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(54) **REINFORCING OVERLAY FOR MATRIX BIT BODIES**

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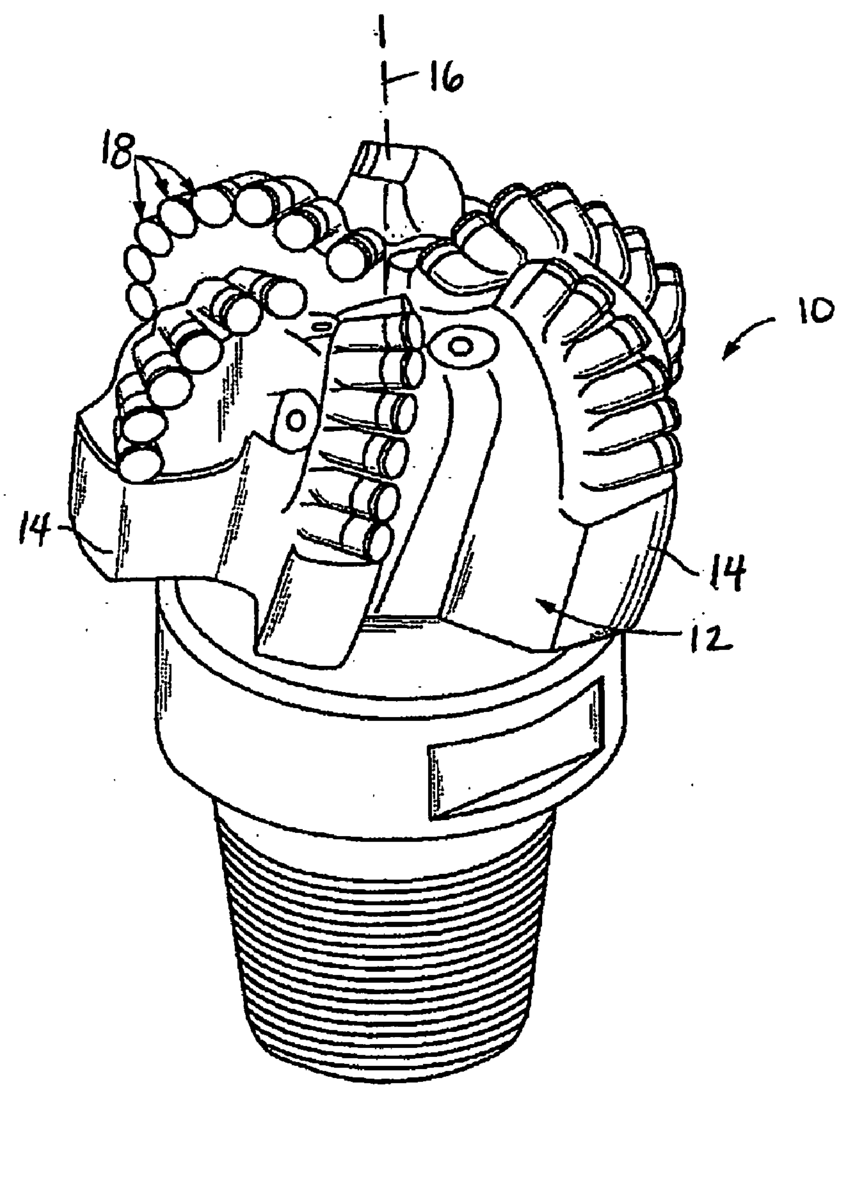
(57) **ABSTRACT**

A drill bit that includes a matrix bit body having a reinforcing overlay thereon and having at least one blade thereon; at least one cutter pocket disposed on the at least one blade; at least one cutter disposed in the at least one cutter pocket; and a braze material disposed between the at least one cutter and the at least one cutter pocket, wherein the reinforcing overlay comprises carbide particles and at least one binder and has a melting point greater than a melting point of the braze material is disclosed.



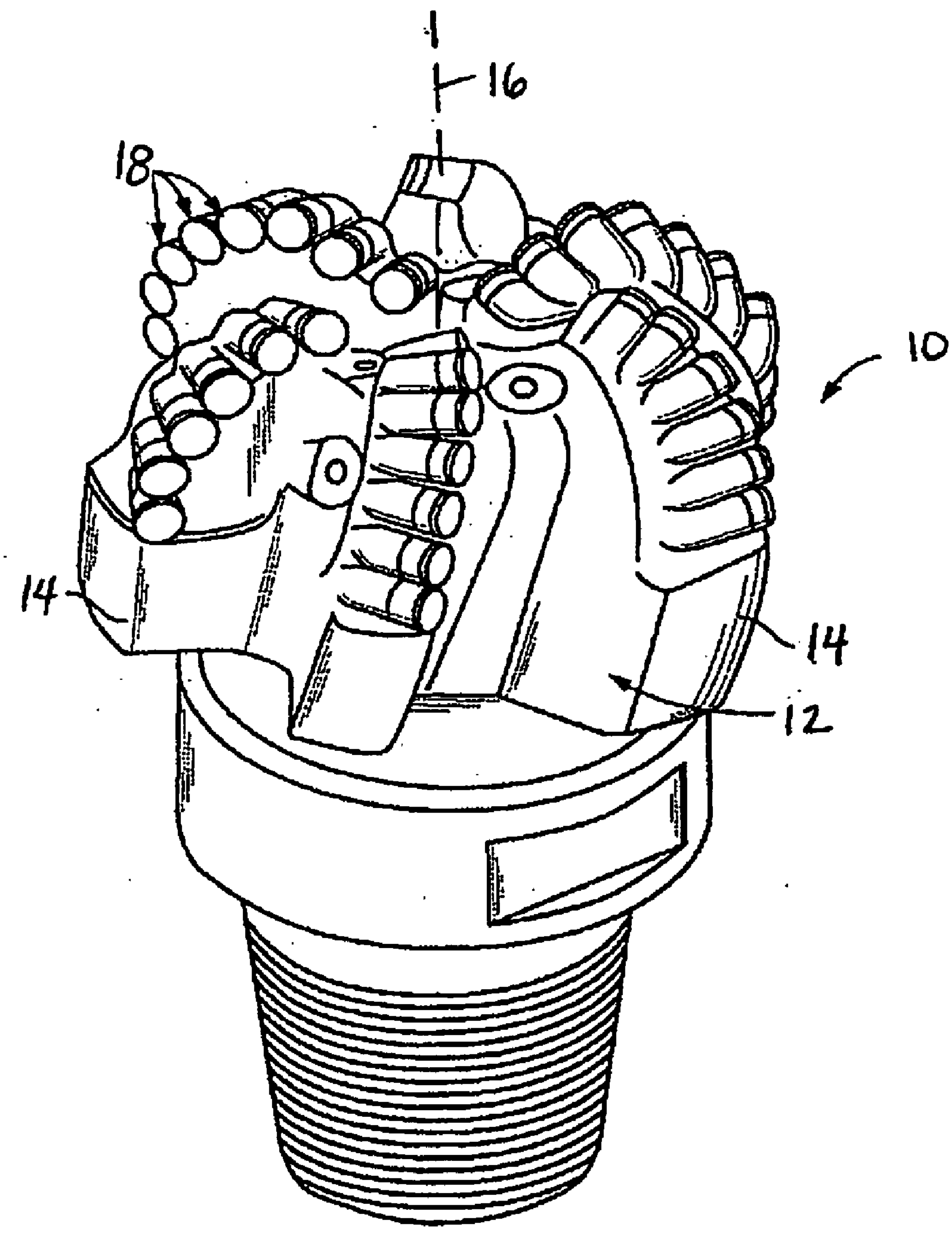


FIG. 1

REINFORCING OVERLAY FOR MATRIX BIT BODIES

BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] Embodiments disclosed herein relate generally to PDC bit bodies. In particular, embodiments disclosed herein relate generally to PDC matrix bit bodies having a reinforcing overlay disposed thereon.

[0003] 2. Background Art

[0004] Polycrystalline diamond compact ("PDC") cutters are known in the art for use in earth-boring drill bits. Typically, bits using PDC cutters include an integral bit body which may be made of steel or fabricated from a hard matrix material such as tungsten carbide (WC). A plurality of PDC cutters is mounted along the exterior face of the bit body in extensions of the bit body called "blades." Each PDC cutter has a portion which typically is brazed in a recess or pocket formed in the blade on the exterior face of the bit body.

[0005] The PDC cutters are positioned along the leading edges of the bit body blades so that as the bit body is rotated, the PDC cutters engage and drill the earth formation. In use, high forces may be exerted on the PDC cutters, particularly in the forward-to-rear direction. Additionally, the bit and the PDC cutters may be subjected to substantial abrasive forces. In some instances, impact, vibration, and erosive forces have caused drill bit failure due to loss of one or more cutters, or due to breakage of the blades.

[0006] As mentioned above, when designing a PDC bit, the bit body may be selected from a steel bit body and a matrix bit body. While steel body bits may have toughness and ductility properties which make them resistant to cracking and failure due to impact forces generated during drilling, steel is more susceptible to erosive wear caused by high-velocity drilling fluids and formation fluids which carry abrasive particles, such as sand, rock cuttings, and the like. Thus, steel body PDC bits are generally coated with a more erosion-resistant material, such as tungsten carbide, to improve their erosion resistance.

[0007] Typically, a hardfacing material is applied, such as by arc or gas welding, to the exterior surface of the drill bit to protect the bit against erosion and abrasion, such as by techniques described U.S. Pat. No. 6,601,475, which is herein incorporated by reference in its entirety. Hardfacing is typically applied to the bit prior to brazing of the cutters to the to the bit body. The hardfacing material typically includes one or more metal carbides, which are bonded to the steel body by a metal alloy ("binder alloy"), which is typically a steel alloy. In effect, the carbide particles are suspended in a matrix of steel forming a layer on the surface of the steel substrate. The carbide particles give the hardfacing material hardness and wear resistance, while the matrix metal provides fracture toughness to the hardfacing. Some typical methods of application of hardfacing include various welding techniques, high velocity cold spray methods, plasma spray and other thermal spray techniques. As improvements in hardfacing materials and application techniques have been made, hardfacing materials used on steel bit bodies generally exhibit better erosion and abrasion resistance than the matrix material used in matrix bit bodies. Hardfacing materials have also been applied in localized regions of a bit body, such as, for example, in the area surrounding the cutter pocket described in U.S. Pat. No. 6,772,849, which is herein incorporated by reference in its entirety.

[0008] In current bit design practices, over seventy five percent of PDC bits are made from matrix bit bodies, mainly because a matrix bit body offers superior erosion resistance as compared to hardfaced steel bodies. With the advent of improved hardfacing materials, the hardfacing materials used on steel bit bodies exhibit better erosion and abrasion resistance as compared to the matrix material itself. However, one of the primary issues concerning hardfacing of steel body bits is the bonding and coverage of the hardfacing material in between pockets and the base of the pockets. During drilling, fluids seep under the hardfacing and erode the steel body. In some instances, because of poor bonding and lack of support, hardfacing material chips off from the surfaces exposing the steel. Thus, difficulties in obtaining good and uniform coverage of the bit body are readily apparent and result in significant erosion of the material, especially in the area surrounding the cutters and cutter pockets.

[0009] Further, many hardfacing materials used are relatively hard and brittle. During use of hardfaced bits, a thin coating of the erosion-resistant material may crack, peel off or wear, exposing the softer steel body which is then rapidly eroded. This can lead to loss of PDC cutters as the area around the cutter is eroded away, causing the bit to fail. Due to the high failure rates caused by the undercutting of the steel body and poor coverage of hardfacing near and between the cutter pockets, a typical steel body bit generally achieve only 1-2 runs per bit.

[0010] The matrix bit body generally is formed by packing a graphite mold with tungsten carbide powder and then infiltrating the powder with a molten copper-based alloy binder. For example, macrocrystalline tungsten carbide and cast tungsten carbide have been used to fabricate bit bodies. Macrocrystalline tungsten carbide is essentially stoichiometric WC which is, for the most part, in the form of single crystals. Some large crystals of macro-crystalline WC are bi-crystals. Carburized tungsten carbide has a multi-crystalline structure, i.e., they are composed of WC agglomerates. Cast tungsten carbide, on the other hand, is formed by melting tungsten metal (W) and tungsten monocarbide (WC) together such that a eutectic composition of WC and W_2C, or a continuous range of compositions therebetween, is formed. Cast tungsten carbide typically is frozen from the molten state and comminuted to a desired particle size.

[0011] A third type of tungsten carbide, which has been typically used in hardfacing, is cemented tungsten carbide, also known as sintered tungsten carbide. Sintered tungsten carbide comprises small particles of tungsten carbide (e.g., 1 to 15 microns) bonded together with cobalt. Sintered tungsten carbide is made by mixing organic wax, tungsten carbide and cobalt powders, pressing the mixed powders to form a green compact, and "sintering" the composite at temperatures near the melting point of cobalt. The resulting dense sintered carbide can then be crushed and comminuted to form particles of sintered tungsten carbide for use in hardfacing.

[0012] Bit bodies formed from either cast or macrocrystalline tungsten carbide or other hard metal matrix materials, while more erosion resistant than steel, lack toughness and strength, thus making them brittle and prone to cracking when subjected to impact and fatigue forces encountered during drilling. This can result in one or more blades breaking off the bit causing a catastrophic premature bit failure. Additionally, the braze joints between the matrix material and the PDC cutters may crack due to these same forces. The formation and propagation of cracks in the matrix body and/or at the braze joints may result in the loss of one or more PDC cutters. A lost cutter may abrade against the bit, causing further accelerated bit damage. However, bits formed with sintered tungsten carbide may have sufficient toughness and strength for a particular application, but may lack other mechanical properties, such as erosion resistance.

[0013] In designing matrix bit bodies, there is often a compromise between achieving good wear resistance/hardness and toughness because wear resistance/hardness and toughness tend to be inversely related. Efforts to enhance one property usually result in a trade-off of the other. Thus, it is difficult to achieve both good wear resistance (especially erosion resistance) in demanding applications while maintaining adequate toughness. To provide adequate toughness for many applications, erosion of the matrix bit body will generally minimize the life of a matrix bit body to 1-3 runs per bit by reducing the capability to rebuild the bit. Additionally, another issue surrounding the use of matrix bit bodies involves cracking of the bit body that can result from the multiple heat cycles that a bit must undergo during brazing. Furthermore, hardfacing materials which have been conventionally applied to steel bit bodies to improve wear/erosion resistance have never been extended to matrix bit bodies because the difference in the substrate material, i.e., matrix material, has always been thought to prevent adhesion/bonding of the hardfacing materials to the matrix body substrate.

[0014] Accordingly, there exists a need for a new matrix body which has high strength and toughness, resulting in improved ability to retain blades and cutters, while maintaining other desired properties such as wear and erosion resistance.

SUMMARY OF INVENTION

[0015] In one aspect, embodiments disclosed herein relate to a drill bit that includes a matrix bit body having a reinforcing overlay thereon and having at least one blade thereon; at least one cutter pocket disposed on the at least one blade; at least one cutter disposed in the at least one cutter pocket; and a braze material disposed between the at least one cutter and the at least one cutter pocket, wherein the reinforcing overlay comprises carbide particles and at least one binder and has a melting point greater than a melting point of the braze material.

[0016] In another aspect, embodiments disclosed herein relate to a drill bit that includes a matrix bit body having a reinforcing overlay thereon and having at least one blade thereon; at least one cutter pocket disposed on the at least one blade; at least one cutter disposed in the at least one cutter pocket; and a braze material disposed between the at least one cutter and the at least one cutter pocket, wherein the reinforcing overlay comprises carbide particles and at least one binder and has a hardness greater than about 50 HRc.

[0017] In yet another aspect, embodiments disclosed herein relate to a method of forming a drill bit that includes forming a matrix bit body having at least one blade thereon, wherein the at least one blade has at least one cutter pocket disposed thereon; applying a reinforcing overlay to the formed matrix bit body; and brazing at least one cutter in the at least one cutter pocket with a braze material.

[0018] Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0019] FIG. **1** is an illustration of a PDC drill bit.

DETAILED DESCRIPTION

[0020] In one aspect, embodiments disclosed herein relate to a matrix bit body for a fixed cutter or PDC drill bit having a reinforcing overlay disposed thereon. Referring to FIG. **1**, a fixed cutter drill bit **10** has a matrix bit body **12** on which a reinforcing overlay may be disposed (not shown). The lower face of the bit body **12** is formed with a plurality of blades **14**, which extend generally outwardly away from a central longitudinal axis of rotation **16** of the drill bit. A plurality of PDC cutters **18** are disposed side by side along the length of each blade. The number of PDC cutters **18** carried by each blade may vary. The PDC cutters **18** are individually brazed to a stud-like carrier (or substrate), which may be formed from tungsten carbide, and are received and secured (brazed) within sockets in the respective blade.

[0021] Matrix Bit Bodies

[0022] As described above, a matrix bit body may include tungsten carbide particles may be surrounded by a metallic binder. The matrix bit body may be formed, for example, by packing a graphite mold with tungsten carbide powder and then infiltrating the powder with a molten binder. Among the types of tungsten carbide particles used in the fabrication of the bit body, those generally used include, for example, macrocrystalline tungsten carbide, cast tungsten carbide, carburized tungsten carbide, and cemented or sintered tungsten carbide.

[0023] In an infiltrated bit body, the metallic binder surrounding the tungsten carbide particles may be formed from a metallic binder powder and an infiltration binder. The metallic binder powder may be pre-blended with the matrix powder hard carbide particles, which is then is infiltrated by an infiltration binder. The term "infiltration binder" herein refers to a metal or an alloy used in an infiltration process to bond the various particles of tungsten carbide forms together. Suitable metals include all transition metals, main group metals and alloys thereof. For example, copper, nickel, iron, and cobalt may be used as the major constituents in the infiltration binder. Other elements, such as aluminum, manganese, chromium, zinc, tin, silicon, silver, boron, and lead, may also be present in the infiltration binder. In one embodiment, the infiltration binder is selected from at least one of nickel, copper, and alloys thereof. In another embodiment, the infiltration binder includes a Cu—Mn—Ni—Zn alloy. Such matrix bit bodies may have, for example, a hardness ranging from 38-45 HRc, a fracture toughness of at least 20 ksi(in$^{0.5}$), and a transverse rupture strength of at least 120 ksi in one embodiment and ranging from about 130 to 180 in another embodiment.

[0024] In one embodiment, the matrix powder comprises a mixture of tungsten carbides and a metallic binder powder. In a particular embodiment, nickel and/or iron powder may be present as the balance of the matrix powder, typically from about 2% to 12% by weight. In addition to nickel and/or iron, other Group VIIIB metals such as cobalt and various alloys may also be used. For example, it is expressly within the scope of the present invention that Co and/or Ni is present as the balance of the mixture in a range of about 2% to 15% by weight. Metal addition in the range of about 1% to about 15% may yield higher matrix strength and toughness, as well as higher braze strength.

[0025] The matrix powder mixture may include at least 80% by weight carbide of the total matrix powder. While reference is made to tungsten carbide, other carbides of Group 4a, 5a, or 6a metals may be used. Although the total carbide may be used in an amount less than 80% by weight of the matrix powder, such matrix bodies may not possess the desired physical properties to yield optimal performance.

[0026] The amount of the metallic binder and carbide hard particles in forming the matrix body may range, in one embodiment, in a ratio of from 30:70 to 40:60 by volume (binder:carbide). In other embodiments, the total carbide may be used in an amount less than 60% by volume or greater than 70% by volume of the matrix body, such matrix bodies may also not possess the desired physical properties to yield optimal performance.

[0031] In one embodiment, the carbide content in the reinforcing overlay may vary from about 40 to 80 weight percent, with a binder alloy constituting the balance of the reinforcing overlay. Binder alloys that may be used in various embodiments disclosed herein may include Ni and Co. In other embodiments, the binder alloy may include Group VIII metals such as Co, Ni, Fe, alloys thereof, or mixtures thereof. By applying a reinforcing overlay comprised of a binder alloy, such as Ni- or Co-based alloys, to a matrix bit body having a composition as disclosed herein, with the present inventors have advantageously discovered that the combination of the particular binder and matrix body composition provides adequate adhesion/bonding of the reinforcing overlay to the matrix substrate. As shown in Table 1 below, various examples of reinforcing overlays suitable for use in the present disclosure are listed.

Coating	Composition	Method of Application	Hardness (HRc)	Melting or Fusion Point
Deloro Stellite 50	WC/NiCrFeSiBC	Spray fused/laser cladded	49–52	M: ~1063° C.
D-Gun 2040	WC/CoC	Super D-Gun	64–69	—
Colmonoy 750	WC/NiWCrCoSiFeB	Flame sprayed/laser cladded	58–63	F: ~1060° C.
GHF5	WC/CoCrNiBSi	Flame sprayed/oxy-acetylene welded	63–70	—
Praxair LW-1N30	WC/Co	D-Gun	70–72	—

[0027] While reference has been made to forming the matrix bit bodies disclosed herein by an infiltration process, no limitation is intended by such description. Rather, it is specifically within the scope of the present invention that a matrix bit body formed by any technique, including for example hot pressing or casting, as described in U.S. Patent Publication No. 2005/0247491, which is herein incorporated by reference in its entirety, may be used in conjunction with the reinforcing overlays disclosed herein.

[0028] Reinforcing Overlay

[0029] The reinforcing overlay that may be disposed on the matrix bit body according to various embodiments disclosed herein may include particles of tungsten carbide or other wear resistant particles (e.g., borides, nitrides, carbides or mixtures thereof) bonded to the matrix bit body by a metal alloy, which is also generally referred to as a binder alloy. In effect, the carbide particles are suspended in a matrix of metal forming a layer on the surface. The wear resistant particles give the reinforcing overlay hardness and wear resistance, while the matrix metal (or alloy) provides fracture toughness to the reinforcing overlay and contributes to the bonding between the reinforcing overlay and the matrix bit body.

[0030] Various types of tungsten carbide may be used in the reinforcing overlay, including cast tungsten carbide, macro-crystalline tungsten carbide, cemented tungsten carbide, and carburized tungsten carbide. One of ordinary skill in the art would recognize that the types, sizes, percentages of the various carbide particles may be varied depending on the properties desired in the reinforcing overlay for a particular application. In various embodiments, carbide combinations suitable for use in the reinforcing overlay disclosed herein may include those combinations described in U.S. Pat. Nos. 4,836,307, 5,791,422, 5,921,330, and 6,659,206, which are herein incorporated by reference in their entirety.

[0032] Many factors affect the durability of the reinforcing overlay in a particular application. These factors include the chemical composition and physical structure (size, shape, and particle size distribution) of the carbides, the chemical composition and microstructure of the matrix metal or alloy, and the relative proportions of the carbide materials to one another and to the matrix metal or alloy. While higher proportions of the wear-resistant particles will increase the wear resistance of the reinforcing overlay, unfortunately it decreases the fracture toughness of the hardfacing overlay and weakens the bonding between the reinforcing overlay and the underlying matrix body.

[0033] In one embodiment, the reinforcing overlay may have a hardness greater than that of the matrix bit body on which it is disposed. In other embodiments, the reinforcing overlay has a hardness of greater than about 50 HRc; from about 50 to 75 HRc in another embodiment; and greater than about 60, 65, and 70 HRc in various other embodiments. In another embodiment, the reinforcing overlay may have a strength greater than the strength of the matrix bit body on which the reinforcing overlay is disposed.

[0034] In some embodiments, the melting point of the reinforcing overlay may be selected in accordance with a particular process of manufacturing the matrix bit body having a reinforcing overlay thereon. That is, the melting point of the reinforcing overlay may be selected to be greater than that of the braze material used to secure the PDC cutting element to the matrix bit body if the reinforcing overlay is applied prior to brazing the cutting elements to the bit body, and conversely, less than the melting point of braze material if the reinforcing overlay is applied subsequent to the brazing of the cutting elements to the bit body. In a particular embodiment, the reinforcing overlay has a melting point greater than that of the braze material used to secure the PDC cutters to the matrix bit body. In another particular embodiment, the reinforcing overlay has a melting point greater than about 1000° C. In yet another particular embodiment, the reinforcing overlay has a melting point ranging from about 1050 to 1400° C.

[0035] The reinforcing overlay may be disposed on substantially all surfaces of the matrix bit body. The thickness of the reinforcing overlay may range from about 0.01 to 0.125 inches in one embodiment. One of skill in the art would recognize the thickness need not be uniform across all surfaces of the matrix bit body; rather, it is within the scope of the present invention that the thickness may be varied to optimize performance.

[0036] Additionally, while the described embodiments make reference to a single reinforcing overlay, no limitation is intended on the scope of the invention by such a description. In fact, during application of the reinforcing overlay, multiple layers of a reinforcing overlay may be applied to the bit body. If multiple layers of a reinforcing overlay are provided, one of ordinary skill in the art would recognize that compositions and resulting properties may be varied across the multiple layers to promote bonding and adhesion of the reinforcing overlay to the matrix body substrate.

[0037] Application of Reinforcing Overlay

[0038] The reinforcing overlay disclosed herein may be applied to the matrix bit body by using one of several various spraying techniques. In various particular embodiments, the reinforcing overlay may be applied by one of a d-gun, spray-and-fuse, or high velocity cold spray technique.

[0039] D-gun (detonation gun) coatings, such as, for example, those described in U.S. Pat. No. 5,535,838, which is herein incorporated by reference in its entirety, include those coatings applied by the use of a d-gun. The d-gun process includes gases, usually consisting of oxygen and a fuel gas mixture, that are fed into a barrel of the gun along with a charge of fine tungsten carbide-based powder. The gases and the resulting detonation wave heat and accelerate the powder as it moves down the barrel. The powder is entrained for a sufficient distance for it to be accelerated to a high velocity and for virtually all of the powder to become molten. A pulse of inert nitrogen gas is used to purge the barrel after each detonation. The process may be repeated many times per second. Each detonation results in the deposition of a coating material, a few microns thick on the surface of the matrix bit body. Additionally, although most coating materials are heated to temperatures well beyond their melting points, substrate temperatures generally remain very low. Thus, in various embodiments, a reinforcing overlay applied by a d-gun process may be applied either prior to or subsequent to brazing of the cutting elements to the bit body.

[0040] The high velocity cold spray, such as that described in U.S. Pat. No. 6,780,458, which is herein incorporated by reference in its entirety, involves a kinetic spray process that uses supersonic jets of compressed gas to accelerate near-room temperature powder particles at ultra high velocities. The unmelted particles, traveling at speeds between 500 to 1,500 m/sec plastically deform and consolidate on impact with their substrate to create a coating. The basis of the cold spray process is the gas-dynamic acceleration of particulates to supersonic velocities (500-1500 m/sec), and hence high kinetic energies, so that solid-state plastic deformation and fusion occur on impact to produce dense coatings without the feedstock material being significantly heated.

[0041] The spray-and-fuse process is a two-step process in which a powdered coating material is deposited by using either a combustion gun or plasma spray gun, and subsequently fused to the matrix body substrate using either a heating torch or a furnace, for example, to temperatures ranging from 700-1200° C. depending on the melting point of the overlay material. The coatings are usually made of nickel or cobalt self-fluxing alloys to which hard particles, such as tungsten carbide, may be added for increased wear resistance. A reinforcing overlay having the desired thickness may be formed by building up several layers at a rate of 0.005 to 0.030 inches per pass. Deposit thickness is controlled by the traverse speed of rotation (when done between centers on cylindrical parts), powder flow, and the number of layers applied.

[0042] Among other typical thermal spray process that may be used are high velocity oxy-fuel spraying (HVOF), high velocity air fuel spraying (HVAF), flame spray, plasma spray or other applicable process as known by one of ordinary skill in the art.

[0043] Among the welding techniques that may be used are an oxyacetylene welding process (OXY), plasma transferred arc (PTA), an atomic hydrogen welding (ATW), welding via tungsten inert gas (TIG), gas tungsten arc welding (GTAW) or other applicable processes as known by one of ordinary skill in the art.

[0044] While above embodiments make reference to tungsten carbide particles, no limitation is intended on the scope of the invention by such a description. It is specifically within the scope of the present invention that other "hard materials" such as metal oxides, metal nitrides, metal borides, other metal carbides, and alloys thereof may be used.

[0045] Advantageously, embodiments disclosed herein provides for a fixed cutter drill bit that may simultaneously achieve the inversely related properties of toughness and wear/erosion resistance. A matrix bit body that includes a reinforcing overlay disclosed herein may possess the benefits of a tough core, providing resistance to cracking, and a superior wear resistant surface. Furthermore, it is generally necessitated that conventional matrix body bits are designed by balancing toughness and wear/erosion resistance; however, the bits disclosed herein may allow for a matrix bit body having improved transverse strength and toughness with aggressive blade design, without the concern of blade failure by erosion or wear. The combination of the tough core and superior wear/erosion resistant exterior may allow faster rate of penetration, superior cutting element retention strength and durability due to the protected cutter surface by preventing erosion of the braze alloy and other areas surrounding the cutters, improved bit life due to minimal erosion of the bit body, and rebuildability of the bit.

[0046] While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

1. A drill bit, comprising:

a matrix bit body having a reinforcing overlay thereon and having at least one blade thereon;

at least one cutter pocket disposed on the at least one blade;

at least one cutter disposed in the at least one cutter pocket; and

a braze material disposed between the at least one cutter and the at least one cutter pocket, wherein the reinforcing overlay comprises carbide particles and at least one binder and has a melting point greater than a melting point of the braze material.

2. The drill bit of claim **1**, wherein the at least one binder comprises at least one of nickel, cobalt, iron, and alloys thereof.

3. The drill bit of claim **1**, wherein the reinforcing overlay has a hardness greater than about 50 HRc.

4. (canceled)

5. The drill bit of claim **1**, wherein the reinforcing overlay has a thickness ranging from about 0.010 to 0.125 inches.

6. The drill bit of claim **1**, wherein the matrix bit body comprises a matrix of tungsten carbide particles and a second binder.

7. The drill bit of claim **6**, wherein the second binder comprises at least one of nickel, cobalt, iron, and copper.

8. The drill bit of claim **6**, wherein the second binder comprises about 30 to 40 volume percent of the matrix bit body.

9. The drill bit of claim **1**, wherein the reinforcing overlay comprises a plurality of layers.

10. (canceled)

11. The drill bit of claim **1**, wherein the reinforcing overlay has a melting point greater than 1000° C.

12. A drill bit, comprising:

a matrix bit body having a reinforcing overlay thereon and having at least one blade thereon;

at least one cutter pocket disposed on the at least one blade;

at least one cutter disposed in the at least one cutter pocket; and

a braze material disposed between the at least one cutter and the at least one cutter pocket,

wherein the reinforcing overlay comprises carbide particles and at least one binder and has a hardness greater than about 50 KRc.

13. (canceled)

14. The drill bit of claim **12**, wherein the reinforcing overlay has a hardness ranging from about 50 to 75 HRc.

15. The drill bit of claim **12**, wherein the matrix bit body has a hardness ranging from about 38 to 45 HRc.

16. The drill bit of claim **12**, wherein the reinforcing overlay has a thickness ranging from about 0.010 to 0.125 inches.

17. The drill bit of claim **12**, wherein the matrix bit body comprises a matrix of tungsten carbide particles and a second binder.

18. The drill bit of claim **17**, wherein the second binder comprises at least one of nickel, cobalt, iron, and copper.

19. The drill bit of claim **17**, wherein the second binder comprises about 30 to 40 volume percent of the matrix bit body.

20. A method of forming a drill bit, comprising:

forming a matrix bit body having at least one blade thereon, wherein the at least one blade has at least one cutter pocket disposed thereon;

applying a reinforcing overlay to the formed matrix bit body; and brazing at least one cutter in the at least one cutter pocket with a braze material.

21. The method of claim **20**, wherein forming the matrix bit body comprises infiltrating a mold filled with carbide particles with a first binder.

22. The method of claim **20**, wherein forming the matrix bit body comprises hot-pressing carbide particles with a first binder.

23. The method of claim **20**, wherein applying the reinforcing overlay comprises using at least one of a spray-and-fuse, d-gun, HVOF, and high velocity cold spray.

24. The method of claim **20**, wherein the reinforcing overlay comprises carbide particLes and a second binder selected from at least one of nickel and cobalt.

25. The method of claim **20**, wherein the reinforcing overlay has a melting point greater than a melting point of the braze material.

26. The method of claim **20**, wherein the forming the matrix bit body and applying the reinforcing overlay occur simultaneously.

27. The method of claim **20**, wherein the applying the reinforcing overlay occurs prior to the brazing the at least one cutter.

28. The method of claim **20**, wherein the applying the reinforcing overlay occurs after the brazing at least one cutter.

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