METHOD FOR MANUFACTURING GRINDSTONE CORRECTOR AND GRINDSTONE, AND GRINDSTONE CORRECTOR, AND GRINDSTONE

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ABSTRACT

The present invention is to increase the flatness of the correcting surface of a grindstone corrector and the grinding surface of the grindstone, thereby enabling to give excellent sharpness to a cutting tool or the like. The present invention is characterized in that a plate-glass is used as a base of the grindstone corrector or a base of the grindstone, and a conductive thin film is formed on the plate-glass by a deposition process or the like, and grinding grain layer of diamond or the like is formed on the conductive thin film by an electrodeposition process. By utilizing the flatness of the plate-glass and employing the electrodeposition process, a grindstone corrector and a grindstone having a grinding grain layer of high flatness on the correcting surface or the grinding surface can be obtained.
FIG. 4
METHOD FOR MANUFACTURING GRINDSTONE CORRECTOR AND GRINDSTONE, AND GRINDSTONE CORRECTOR, AND GRINDSTONE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a grindstone corrector for correcting the grinding surface of the grindstone, and a grindstone.

[0003] 2. Description of the Related Art

[0004] In general, the grinding surface of a grindstone wears out into the concaved or convexed shape from use. As a tool for correcting the grinding surface into a flat surface, there is a grindstone corrector for grinding the grinding surface to correct it into a flat surface such as shown in FIG. 5. As an example of a known grindstone corrector, there is a grindstone corrector which requires sprinkling water together with an abrasive onto its upper surface. The grinding surface of the grindstone is rubbed against the upper surface and is grinded by the abrasive into a flat surface. There is another known grindstone corrector which includes grinding grains as an abrasive beforehand firmly attached onto its surface for grinding a grinding surface of a grindstone.

[0005] The former-type grindstone corrector requires sprinkling an abrasive together with water onto the correcting surface of the base thereof against which the grinding surface of a grindstone is to be rubbed. The latter-type grindstone corrector can grind a grindstone after simply sprinkling water thereon because grinding grains are firmly attached onto the correcting surface of the base beforehand. For the latter-type grindstone corrector, an electrodeposition process is known as means of firmly attaching grinding grains onto the base beforehand (for example, see the non-patent document 1). This process is characterized in that it can form a grinding grain layer having a relatively uniform thickness over the base surface.

[0006] [Non-patent document 1]: “Machines and tools” by Industrial Research Institute, Vol. 28, No. 10 (1982)

SUMMARY OF THE INVENTION

[0007] However, the former-type grindstone corrector which requires sprinkling an abrasive together with water thereon has a problem that the abrasive freely moves on the correcting surface of the grindstone corrector for grinding the grinding surface of the grindstone, and there are some cases where the distribution of the grinding grains becomes non-uniform. In such cases, large concaves and convexes tend to be formed on the grinding surface of the grindstone. On the other hand, for the latter-type grindstone corrector including grinding grains firmly attached on its upper surface by means of nickel electrodeposition process to form a grinding grain layer, it is common to constitute the base by a metal such as cast iron, copper alloy, or the like which is a conductive material in order to allow the electrodeposition. The surface of the base made of such a metal is hard to process into a flat shape and large concaves and convexes are formed on the upper surface thereof. Therefore, even if the grinding grain layer can be formed into a relatively uniform thickness on the upper surface of the base, its correcting surface has large concaves and convexes because of the concaves and convexes on the upper surface of the base.

[0008] As described above, when the conventional grindstone corrector is used, the concave and convex shapes on the correcting surface cause poor flatness of the grinding surface of the grindstone which is rubbed for correction on the grindstone corrector. The cutting tools or the like which have been corrected on the aforementioned grindstone have poor sharpness and do not exhibit good cutting performance.

[0009] In order to solve the above-described problems, a first objective of the present invention is to provide a method for manufacturing a grindstone corrector in which the flatness of the upper surface of the base of the grindstone corrector is improved and in turn the flatness of the correcting surface of the grinding grain layer formed on the base is also improved, with the result that the grinding surface of the grindstone which is grinded by the grindstone corrector is finished into further flat shape; and a grindstone corrector.

[0010] A second objective of the present invention is to provide a method for manufacturing a grindstone in which the flatness of the upper surface of the base of the grindstone is improved, with the result that the grinding surface on the grinding grain layer formed on the base is finished into further flat shape; and a grindstone.

[0011] The invention recited in claim 1 is characterized in a method for manufacturing a grindstone corrector in which a grinding grain layer is formed by an electrodeposition process, including the steps of: preparing a plate-glass as a base of the grindstone corrector; forming a conductive thin film onto an upper surface of the plate-glass; and firmly attaching diamond grinding grains onto said conductive thin film by an electrodeposition process.

[0012] The invention recited in claim 2 is characterized in a method for manufacturing a grindstone in which a grinding grain layer is formed by an electrodeposition process, including the steps of: preparing a plate-glass as a base of the grindstone; forming a conductive thin film onto an upper surface of said plate-glass; and firmly attaching a grinding grain layer onto said conductive thin film by an electrodeposition process.

[0013] The invention recited in claim 3 is characterized in a grindstone corrector including a base made of a plate-glass, a conductive thin film covering an upper surface of the base, and a grinding grain layer including diamond grinding grains firmly attached onto said conductive thin film.

[0014] The invention recited in claim 4 is characterized in that, in the grindstone corrector recited in claim 3, the thickness of the conductive thin film is set to 0.01 μm to 1 μm.

[0015] The invention recited in claim 5 is characterized in a grindstone including a base made of a plate-glass, a conductive thin film covering an upper surface of the base, and a grinding grain layer firmly attached onto said conductive thin film.

[0016] The invention recited in claim 6 is characterized in that, the grindstone recited in claim 2, the thickness of the conductive thin film is set to 0.01 μm to 1 μm.
In the invention recited in claim 1, the method for manufacturing the grindstone corrector is arranged so that the conductive thin film is formed on the surface of the plate-glass having a flat surface, and the electrodeposition layer is formed on the conductive thin film. Thus-arranged method is capable of giving further flatness to the correcting surface of the grindstone corrector or the grinding surface of the grindstone by utilizing the flatness of the surface flatness which is the characteristic of the plate-glass and the uniformity of the thickness of the grinding grain layer which is the characteristic of the electrodeposition process.

In the invention recited in claim 2, the method for manufacturing the grindstone is arranged so that a conductive thin film is formed on the surface of the plate-glass and the electrodeposition layer is formed thereon. Thus-arranged method is capable of giving further flatness to the grinding surface of the grindstone by utilizing the surface flatness which is the characteristic of the plate-glass and the uniformity of the thickness of the grinding grain layer which is the characteristic of the electrodeposition process.

In the invention recited in claim 3, it is possible to obtain a grindstone having a flat grinding surface by correcting the grindstone using the grindstone corrector of the present invention. Therefore, it is possible to give excellent sharpness to the cutting tool or the like which is grinded by the grindstone.

In the invention recited in claim 4, the thickness of the conductive thin film formed onto the plate-glass is set to 0.01 μm to 1 μm. In this arrangement, it is possible to obtain a grindstone corrector including a correcting surface with higher flatness by utilizing the surface flatness which is the characteristic of the plate-glass and the uniformity in the thickness of the grinding grain layer which is the characteristic of the electrodeposition process while suppressing the influence to the flatness of the correcting surface.

In the invention recited in claim 5, since the grindstone of the present invention has a flat grinding surface, it is possible to give excellent sharpness to the grinded cutting tool or the like.

In the invention recited in claim 6, the thickness of the conductive thin film formed onto the plate-glass is set to 0.01 μm to 1 μm. In this arrangement, it is possible to obtain a grindstone including a grinding surface with higher flatness by utilizing the surface flatness which is the characteristic of the plate-glass and the uniformity of the thickness of the grinding grain layer which is the characteristic of the electrodeposition method while suppressing the influence to the flatness of the grinding surface.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of a grindstone corrector of the first embodiment;

FIG. 2 is a perspective view of a grindstone corrector of the first embodiment;

FIG. 3 is a cross-sectional view of a grindstone of the second embodiment;

FIG. 4 is a cross-sectional view of a grindstone; and

FIG. 5 is a perspective view showing a grindstone corrector and a grindstone.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Hereinafter, embodiments of the present invention will be described based on FIGS. 1 to 5.

First Embodiment

FIG. 1(a) is a cross-sectional view of a grindstone corrector showing an embodiment according to the present invention. As is shown in this drawing, a grindstone corrector according to the present invention has a structure in which a plate-glass having a thickness of 8 mm is used as a base 2 for example, and a correcting surface 21 is formed on the uppermost surface, for correcting a grinding surface of a grindstone 4 which will be described later. Further, the correcting surface 21 is made of diamond grinding grains formed on a later-described conductive thin film 22 and capable of grinding the grinding surface of the grindstone. In the present invention, the thickness of the plate-glass is set to 8 mm. However, the plate-glass may be in any thickness depending on the material of the plate-glass and the use environment, as far as the thickness gives sufficient strength to the plate-glass.

By the diamond grinding grains on the correcting surface, the grinding surface of the grindstone worn out into the substantially concave shape or substantially convexed shape from use is corrected. Specifically, water is sprinkled over the correcting surface 21 of the base. Then, the grinding surface of the grindstone is pressed against the correcting surface 21, and is rubbed forward and backward, leftward and rightward, and diagonally. The diamond grinding grains on the correcting surface grind the grinding surface of the grindstone so as to correct the grinding surface into a flat shape.

On the other hand, as shown in FIG. 4, the grindstone to be corrected by the grindstone corrector has a structure in which a grinding layer 42 having a grinding function and a base 43 made of wood or the like having no grinding function located below the grinding layer 42 are integrated into one piece unit. The upper surface of the grinding layer 42 and the lower surface of the base 43 are formed into a rectangle shape. Further, the grindstone has a grinding layer made of grinding grains having hardness lower than that of diamond such as alumina (Al₂O₃), silicon carbide (SiC) and the like or CBN (cubic boron nitride). The upper surface of the grinding layer 42 constitutes the grinding surface 41 of the grindstone 4. The grinding surface 41 is capable of grinding cutting tools such as kitchen knives, razors, scissors, chisels, planners, and the like.

By the way, the reason why the plate-glass is used as a base of the grindstone corrector as described above is that the flatness of the surface of the plate-glass is very excellent. As a result of actual measurement, a cast iron-base which has been conventionally used has an upper surface with flatness of 17 μm when it has a length of 250 mm, and a copper alloy-base which has been conventionally used has an upper surface with flatness of 14 μm. Contrarily, a plate-glass has a surface with flatness of 7 μm. This value is half or less of the conventional bases. Therefore, by forming a conductive thin film on the surface of a plate-glass having excellent flatness, and then forming a diamond grinding
Further, as described above, diamond grinding grains 24 are provided to the grindstone corrector 1 on its correcting surface 21. As shown in FIG. 1(b), the diamond grinding grains 24 are firmly attached on to the conductive thin film 22 provided on the upper surface of the base 2 (plate-glass) by an electrodeposition process. The reason why the conductive thin film 22 is formed on the plate-glass is that the conductive thin film 22 allows the formation of an electrodeposition layer 23 that holds the diamond grinding grains 24 on the plate-glass which is a non-conductive material.

The conductive thin film 22 is formed of a conductive material such as copper onto the upper surface of the plate-glass as a base 2 by a process such as vacuum deposition or sputtering deposition, electroless plating, sintering film formation, or the like. Thus-formed conductive thin film is in a thickness of 1 μm, for example. Then, electrodeposition is performed by electrodeposition process in a state where diamond grinding grains are placed on the upper surface of the conductive thin film to form the electrodeposition layer 23. Subsequently, thus-formed electrodeposition layer 23 is allowed to hold diamond grinding grains 24, so that the diamond grinding grains 24 are firmly attached onto the conductive thin film 22. In this first embodiment, a nickel electrodeposition process is employed as electrodeposition means. Any other electrodeposition processes may be employed as far as they provide a bonding force of the same level as of the nickel electrodeposition process.

By the way, it is desirable that the conductive thin film is in a thickness of 0.01 μm to 1 μm. If the thickness exceeds 1 μm, the conductive thin film formed on the plate-glass has poor uniformity in the film thickness. In this case, the effect of the surface flatness which is the characteristic of the plate-glass is lowered. On the other hand, if the thickness is less than 0.01 μm, the resultant conductive thin film has significantly increased electric resistance. In this case, the potential distribution in the conductive thin film becomes large and an electrodeposition layer having a uniform thickness cannot be obtained.

In this embodiment, diamond grinding grains having grain size of #270 are employed. Any other diamond grinding grains may be employed as far as they have a grain size of #270 to #500 (grain diameter φ54 to φ29 μm). If the diamond grinding grains are rough with the grain size exceeding #270 (grain diameter φ54), the grinding surface of the grindstone to be grinded by this grindstone corrector becomes too rough. In this case, it becomes difficult to give excellent sharpness to the cutting tool using the grinding surface. Contrarily, if the diamond grinding grains are small with the grain size smaller than #500 (grain diameter φ29 μm), it is impossible to ensure sufficient projection of the diamond grinding grains. In this case, the correction (grinding) efficiency of the grinding surface of the grindstone is lowered.

Further, the projection from the electrodeposition layer 23 of the diamond grinding grains 24 that constitute the correcting surface 21 of the grindstone corrector is set to 0 to 4% of an average grain diameter immediately after the electrodeposition. Even if the projection of the diamond grinding grains is 0% of an average grain diameter, actually, diamond grinding grains having grain diameters larger than an average grain diameter projects from the surface of the electrodeposition layer 23. During the process of correcting the correcting surface of the grindstone by means of the correcting surface of the grindstone corrector, the grinding grains of the grindstone made of alumina (Al₂O₃), silicon carbide (SiC), or the like as a material of the grindstone fall out. The fall-out grinding grains grind the electrodeposition layer 23 on the correcting surface to retract the electrodeposition layer 23, resulting in allowing the diamond grinding grains to project from the electrodeposition layer. For this reason, also by setting the projection of the diamond grinding grains to fall within the above-described range, clogging is hard to occur on the correcting surface 21. Further, during the process of correcting the grinding surface of the grindstone, the projection of the diamond grinding grains on the correcting surface of the grindstone corrector can be optimized to a value corresponding to the grain size of the grinding grains of the grindstone which is a substance to be grinded.

Further, the correcting surface including the diamond grinding grains is formed with a plurality of storage grooves 26 on the correcting surface side, as shown in FIG. 2. When the grinding surface 41 of the grindstone is grinded by the diamond grinding grains included in the correcting surface 21 of the grindstone corrector, the storage grooves serve to store the grinding grains of the grindstone. This arrangement further facilitates to avoid the correcting surface from clogging when the grindstone is corrected.

The storage grooves 26 are formed in any one of the following processes. In one process, after the conductive thin film 22 is formed on the upper surface of the plate 2, the portions to be contact with the grinding surface 41 of the grindstone are masked; and then, for example, sand blast is performed to form the storage grooves 26 in a thickness of about 1 mm over substantially the entire surface of the correcting surface. In the other process, the storage grooves 26 are formed by sandblast or the like before forming the conductive thin film 22. When the former process is employed, it is desirable that the portions to be masked are continuous in such a manner as to be electrically conductive for convenience of electrodeposition.

Here, the shape of the storage grooves is not limited to that of this embodiment, and may assume any other shapes. The storage grooves are not necessarily formed as far as clogging is avoidable. By the way, in this embodiment, although the storage grooves are formed by employing a combination of film resist and sand blast, any other known techniques may be alternatively employed. For example, a resist process which uses photosist, a paper adhesive tape, a cloth adhesive tape, or the like may be employed, or an etching process which uses a chemical agent such as fluorine oxide may be employed. In addition, the storage grooves may be in any depth as far as they can avoid clogging and can maintain the strength of the base.

In the above-described sintering film formation process, an Ag conductive paste containing glass fine grains is applied; after the application of the paste, the glass fine grains are heated at 500 to 700° C. to be fused and bonded as well as solidified to be used as a conductive cover film.
According to this process, the resultant conductive cover film had strong adhesive force to the plate-glass which is used as the base 2.

[0042] Specifically, the main composition of the glass-containing Ag conductive paste (a commercially available from Okuno Chemical Industries Co., Ltd.) is 5 weight % of glass frit (glass fine grains of \( \Phi 2 \) to \( 4 \mu m \)), 55 weight % of organic binder, and 40 weight % of Ag powder (silver powder having grain diameter of micron level). The glass frit is glass fine powder having a composition of bismuth system, zinc system, or silica system and having a softening temperature of 500 to 700° C., and melts at temperature far lower than the melting temperature of the plate-glass to bond with the plate-glass.

[0043] Therefore, the glass-containing Ag conductive paste is applied by application means such as silk printing or the like onto the plate-glass to be used as the base 2 into the thickness of about 5\( \mu \)m to 7\( \mu \)m, and then, is sintered at 500 to 700° C. for about 15 minutes to form a conductive thin film 22. After the formation of the conductive thin film 22, electrodeposition is performed by an electrodeposition process in a state where diamond grinding grains are placed on the upper surface of the conductive thin film 22 as is conducted above. Thus-formed electrodeposition layer 23 is allowed to hold the diamond grinding grains 24 so that the diamond grinding grains 24 are firmly attached onto the conductive thin film 22.

Second Embodiment

[0044] Next, another embodiment of the present invention will be described by way of FIG. 3. The second embodiment relates to a grindstone 3, and a plate-glass having a thickness of 8 mm is used as a base 31 of the grindstone 3. On the base 31, a conductive thin film 32 is formed into a thickness of 1 \( \mu m \), and a grinding grain layer 33 is formed onto the conductive thin film by an electrodeposition process. As the electrodeposition means, a nickel electrodeposition process is employed, and diamond is employed as grinding grains.

[0045] The grinding grains to be used in the grindstone 3 are made of alumina (\( \text{Al}_2\text{O}_3 \)), silicon carbide (SiC), or diamond depending on the substance to be grinded such as a cutting tool. The grain size of the grinding grains or the projection of the grinding grains from the electrodeposition layer is properly selected and set. Since the grinding grains are electrodeposited to form a single layer and cannot be corrected by the grindstone corrector, it is preferable to use diamond grinding grains or cubic boron carbide (CBN) which have especially high hardness and hard to be worn out.

[0046] On the other hand, the grindstone of the present invention is not formed with storage grooves for storing the grinding grains as of the grindstone corrector 1 shown in the first embodiment. The grindstone is for use in grinding a cutting tool and the like. Therefore, there are no grinding grains falling out of the substance to be grinded as is the case in the first embodiment where the grinding surface of the grindstone is corrected, and the grinding grains scarcely fall out from the grindstone 3 itself and scarcely wear out. The other manufacturing methods and structures are the same as of the first embodiment, the detailed descriptions thereof are omitted.

[0047] By the way, in both of the first embodiment and second embodiment described above, the grindstone corrector and the grindstone are manufactured by use of a general-purpose plate-glass. In the application where higher flatness is required, the plate-glass may be grinded again to have a predeetermined flatness, and after that, the same process is repeated to manufacture a grindstone corrector or a grindstone. Although a plate-glass of having flatness of 10 \( \mu m \) or lower is normally used, it is preferable to process the plate-glass by the regrounding process or the like to reduce the flatness of the plate-glass into 7 \( \mu m \) or lower.

[0048] Further, in both of the first embodiment and second embodiment, the plate-glass as the base has a shape of substantially rectangular solid. Alternatively, the plate-glass is processed into the shape of disc, and a correcting surface or a grinding surface is formed to produce a rotary grindstone corrector or a grindstone.

What is claimed is:

1. A method for manufacturing a grindstone corrector in which a grinding grain layer is formed by an electrodeposition process, comprising the steps of: preparing a plate-glass as a base of the grindstone corrector; forming a conductive thin film onto an upper surface of the plate-glass; and firmly attaching diamond grinding grains onto said conductive thin film by an electrodeposition process.

2. A method for manufacturing a grindstone in which a grinding grain layer is formed by an electrodeposition process, comprising the steps of: preparing a plate-glass as a base of the grindstone; forming a conductive thin film onto an upper surface of said plate-glass; and firmly attaching a grinding grain layer onto said conductive thin film by an electrodeposition process.

3. A grindstone corrector comprising a base made of a plate-glass, a conductive thin film covering an upper surface of said base, and a grinding grain layer including diamond grinding grains firmly attached onto said conductive thin film.

4. A grindstone corrector according to claim 3, wherein the thickness of the conductive thin film is set to 0.01 \( \mu m \) to 1 \( \mu m \).

5. A grindstone comprising a base made of a plate-glass, a conductive thin film covering an upper surface of the base, and a grinding grain layer firmly attached onto said conductive thin film.

6. A grindstone according to claim 5, wherein the thickness of the conductive thin film is set to 0.01 \( \mu m \) to 1 \( \mu m \).