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TITLE OF INVENTION

METAL SURFACE TREATMENT METHOD AND A METALLIC MATERIAL
TREATED THEREBY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of treating a metal surface on which various ceramics including TiN etc are coated, and to a metallic material treated thereby.

2. Description of the Related Art

In general, a ceramic coating can be given to any kind of metal surface. Therefore, the metal surface after being machined is often coated with a ceramic without any further treatment. By the way, when a surface is processed by a lathe, the waviness caused by the cutting edge of the tool is left on the surface. As the compression stress remains in the coating, if such a crest and a valley remain on the surface, the stress is concentrated on that part to cause peeling.

In order to solve this problem, sometimes grinding is carried out using a grind stone. However, by the grinding, the metal surface is again subjected to machining, and then the abrasive grain in the grind stone bites and scrapes off the metal surface. In such a case, under magnification, a ditch is found to be formed and an unstable metal flake which easily comes off, such as a burr, is found in the ditch.

When the above-mentioned surface is subjected to coating, the coating is given on the unstable metal flake. And this part comes off easily and peeling starts from that part. In order to remove these unstable substances, so called sand blasting treatment has been conventionally carried out in which fine sand and the like is mixed with compressed air and blown against the surface. But, in this method, removal of the unstable substances leads to roughen

the surface to provide asperities. And when coating is carried out on the surface with asperities, stress is concentrated on this part, as mentioned before, thus this part becomes the origin of the peeling.

To avoid providing asperities with sharp edge, in some cases glass beads and metal spheres are blown against the surface by the sand blasting. But the spherical shape weakens the performance of removing the unstable metal flakes, and as the surface is hit by the balls, the remaining unstable flakes are buried into the surface layer. These would be dropped later when the coated product is actually used. As described above, none of the conventional treatment methods have been successful in providing satisfactory surface conditions.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a metal surface treatment method in which unstable foreign matters such as an unstable burr produced during machining, a white layer and segregated alloy components are removed from the machined metal surface and surface defects such as microcracks and small holes are filled, asperities with sharp edge are leveled, and a metal surface which is suitable for coating can be produced.

Another object of the present invention is to provide a metallic material which is treated by the above-mentioned metal surface treatment method.

In order to achieve the object of the present invention, there is provided a metal surface treatment method comprising a first treatment step in which first powder having a predetermined size and abrasive properties is mixed with compressed air and blown with a predetermined pressure against the target metal surface so that an unstable burr, and a white layer on the metal surface, or segregated substances coming up to the surface are removed, and a second treatment step in which second powder having a

predetermined size and a spherical shape is mixed with compressed air and blown with a predetermined pressure against the above-mentioned metal surface so that acute corners present on the metal surface are rounded and smoothed, and small holes are filled.

The above-mentioned first powder is Al_2O_3 or SiC and as the above-mentioned second powder, glass balls, iron balls, quartz balls or marble balls can be used. The above-mentioned first powder and the second powder preferably have a size of from 10μ to 50μ . The predetermined pressure employed in the above-mentioned first treatment step for blowing can be 0.3 kgf/cm^2 - 3 kgf/cm^2 and the predetermined pressure employed in the above-mentioned second treatment step for blowing can be 1.0 kgf/cm^2 - 3 kgf/cm^2 .

According to the present invention, the above-mentioned treatment method may further comprise a third treatment step in which the above-mentioned first powder is mixed with compressed air and blown with a predetermined pressure against the target metal surface so that fine asperities are formed. The size of the above-mentioned fine asperities is preferably 1μ - 5μ . A metallic material according to the present invention is one having subjected to the surface treatment by any of the above-mentioned metal surface treatment methods.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of a SEM (Scanning Electron Microscope) photograph (magnification: $\times 5,000$) showing the non-treated condition of a metallic material surface just after machining.

FIG. 2 is a schematic illustration of a SEM photograph (magnification: $\times 5,000$) of the metallic material surface which has been treated by the metal surface treatment method of the present invention, showing the condition after the first and second treatment processes.

FIG. 3 is a schematic illustration of a SEM photograph

(magnification: x5,000) of the metallic material surface which has been treated by the metal surface treatment method of the present invention, showing the condition after the first, second, and third treatment processes.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention will be further illustrated with the accompanying drawings. A powder having abrasive properties such as Al_2O_3 and SiC having a size of from $10\ \mu$ to $50\ \mu$ (hereinafter referred to as "Powder A") is mixed with compressed air, and blown against the target surface of a metallic material at a pressure of $0.3\ \text{kgf/cm}^2$ - $3\ \text{kgf/cm}^2$. Thereby, an unstable burr and a white layer on the metal surface, and segregated substances coming up to the surface can be removed and foreign substances which come off easily can be eliminated.

Then a spherical powder such as glass balls, iron balls, quartz balls or marble balls having a size of from $10\ \mu$ to $50\ \mu$ (hereinafter referred to as "Powder B") is mixed with compressed air and blown against the above-mentioned metal surface at $1.0\ \text{kgf/cm}^2$ - $3\ \text{kgf/cm}^2$. Acute corners present on the metal surface can be rounded and smoothed, and small holes are filled so that the concentration of the stress in the coated ceramic, which will result in a base point for peeling, can be prevented. For the coating by chemical vapor deposition in which the coating film diffuses into the metal surface layer, the above-mentioned treatment is adequate.

However, for the physical vapor deposition in which a crystal is deposited and developed on the metal surface, the surface treated by Powder A followed by treatment with Powder B (hereinafter referred to as "Surface A/B") rather becomes an inappropriate surface since it does not have nuclei for starting crystallization.

Therefore, for obtaining a dense crystalline coat, it is necessary to intentionally provide asperities of $1\ \mu$ - 5

μ on the Surface A/B, which does not cause stress concentration after the coating is carried out. Such surface condition (hereinafter referred to as "Surface A/B/A") can be obtained by mixing Powder A with compressed air and blowing it against the surface at a pressure of 0.2 kgf/cm² - 1.5 kgf/cm². The surface A/B/A has an infinity of asperities having a size of 1 μ - 5 μ , but the asperities only serve as the nuclei of the crystal and are not big enough to cause stress concentration after the coating, to result in peeling. The asperities existing on the non-treated surface, that allow the stress concentration, are treated during the treatment for producing the Surface A/B and the Surface A/B/A becomes the most suitable surface for the coating.

Next, an example of Heis End Mill Cutter treated with this method will be explained. FIG. 1 is a schematic illustration of a SEM photograph (magnification: x5,000) of a cutting edge showing the non-treated condition of the metallic material surface just after the machining. This figure shows that many ditches are generated by machining and burrs 2 are generated by the stress applied during the machining in the machined edge part which is not subjected to any further treatment.

FIG. 2 is a schematic illustration of the metallic material surface which has been treated by the metal surface treatment method of the present invention, showing the same spot of the cutting edge; Surface A/B which is treated by Powder A and Powder B. Acute asperities are eliminated and made into smooth hill-like asperities 3.

FIG. 3 is a metallic material surface which is further treated with Powder A, in which asperities are intentionally provided, as needed, on the Surface A/B to provide Surface A/B/A. There, numerous asperities 4 having a size of 1 μ - 5 μ are provided on the surface, and yet such acute asperities seen in FIG. 1 that allow stress to be concentrated, or unstable burrs and the like are removed.

The above-mentioned explanation is given on a case in which coating is done on a metal surface, but the metal surface treatment according to the present invention can also be effective in the case of plating which requires the same kind of surface conditions. The metal surface treatment of the present invention is also effective for tools that require mechanical strength in which breakage might occur because of burrs and segregated substances. It is also effective for a metal mold for plastics as the burrs and white layer may catch the resin and result in sticking in mold.

As described above, according to the present invention, an unstable substance such as a burr which comes off easily, a white layer and a segregated substance is removed from the metal surface to provide a clean surface, and the surface is so treated that acute asperities are smoothed and microcracks or small holes are filled. For the coating which requires nuclei of crystals, asperities which result in the nuclei are intentionally provided on the smoothed surface.

Accordingly, a dense crystalline coating can be provided on a matrix of high mechanical strength. Thereby, a metallic material having such surface conditions that allow a coat of high hardness to be bonded with high adhesive strength, can be obtained.



WHAT IS CLAIMED IS:

1. A metal surface treatment method comprising:
a first treatment step in which first powder having a predetermined size and abrasive properties is mixed with compressed air and blown with a predetermined pressure against a target metal surface so that an unstable burr, and a white layer on the metal surface, or segregated substances coming up to the surface are removed; and
a second treatment step in which second powder having a predetermined size and a spherical shape is mixed with compressed air and blown with a predetermined pressure against the said metal surface so that acute corners present on the metal surface are rounded and smoothed, and small holes are filled.
2. A metal surface treatment method according to claim 1, in which said first powder is Al_2O_3 or SiC and said second powder comprises glass balls, iron balls, quartz balls or marble balls.
3. A metal surface treatment method according to claim 1, in which the size of said first powder and the size of said second powder is of from 10μ to 50μ .
4. A metal surface treatment method according to claim 1, in which the predetermined pressure employed in said first treatment step for blowing can be 0.3 kgf/cm^2 - 3 kgf/cm^2 and the predetermined pressure employed in said second treatment step for blowing can be 1.0 kgf/cm^2 - 3 kgf/cm^2 .
5. A metal surface treatment method according to claim 1, further comprises a third treatment step in which said first powder is mixed with compressed air and blown with a predetermined pressure against the target metal



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surface so that fine asperities are formed.

6. A metal surface treatment method according to claim 5, in which the size of said fine asperities is of from 1 μ to 5 μ .

7. A metallic material which is treated by a metal surface treatment method according to claim 1.

8. A metallic material which is treated by a metal surface treatment method according to claim 4.