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[54] **METAL-COATED DIAMONDS IN A METAL ALLOY MATRIX**

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Related U.S. Application Data

[63] Continuation of Ser. No. 153,105, June 14, 1971, abandoned.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **51/295;** 51/309
[51] **Int. Cl.** **B24d 3/06**
[58] **Field of Search** 51/295, 309

[56] **References Cited**

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[57] **ABSTRACT**

A compact comprising substantially graphite-free diamond particles having a continuous coating of titanium or molybdenum held in a matrix into which the titanium or molybdenum can diffuse. The matrix may for example, be an alloy selected from the group of Fe/Ni, Ni/Co/Cr/Fe, Fe/Si and Ti/Si alloys. The invention also provides a method of making such a compact by mixing the desired metal powders in suitable proportions with the coated diamond particles and compacting the mixture under pressure and temperature conditions in the diamond stable zone.

5 Claims, No Drawings

METAL-COATED DIAMONDS IN A METAL ALLOY MATRIX

This is a continuation of application Ser. No. 153,105, filed June 14, 1971, and now abandoned.

This invention relates to compacts and it is an object of the present invention to provide a compact having improved properties over compacts of the prior art.

According to the invention there is provided a compact comprising substantially graphite-free diamond particles having a continuous coating of titanium or molybdenum held in a matrix compatible with the titanium or molybdenum coating. The term compatible means that the matrix must be such as allow diffusion of the titanium or molybdenum into it.

The matrix may be an alloy selected from the group of Fe/Ni, Ni/Co/Cr/Fe, Fe/Si, Ti/Si, Ti/Ni and Ti/Fe alloys, but is preferably one of the following alloys: Ni/Co/Cr/Fe:: 34/18/14/5 Fe/Ni:: 12/5 Fe/Si:: 63/2

All the above-mentioned ratios are weight for weight.

The matrix may also advantageously be tungsten carbide bonded with a transition metal of the 8th group, preferably cobalt. The transition metal is preferably present in the amount of about 10 percent by weight of the tungsten carbide.

The thickness of the titanium or molybdenum coat would normally be of the order of 1,000 to 2,000A, but coats of greater thickness can also be used.

The titanium or molybdenum coated diamonds for use in the compacts may be prepared by methods known to the art. The coating may, for example, be deposited on to the diamond surface by the method of vacuum deposition described in "Vacuum Deposition of Thin Films" by L. Holland, Chapman and Hall, 1st Edition 1956. In order to create a titanium/diamond or molybdenum/diamond bond, as the case may be, the coated diamond may be heated to a temperature of greater then 500°C to form the desired bond. However, this heating is not necessary as the during compact manufacture temperatures above 500°C are encountered and the bond formation can therefore be obtained during the compact manufacture.

Further according to the invention, there is provided a method of making a compact including the steps mixing diamond particles having a continuous coating of titanium or molybdenum with a matrix material suitable to provide, on compaction, a matrix compatible with the titanium or molybdenum coating of the particles and compacting the mixture under pressure and temperature conditions in the diamond stable zone.

The diamond stable zone is a set of conditions known to the art and the Applicant refers to Berman R, and Simon F, Z. Elektrochem, Vol 59, 1955 page 333 in this regard.

Preferably, the pressure during compaction is about 60 kilobars and the temperature is between about 1,200° and 1,400°C.

Embodiments of the invention will now be described.

Diamond compacts having a variety of matrices were prepared in the following manner:

In all cases, diamond grit having a continuous titanium or molybdenum coating and the metal powders necessary to make the desired alloy were weighed into a plastic bottle. If for example, an iron/nickel alloy (12:5) was desired then 12 parts by weight of iron powder and 5 parts by weight of nickel powder were weighed into the bottle. The metal powders and grit

were then mixed by placing the bottle in a milling machine for about 20 minutes. The mixture was placed in a graphite mould and loaded into a standard synthesis capsule. If the synthesis volume was not completely filled by the mould, compacted graphite was added to the capsule to fill the balance of the volume.

The mixture was then subjected to compaction for about five minutes at a pressure of about 60 kilobars and a temperature of between 1,200° and 1,400°C. These temperatures and pressures are in the diamond stable zone.

Using the above-mentioned method a number of diamond compacts were manufactured. Table I below sets out the diamond grit particle size and the matrix material used in these compacts.

TABLE I

Compact	Diamond Particle Size (mesh)	Matrix
1	60/80	Fe/Ni::12/5
2	140/170	Fe/Ni::12/5
3	−325	Fe/Ni::12/5
4	60/80	WC — 10% Co.
5	140/170	Ti/Ni::37/6
6	60/80	Cu/Al::65/5
7	60/80	Fe/Si::6.3/2
8	140/170	Fe/Si::63/2
9	60/80	Ti/Si::34/3
10	140/170	Ni/Co/Cr/Fe::34/18 14/5
11	140/170	Ti/Fe::31/15

In all the above cases, the diamond content of the compacts was 65% Vol/Vol.

The above mentioned compacts were compared in properties with a compact comprising uncoated diamond grit in a titanium-silicon matrix and it was found on an average that the grinding efficiency ratios of the invented compacts were greater than 1. The efficiency ratio is the ratio of wear under a set of abrading conditions of the invented compact to the wear under the same set of conditions of the standard compact times a conversion factor. The conversion factor reflects the differing densities of the matrices.

A value of greater than 1 indicates that the invented compact has superior abrasion resistance to the standard compact. Of the results, the most significant were those obtained for the compacts having Fe/Ni, WC bonded with 10% Co, Ni/Co/Cr/Fe, and Fe/Si matrices where the efficiency ratios were found to be 1.59, 4.53, 3.79 and 1.50, respectively.

We claim:

1. A compact consisting essentially of substantially graphite-free diamond particles having a continuous metal coating of thickness from 1,000 to 2,000A chemically bonded thereto and held in a matrix by a diffusion alloy of the metal and the matrix at the metal/matrix interface, the metal being selected from the group consisting of titanium and molybdenum and the matrix being selected from the group consisting of Fe/Ni, Ni/Co/Cr/Fe and Fe/Si alloys and WC bonded with a transition metal of the VIII group, said compact having a grinding efficiency ratio greater than 1.

2. A compact according to claim **1**, wherein the matrix is an Fe/Ni alloy the ratio of iron to nickel in the alloy being 12/5.

3. A compact according to claim **1**, wherein the matrix is a Ni/Co/Cr/Fe alloy, the ratio of the metals in the alloy being 34/18/14/5.

4. A compact according to claim **1** wherein the matrix is an Fe/Si alloy the ratio of the iron to the silicon in the alloy being 63/2.

5. A compact according to claim **1** wherein the matrix is WC bonded with cobalt which is present in the amount of about 10 percent by weight of the WC.

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