2,3,4-tetrazole, 1,2,3,4-oxatrizole, 1,2,3,4-
thiatriazole, 2H-1,2,3,4-tetrazole, 1,2,3,5-oxatrizole, 1,2,3,
5-thiatriazole, indazole, benzimidazole, benzotriazole and salts thereof, and oxalic acid, succinic acid, malonic acid, glutaric acid, adipic acid, pimelic acid, suberic acid, azelaic acid, sebacic acid, didodecanoic acid, maleic acid, fumaric acid, phthalic acid, isophthalic acid, terephthalic acid, glycine acid, lactic acid, hydroxy butyric acid, glyceric acid, tartaric acid, malic acid, tartronic acid, hydrazyclic acid, mandelic acid, citric acid and ascorbic acid. Examples of protective colloids include gelatin, albumin, gum arabic, protaric acid and lyeallic acid.

[0026] The spherical silver powder thus obtained may be processed by a surface smoothing process which mechanically causes particles to collide with each other, and then, silver agglomerates may be removed from the spherical silver powder by a classification. If the spherical silver powder thus obtained is used for forming a photosensitive paste, the sensitivity of the photosensitive paste thus formed is good, and the linearity of the pattern thus obtained is very good, so that it is possible to obtain a fine pattern. The silver powder thus obtained has an excellent releasability from a printing plate if it is used for carrying out a printing method, and has an excellent transferability if it is used for carrying out a transferring method, so that the silver powder can be suitably used for carrying out various methods.

[0027] Examples of a spherical silver powder and a method for producing the same according to the present invention will be described below in detail.

[0028] To 3600 ml of an aqueous solution containing 12 g/l silver nitrate as silver ions, 300 ml of industrial aqueous ammonia was added to form an aqueous silver ammine complex solution. To the aqueous silver ammine complex solution thus formed, 60 g of sodium hydroxide was added to control the pH of the solution. Then, 90 ml of industrial formalin serving as a reducing agent was added to the solution in 10 seconds. Immediately thereafter, 0.5 g of stearic acid emulsion was added to the solution to obtain a silver slurry. Then, the silver slurry thus obtained was filtered, washed with water, dried to obtain a silver powder. Then, the surface of the silver powder thus obtained was smoothed by a surface smoothing process using a high-speed mixer, and the silver powder thus smoothed was classified to remove silver agglomerates having a greater diameter than 8 μm.

[0029] The crystallite diameter of the silver powder thus obtained was calculated. In addition, the BET specific surface area, tap density and mean particle diameter D_{50} of the silver powder were measured, and the conductivity thereof was evaluated. Furthermore, it was confirmed by a scanning electron microscope (SEM) that the silver powders obtained in this example and in examples and comparative examples described later were spherical silver powders.

[0030] The crystallite diameter of the silver powder was obtained by the following Scherrer expression:

\[ D_{hkl} = \frac{K \lambda}{\beta \cos \theta} \]

[0031] wherein Dhkl denotes a crystallite diameter (the size of a crystallite in a direction perpendicular to hkl) (angstrom), and λ denotes the wavelength (angstrom) of measuring X-rays (1.5405 angstroms when a Cu target is used), β denoting the broadening (rad) (expressed by a half-power band width) of diffracted rays based on the size of the crystallite, θ denoting a Bragg angle (rad) of the angle of diffraction (which is an angle when the angle of incidence is equal to the angle of reflection and which uses the angle at a peak top) and K denoting the Scherrer constant (which varies in accordance with the definition of D and β, and K=0.94 when the half-power band width is used as β).

Furthermore, a powder X-ray diffractometer was used for carrying out measurement, and peak data on the (200) plane were used for carrying out calculation.

[0032] The evaluation of the conductivity was carried out as follows. First, 65 parts by weight of the silver powder, 14 parts by weight of an acrylic resin (BR-105 commercially available from Mitsubishi Rayon Co., Ltd.), 21 parts by weight of an organic solvent (diethylene glycol monoethyl ether acetate (reagent)), and 1 part by weight of a glass frit (GA-8 commercially available from Nippon Electric Glass Co., Ltd.) were measured to be kneaded by a three-roll mill to prepare a paste. Then, the paste was printed on a commercially available soda glass substrate to be fired at 550°C for ten minutes to obtain a sintered body. The conductivity of the sintered thus obtained was evaluated. It was evaluated that the conductivity was good if the value of resistance of the sintered body was not greater than 3×10^{-6} Ω·cm and was stable, and that the conductivity was not good if the value of resistance of the sintered body was greater than 3×10^{-6} Ω·cm or was not stable.

[0033] As a result, the crystallite diameter was 32.4 nm, and the BET specific surface area was 0.75 m²/g. In addition, the tap density was 5.0 g/cm³, and the mean particle diameter D_{50} was 1.4 am. Moreover, the conductivity was good. Furthermore, the ratio (Dx/BET) of the crystallite diameter Dx (nm) to the BET specific surface area (m²/g) was 43.

Example 2

[0034] To 3600 ml of an aqueous solution containing 12 g/l silver nitrate as silver ions, 180 ml of industrial aqueous ammonia was added to form an aqueous silver ammine complex solution. To the aqueous silver ammine complex solution thus formed, 7 g of sodium hydroxide was added to control the pH of the solution. Then, 192 ml of industrial formalin serving as a reducing agent was added to the
solution in 10 seconds. Immediately thereafter, 0.1 g of oleic acid was added to the solution to obtain a silver slurry. Then, the silver slurry thus obtained was filtered, washed with water, dried to obtain a silver powder. Then, the silver powder thus obtained was pulverized by a food mixer.

With respect to the silver powder thus obtained, the calculation of a crystallite diameter, the measurement of a BET specific surface area, tap density and mean particle diameter D_{50}, and the evaluation of conductivity were carried out by the same methods as those in Example 1. As a result, the crystallite diameter was 29.6 nm, and the BET specific surface area was 0.46 m²/g. In addition, the tap density was 4.7 g/cm³, and the mean particle diameter D_{50} was 2.1 μm. Moreover, the conductivity was good. Furthermore, the ratio (Dx/BET) of the crystallite diameter Dx (nm) to the BET specific surface area (m²/g) was 64.

Example 3

To 3600 ml of an aqueous solution containing 12 g/l silver nitrate as silver ions, 180 ml of industrial aqueous ammonia was added to form an aqueous silver ammine complex solution. To the aqueous silver ammine complex solution thus formed, 1 g of sodium hydroxide was added to control the pH of the solution. Then, 192 ml of industrial formalin serving as a reducing agent was added to the solution in 15 seconds. Immediately thereafter, 0.1 g of stearic acid was added to the solution to obtain a silver slurry. Then, the silver slurry thus obtained was filtered, washed with water, dried to obtain a silver powder. Then, the surface of the silver powder thus obtained was smoothed by a surface smoothing process using a high-speed mixer, and the silver powder thus smoothed was classified to remove silver agglomerates having a greater diameter than 11 μm.

With respect to the silver powder thus obtained, the calculation of a crystallite diameter, the measurement of a BET specific surface area, tap density and mean particle diameter D_{50}, and the evaluation of conductivity were carried out by the same methods as those in Example 1. As a result, the crystallite diameter was 33.3 nm, and the BET specific surface area was 0.28 m²/g. In addition, the tap density was 5.4 g/cm³, and the mean particle diameter D_{50} was 3.1 μm. Moreover, the conductivity was good. Furthermore, the ratio (Dx/BET) of the crystallite diameter Dx (nm) to the BET specific surface area (m²/g) was 119.

Example 4

To 3600 ml of an aqueous solution containing 12 g/l silver nitrate as silver ions, 150 ml of industrial aqueous ammonia was added to form an aqueous silver ammine complex solution. To the aqueous silver ammine complex solution thus formed, 13 ml of industrial hydrazine serving as a reducing agent was added to the solution in 2 seconds. Immediately thereafter, 0.2 g of oleic acid was added to the solution to obtain a silver slurry. Then, the silver slurry thus obtained was filtered, washed with water, dried to obtain a silver powder. Then, the surface of the silver powder thus obtained was smoothed by a surface smoothing process using a high-speed mixer.

With respect to the silver powder thus obtained, the calculation of a crystallite diameter, the measurement of a BET specific surface area, tap density and mean particle diameter D_{50}, and the evaluation of conductivity were carried out by the same methods as those in Example 1. As a result, the crystallite diameter was 34.0 nm, and the BET specific surface area was 0.86 m²/g. In addition, the tap density was 4.0 g/cm³, and the mean particle diameter D_{50} was 1.7 μm. Moreover, the conductivity was good. Furthermore, the ratio (Dx/BET) of the crystallite diameter Dx (nm) to the BET specific surface area (m²/g) was 39.

Comparative Example 1

To 3600 ml of an aqueous solution containing 6 g/l silver nitrate as silver ions, 50 ml of industrial aqueous ammonia was added to form an aqueous silver ammine complex solution. To the aqueous silver ammine complex solution thus formed, 60 ml of industrial aqueous hydrogen peroxide serving as a reducing agent was added to the solution in 15 seconds. Immediately thereafter, 0.1 g of sodium stearate was added to the solution to obtain a silver slurry. Then, the silver slurry thus obtained was filtered, washed with water, dried to obtain a silver powder.

With respect to the silver powder thus obtained, the calculation of a crystallite diameter, the measurement of a BET specific surface area, tap density and mean particle diameter D_{50}, and the evaluation of conductivity were carried out by the same methods as those in Example 1. As a result, the crystallite diameter was 47.8 nm, and the BET specific surface area was 0.15 m²/g. In addition, the tap density was 5.0 g/cm³, and the mean particle diameter D_{50} was 6.5 μm. Moreover, the conductivity was not good. Furthermore, the ratio (Dx/BET) of the crystallite diameter Dx (nm) to the BET specific surface area (m²/g) was 318.

Comparative Example 2

With respect to a commercially available atomized silver powder (5 μm), the calculation of a crystallite diameter, the measurement of a BET specific surface area, tap density and mean particle diameter D_{50}, and the evaluation of conductivity were carried out by the same methods as those in Example 1. As a result, the crystallite diameter was 42.6 nm, and the BET specific surface area was 0.21 m²/g. In addition, the tap density was 5.2 g/cm³, and the mean particle diameter D_{50} was 5.3 μm. Moreover, the conductivity was not good. Furthermore, the ratio (Dx/BET) of the crystallite diameter Dx (nm) to the BET specific surface area (m²/g) was 203.

These results are shown in Table. In Table, conductivity is shown by “good” if the evaluation of conductivity is good, and conductivity is shown by “no good” if the evaluation of conductivity is not good.

<table>
<thead>
<tr>
<th></th>
<th>Crystallite Diameter Dx (nm)</th>
<th>BET (m²/g)</th>
<th>Tap Density (g/cm³)</th>
<th>D_{50} (μm)</th>
<th>Dx/BET</th>
<th>Conductivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example 1</td>
<td>32.4</td>
<td>0.75</td>
<td>5.0</td>
<td>1.4</td>
<td>43</td>
<td>good</td>
</tr>
<tr>
<td>Example 2</td>
<td>29.6</td>
<td>0.46</td>
<td>4.7</td>
<td>2.1</td>
<td>64</td>
<td>good</td>
</tr>
<tr>
<td>Example 3</td>
<td>33.3</td>
<td>0.28</td>
<td>5.4</td>
<td>3.1</td>
<td>119</td>
<td>good</td>
</tr>
<tr>
<td>Example 4</td>
<td>34.0</td>
<td>0.86</td>
<td>4.0</td>
<td>1.7</td>
<td>39</td>
<td>good</td>
</tr>
<tr>
<td>Comparative Example 1</td>
<td>47.8</td>
<td>0.15</td>
<td>5.0</td>
<td>6.5</td>
<td>318</td>
<td>no good</td>
</tr>
<tr>
<td>Comparative Example 2</td>
<td>42.6</td>
<td>0.21</td>
<td>5.2</td>
<td>5.3</td>
<td>203</td>
<td>no good</td>
</tr>
</tbody>
</table>
What is claimed is:

1. A spherical silver powder wherein a ratio (Dx/BET) of a crystallite diameter Dx (nm) to a BET specific surface area (m²/g) is in the range of from 5 to 200.

2. A spherical silver powder as set forth in claim 1, which has a crystallite diameter of not greater than 40 nm, and a mean particle size of not greater than 5 μm.

3. A spherical silver powder as set forth in claim 1, which has a tap density of not less than 2 g/cm³, and a BET specific surface area of not greater than 5 m²/g.

4. A spherical silver powder as set forth in claim 2, which has a tap density of not less than 2 g/cm³, and a BET specific surface area of not greater than 5 m²/g.

5. A method for producing a spherical silver powder as set forth in claim 1, wherein an aqueous solution containing a reducing agent is added to a water reaction system containing silver ions, to deposit silver particles by reduction to produce the spherical silver powder.

6. A method for producing a spherical silver powder as set forth in claim 5, wherein a dispersing agent is added to a slurry-like reaction system before or after said silver particles are deposited.

7. A method for producing a spherical silver powder as set forth in claim 6, wherein said dispersing agent is at least one selected from the group consisting of fatty acids, fatty acid salts, surface active agents, organic metals, chelating agents and protective colloids.

8. A method for producing a spherical silver powder as set forth in claim 5, wherein said reducing agent contained in said aqueous solution containing the reducing agent is at least one selected from the group consisting of ascorbic acid, alkanol amine, hydroquinone, hydrazine and formalin.

9. A method for producing a spherical silver powder as set forth in claim 5, wherein said aqueous solution containing the reducing agent is added at a rate of not lower than 1 equivalent/min with respect to the content of silver in said water reaction system containing silver ions.

10. A method for producing a spherical silver powder as set forth in claim 5, wherein a surface of said spherical silver powder is smoothed by a surface smoothing process which mechanically causes particles to collide with each other.

11. A method for producing a spherical silver powder as set forth in claim 10, wherein silver agglomerates are removed by a classification after said surface smoothing process.