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METHOD OF CHEMICALLY BONDING CARBON-TITANIUM ALLOY TO A DIAMOND SURFACE

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U.S. Cl. 51—293 2 Claims

ABSTRACT OF THE DISCLOSURE

This invention is to obtain a chemically bonded diamond structure by making the surface skin of a diamond powder react with metallic titanium so as to be chemically synthesized into a carbon titanium alloy whereby the chemically atomically bonded carbon titanium alloy may strongly bond the diamond powder in the surface skin of the enclosed diamond after the reaction.

This invention relates to a chemically bonded diamond structure and a method of making the same.

This invention is to obtain a chemically bonded diamond structure by strongly and compactly bonding a diamond powder with titanium carbide.

According to the present invention, the surface skin of a diamond powder is made to react with metallic titanium so as to be chemically synthesized into an alloy of carbon and titanium and so that the diamond powder may be chemically bonded with the thus produced carbon titanium alloy and this operation is carried out under a high pressure where the diamond is not converted to graphite so that a diamond bond having a strongly bonded compact structure may be obtained.

The above mentioned metallic titanium is obtained by pyrolyzing hydrogenated titanium. When a mixture of a diamond powder and hydrogenated titanium is heated, the hydrogenated titanium will be pyrolyzed and a mixture of metallic titanium and the diamond powder will be obtained. When the mixture is exposed for several minutes to a high temperature and high pressure within the range of the temperature and pressure conditions in the stable zone of diamond, the surface skin of the diamond powder will be chemically synthesized into a carbon titanium alloy without converting the diamond to graphite. The diamond powder is bonded with the thus produced carbon titanium alloy as a feature of the present invention.

An object of the present invention is to obtain a diamond bond having a strong bonding force by synthesizing the surface skin part of a diamond powder into a carbon titanium alloy by employing hydrogenated titanium as a raw material.

A further object of the present invention is to produce a diamond bond cheaply at a high yield.

According to the present invention, first of all, a mixture of a diamond powder and a hydrogenated titanium powder is heated to be pyrolyzed at a temperature of about 600° C. so that nascent hydrogen strong in the activity and nascent metallic titanium may be produced and the clean diamond powder washed by the nascent hydrogen strong in the activity and the pure nascent metallic titanium powder may be a mixed state and then the mixture is heated at a temperature of about 1750° C. in a reaction chamber so that a reaction may occur between the surface skin of the diamond powder and the metallic titanium. When diamond is exposed to a temperature of 1750° C. under the normal pressure, the diamond will be converted to graphite. Therefore, in order to prevent it, diamond is exposed to a high pressure of about 62,000 atmospheres.

The functional relation between the temperature and pressure in such case can be calculated by the Berman-Simmon's heat balance chemical equation. That is to say, when the mixture of the pure nascent metallic titanium powder and the clean diamond powder produced in the preceding step is exposed to a temperature of about 1750° C. and a pressure of about 62,000 atmospheres in the temperature and pressure conditions in the stable zone of diamond, the surface skin of the diamond powder will react with the nascent metallic titanium so as to be chemically synthesized into a carbon titanium alloy without converting the diamond into graphite and the diamond powder will be strongly and compactly chemically bonded with said carbon titanium alloy.

The present invention shall now be explained with reference to an example. For the raw materials were used a diamond powder of respective sizes of 400 to 1600 meshes and a substantially colloid fine powder of hydrogenated titanium as well mixed at a ratio of 80% by volume of the diamond powder and 20% by volume of the hydrogenated titanium powder. For the apparatus was used a high temperature high pressure apparatus which could generate a temperature of 2000° C. and a pressure of 100,000 atmospheres to be used for the production of diamond.

That is to say, the above mentioned raw materials were put into the reaction chamber of the high temperature high pressure apparatus, were first heated to about 600° C. so that the hydrogenated titanium might by pyrolyzed, were then subjected to a pressure of about 62,000 atmospheres and were then heated to about 1750° C. They were kept for 7 minutes as exposed to the temperature of about 1750° C. and the pressure of about 62,000 atmospheres.

Then, the temperature in the reaction chamber was reduced to 150° C., the surface skin of the diamond was made to react with the metallic titanium and the synthesized carbon titanium alloy was coagulated.

Then, the pressure was reduced to the atmospheric pressure and a diamond bond was recovered.

The diamond bond recovered here had a compact structure in which the carbon titanium alloy having synthesized the surface skin of the diamond powder had bonded the adjacent diamond powder.

According to this method, in the high pressure high temperature apparatus, when hydrogenated titanium is heated to 600° C., it will be first pyrolyzed to become nascent hydrogen strong in the activity and pure nascent metallic titanium, this nascent hydrogen will wash the diamond powder and will clean its surface and therefore this mixture will become a mixture of a very clean and pure diamond powder having no impurity and a metallic titanium powder. When the mixture is heated at a high temperature of about 1750° C. under a high pressure of about 62,000 atmospheres, the diamond will be in a stable zone and therefore will not be graphitized, the cleaned surface skin of the diamond powder will react with the pure metallic titanium powder to become a carbon titanium alloy and therefore the diamond powder will all become a carbon titanium alloy continuous in the surface skin and will be chemically bonded in the structure. If only the temperature is reduced while the powder is exposed to a high pressure, the carbon titanium alloy bonded with the surface of the diamond powder will coagulate under the high pressure and will perfectly strongly bond the diamond powder in a pure state. Therefore, the recovered diamond bond taken out of the reaction chamber by

reducing the pressure here will have a chemically strongly bonded very compact structure.

As the method of producing a chemically bonded diamond structure according to the present invention is carried out under the temperature and pressure conditions in the stable zone of diamond, the diamond will not be converted to graphite during the process of producing a diamond bond, therefore there will be no loss of diamond by its conversion to graphite, the bonding force will not be weakened by the conversion of diamond to graphite and a strongly bonded diamond structure will be obtained.

Further, when hydrogenated titanium is used as a raw material for metallic titanium to produce a carbon titanium alloy bonding a diamond powder as mentioned above, the surface skin of the diamond powder will be able to be chemically synthesized into a carbon titanium very high in the purity. As the bond of such carbon titanium alloy with diamond is a chemical atomic bond, the bonding force of the diamond bond will be very strong. By the producing method of the present invention having such characteristics, an excellent bonded diamond structure can be produced cheaply at a high yield.

Further, the chemically bonded diamond structure of the present invention having such characteristics as are mentioned above is an excellent hard material. Therefore, cutting tools made of the chemically bonded diamond structure of the present invention are advantageous to be used for working hard materials. Further, dies made of the chemically bonded diamond structure of the present invention will show a strong durability when used to draw or form metallic materials. Thus, the product of the present invention can be very effectively used.

What is claimed is:

1. A method of producing a chemically bonded diamond structure, comprising the steps of mixing a diamond powder and a hydrogenated titanium powder, heating said mixture to pyrolyze the hydrogenated titanium, thereby producing a mixture of a clean diamond powder and a nascent titanium, and heating said mixture of diamond powder and nascent titanium to a temperature of about 1750° C. and at a pressure of about 62,000 atmospheres under temperature-pressure conditions in the stable zone of diamond for several minutes whereby a carbon-titanium alloy is chemically bonded to the diamond powder in an atomic state on the surface of the powder so as to form a compact structure.

2. A method of making chemically bonded diamond structures comprising the steps of heating a mixture of a diamond powder and a hydrogenated titanium powder at a pyrolyzing temperature of the hydrogenated titanium to produce nascent metallic titanium and nascent hydrogen gas, washing the diamond powder with said nascent hydrogen gas so as to produce a clear diamond powder, then exposing thus cleaned diamond powder and a nascent metallic titanium to a temperature of about 1750° C. and a pressure of about 62,000 atmospheres under temperature-pressure conditions in the stable zone of diamond, keeping this state for at least about seven minutes to react the surface skin of the diamond powder with the metallic titanium to be chemically synthesized into a carbon titanium alloy, subsequently coagulating the carbon titanium alloy by reducing only the temperature without lowering the pressure and thereafter reacting the surface skin of the diamond powder with the metallic titanium by lowering the pressure, whereby the diamond powder may be strongly bonded with the chemically synthesized carbon titanium alloy.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,464,804 September 2, 1969

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It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, line 4, "assignor to" should read -- assignor of one-half to --.

Signed and sealed this 21st day of April 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents