Description

The present invention discloses a method for removing a top coating from a bond coating adhered to a substrate according to the precharacterizing portion of claim 1, and a method for removing a bond coating according to the precharacterizing features of claim 13.

This invention relates to the removal of coating materials, and specifically to the removal of abradable, wear resistant, and thermal barrier coating materials which have been applied by either sintering powder or fibers, or by plasma spraying, utilizing liquid jet erosion.

The DE-U-8 907 917.5 describes a method for removing a coating from a substrate in utilizing a liquid jet having means for directing the liquid jet, means for creating a sufficient pressure to remove the coating, means to provide the relative motion between the coating and the liquid jet and means for supplying the liquid.

Various types coatings and sintered materials are used in numerous applications, such as in gas turbine engines to increase efficiency and/or protect components from heat and wear. Types of materials include thermal barrier coatings, abrasive coatings, abradable seals, and hard facing; hereafter referred to as coatings.

Since excessive blade/case clearances and disc/vane clearances within turbine engines allow the escape of gases which decreases engine efficiency, an abradable seal can be applied to minimize the clearances between the rotating and the stationary components. Thermal barrier coatings can be utilized to provide protection against high temperatures, while abrasive coatings can be used to prevent detrimental rub interactions and hard facing can be used to reduce wear.

Some coatings are applied by plasma or flame spraying; introducing particles (usually powders) into a hot gas stream or flame (respectively) which causes the particles to splat onto the substrate surface where they adhere and build up as a coating. Application of particles (i.e. AB-1) or short wires (i.e. Feltmetal™) onto a substrate; by presintering or partial sintering and then brazing, can be used to produce abradable coatings comprised of bonded particles, wires, or powders and void spaces; while bond coats can be produced by plasma spraying or vapor deposition. Bond coats are usually used in plasma spray and vapor deposition applications; a bond coat being a layer of metallic composition applied to the substrate before the coating is applied. US-A-. 3,542,530, 3,676,085, 3,754,903, 3,879,831, 3,928,026, and 4,704,332, describe various coatings, while US-A-. 3,413,136, 4,055,705, and 4,321,311 describe application techniques.

A common characteristic of these types of coatings is that the coating strength (cohesive strength) is relatively low; plasma sprayed or partially sintered particles are not well bonded to each other and there is usually porosity present. The strength of the coating is less than that of the substrate.

During engine maintenance, these coatings must frequently be removed; a process difficult to reliably preform and which frequently results in substrate damage. Various techniques have been employed for the removal of coatings: machining, chemical stripping, machining followed by chemical stripping (see for example US-A-.4,339,282, and 4,425,185;),and grit blasting. For example, machining followed by chemical stripping requires that the component be held stationary while a machining tool removes the majority of the coating. A chemical solution, usually either a very strong acid or base, is then applied to the coating surface to disintegrate the remaining coating material. This technique requires extreme precision; without proper hardware alignment during machining damage to the substrate material occurs, while the chemical solution used tends to attack the substrate material. This process is also time consuming and labor intensive. Additionally, the chemical step, can produce hazardous waste. The individual processes of chemical stripping and machining also have the above described problems.

Another commonly used method, abrasive or grit blasting, also often results in damaged or destroyed components. This process consists of projecting abrasive particles in a compressed air stream against the coating. Since this technique requires immediate termination upon substrate exposure to prevent damage, it requires skilled operators.

Liquid jets above 68.95 MPa (10,000 psi), to the best of our knowledge, have not been utilized in the removal of coatings. Relatively low pressure liquid jets, 13.79 to 20.69 MPa (2,000 to 3,000 psi), have been applied in areas such as: cleaning applications, nuclear contamination removal, concrete scarifying, and barnacle and hull fouling removal, but not in an inorganic coating removal process.

Accordingly, an objective of this invention is to provide a convenient, cost effective, environmentally safe technique of removing coatings.

The method of the present invention for removing a top coating from a bond coating is defined in the characterizing portion of claim 1 and the method for removing the bond coating is defined in the characterizing portion of claim 13.

The present invention involves the removal of coatings utilizing a liquid jet erosion process. The liquid jet, while striking the coating at an angle, traverses the region, removing the coating. De-

pending on the liquid pressure, the liquid stream erodes the abradable seal/thermal barrier with virtually no damage to the bond coat (if present), or can remove both the abradable seal/thermal barrier and bond coat simultaneously without substrate damage.

The invention process can be used to remove plasma sprayed and sintered coatings whose cohesive strength is significantly less than that of the substrate.

The foregoing and other features and advantages of the present invention will become more apparent from the following description and accompanying drawings.

Fig. 1 is a basic embodiment of this invention.

Fig. 1A is a cross-section of Fig. 1 which reveals the various layers of the coating.

Fig. 2 shows the results of utilizing a liquid jet removal process at varying pressures.

The removal of coatings using current techniques is a difficult, inexact process. It requires skilled technicians, a substantial amount of time, expensive equipment, and frequently, the component is destroyed.

The removal of the coating, bond coat, or both without damage to the substrate material can be achieved with a liquid jet erosion technique; making it a viable alternative to the prior art.

As previously mentioned, this invention uses a liquid jet erosion process to remove coatings. Critical parameters (see Fig. 1) include the nozzle distance from the coating, and the liquid pressure. Depending on equipment and pressure constraints, the nozzle can be placed up to approximately 15.2 or even 30.5 cm (6 or even 12 inches) from the coating surface, however, lesser distances are preferred, with 6.35 to 19.0 mm (1/4 to 3/4 inch) especially preferred.

The angle between the liquid contact and the coating is a matter of preference. An angle of between 20° to 90° can be used, with an angle of between 30° and 90° preferred, and an angle of about 45° especially preferred (see Fig. 1). The angle, not a critical parameter, causes the liquid to remove the coating fragments from the region where the jet impacts the coating. The direction of rotation effects the fragment location post-removal. It is preferred to rotate the component such that the motion is toward the smallest angle formed between the liquid stream and the component. Although this is merely a matter of preference, this rotation directions helps to remove the fragments from the interaction zone thereby ensuring that they to do not interfere with the process.

The liquid stream can consist of any liquid having a viscosity between 0.25 mPa s (centipoise)and 5.00 mPa s (centipoise)at 25°C and 101.3 kPa (1 atm)and which will not damage the bond coat or substrate material, including water based liquids. Higher viscosity liquids tend to present flow problems with respect to spraying the liquid at high pressures, while lower viscosity liquids can be difficult to pressurize, possibly increasing equipment costs. Water, viscosity approximately 0.95 mPa s (centipoise) at 25°C and 101.3 kPa (1 atm), is preferred for reasons of cost and waste disposal. Although additives, such as wetting agents, or various chemicals which will degrade the coating without damaging the component, may also be useful.

A water jet pressure sufficient to remove the coating and/or the coating and the bond coat is required. Since pressures greater than about 413.7 MPa (60,000 psi)will damage most gas turbine substrate materials, lower pressures must be used. The optimum liquid Pressure ranges from about 137.9 MPa(20,000) to about 413.7 MPa. (60,000 psi), with about 172.4 MPa (25,000) to about 275.8 MPa (40,000 psi) preferred. The factors which determine the exact pressure required include the type of coating and if the coating is to be removed down to the bond coat or to the substrate. (see Fig. 1A; coating (1) and bond coat (2)). Exact pressures limits are also related to nozzle geometry and spacing, and to the specific substrate involved. In practice, the skilled artisan can readily determine the pressure which causes substrate damage and/or the pressure which causes bond coat removal and reduce this pressure to arrive at a suitable process pressure.

Fig. 2 shows the effects of varying pressures when using this invention. As the pressures decreased, from run (A) to (D), the amount of seal removed also decreases, to the point where the abradable seal/thermal barrier is removed with virtually no damage to the bond coat, (D).

This invention will be made clearer with reference to the following illustrative examples.

EXAMPLE 1

The following procedure is used to remove a plasma sprayed hard face coating, coating and bond coat, (consisting of 20 v/o of an 80 nickel, 20 chromium alloy, balance chromium carbide) from a substrate material.

1. The coated substrate material is arranged such that relative motion can be produced between it and the water jet nozzle.
2. The water jet nozzle is placed so that the exit end of the nozzle is about 6.35 mm (1/4 inch)-from the coating and the water stream contacts the coating at an angle of 45° (refer to Fig. 1).
3. The water pressure is 275.8 MPa (40,000 psi).

4. Relative motion is created between the water stream and the coating such that as the coating is removed the component advances to the next region to be removed.
5. The removal time is dependant upon the surface area of the coating. The time will range from 5 minutes to 10 minutes for typical gas turbine engine components.

EXAMPLE 2

A sintered abradable coating (consisting of approximately 65 v/o nickel, 35 v/o chrome, balance aluminum) can be removed by following the specifications set forth in Example 1, while substituting a pressure of 241.3 MPa (35,000 psi) for the 275.8 MPa (40,000 psi) in step 4.

This process can be used for any coating which has strength less than that of the substrate, by adjusting the pressure such that it removes the coating without bond coat damage, or the bond coat without substrate damage.

Although this invention has been shown and described with respect to detailed embodiments thereof, it will be understood by those skilled in the art that various changes in form and detail thereof may be made without departing from scope of the claimed invention.

Claims

1. A method for removing a top coating from an underlying bond coating adhered to a substrate, utilizing a liquid jet, said liquid jet having means for directing the liquid, means for creating sufficient pressure to remove the coating, means to provide the relative motion between the coating and the liquid jet, and means for supplying the liquid, which comprises:
   a) supplying the liquid at a sufficient pressure to remove the coating;
   b) providing relative motion between the coating and the liquid jet,
   characterized in that the liquid jet strikes the top coating at a pressure sufficient to remove the top coating until the bond coating is exposed, whereby the bond coating and the substrate material suffer essentially no damage and can be reused.

2. A method as in claim 1 characterized in that the top coat is selected from the group of plasma sprayed, flame sprayed, and sintered coatings.

3. A method as in claim 1 characterized in that the top coat is an abradable material.

4. A method as in claim 1 characterized, in that the top coating is a thermal barrier.

5. A method as in claim 1 characterized in that the top coating is an abrasive material.

6. A method as in claim 1 characterized in that the top coating is a hard facing material.

7. A method as in claim 1 characterized in that the liquid pressure is from 137.9 MPa (20,000 psi) to 413.7 MPa (60,000 psi).

8. A method as in claim 1 characterized in using a nozzle as the means for directing the liquid flow.

9. A method as in claim 1 characterized in that the liquid is selected from the group of liquids consisting of all liquid which does not degrade the bond coating, and has a viscosity between 0.25 mPa s (centipoise) and 5.00 mPa s (centipoise) at 25 °C and 101,3 kPa (1 atm).

10. A method as in claim 1 characterized in that the liquid is selected from the group consisting of water based liquids.

11. A method as in claim 1 characterized in that the liquid is essentially water.

12. A method as in claim 1 characterized in that the angle between the liquid stream and the top coating is between 20° and 70°; whereby the angle causes the liquid stream to clean away the coating fragments.

13. A method for removing a bond coating utilizing a liquid jet, said liquid jet having means for directing the liquid jet, means for creating sufficient pressure to remove the bond coating, means to provide the relative motion between the bond coating and the liquid jet, and means for supplying the liquid jet, which comprises:
   a) supplying the liquid jet at a sufficient pressure to remove the bond coating;
   b) providing relative motion between the bond coating and the liquid jet, characterized in that the liquid jet strikes the bond coating at a pressure of above about 137.9 MPa to remove the bond coating until the substrate material is exposed whereby the substrate material suffers essentially no damage.

14. A method as in claim 13 characterized in that the bond coat is produced using a method selected from the group consisting of plasma

4. Relative motion is created between the water stream and the coating such that as the coating is removed the component advances to the next region to be removed.
5. The removal time is dependant upon the surface area of the coating. The time will range from 5 minutes to 10 minutes for typical gas turbine engine components.

EXAMPLE 2

A sintered abradable coating (consisting of approximately 65 v/o nickel, 35 v/o chrome, balance aluminum) can be removed by following the specifications set forth in Example 1, while substituting a pressure of 241.3 MPa (35,000 psi) for the 275.8 MPa (40,000 psi) in step 4.

This process can be used for any coating which has strength less than that of the substrate, by adjusting the pressure such that it removes the coating without bond coat damage, or the bond coat without substrate damage.

Although this invention has been shown and described with respect to detailed embodiments thereof, it will be understood by those skilled in the art that various changes in form and detail thereof may be made without departing from scope of the claimed invention.

Claims

1. A method for removing a top coating from an underlying bond coating adhered to a substrate, utilizing a liquid jet, said liquid jet having means for directing the liquid, means for creating sufficient pressure to remove the coating, means to provide the relative motion between the coating and the liquid jet, and means for supplying the liquid, which comprises:
   a) supplying the liquid at a sufficient pressure to remove the coating;
   b) providing relative motion between the coating and the liquid jet,
   characterized in that the liquid jet strikes the top coating at a pressure sufficient to remove the top coating until the bond coating is exposed, whereby the bond coating and the substrate material suffer essentially no damage and can be reused.

2. A method as in claim 1 characterized in that the top coat is selected from the group of plasma sprayed, flame sprayed, and sintered coatings.

3. A method as in claim 1 characterized in that the top coat is an abradable material.

4. A method as in claim 1 characterized, in that the top coating is a thermal barrier.

5. A method as in claim 1 characterized in that the top coating is an abrasive material.

6. A method as in claim 1 characterized in that the top coating is a hard facing material.

7. A method as in claim 1 characterized in that the liquid pressure is from 137.9 MPa (20,000 psi) to 413.7 MPa (60,000 psi).

8. A method as in claim 1 characterized in using a nozzle as the means for directing the liquid flow.

9. A method as in claim 1 characterized in that the liquid is selected from the group of liquids consisting of all liquid which does not degrade the bond coating, and has a viscosity between 0.25 mPa s (centipoise) and 5.00 mPa s (centipoise) at 25 °C and 101,3 kPa (1 atm).

10. A method as in claim 1 characterized in that the liquid is selected from the group consisting of water based liquids.

11. A method as in claim 1 characterized in that the liquid is essentially water.

12. A method as in claim 1 characterized in that the angle between the liquid stream and the top coating is between 20° and 70°; whereby the angle causes the liquid stream to clean away the coating fragments.

13. A method for removing a bond coating utilizing a liquid jet, said liquid jet having means for directing the liquid jet, means for creating sufficient pressure to remove the bond coating, means to provide the relative motion between the bond coating and the liquid jet, and means for supplying the liquid jet, which comprises:
   a) supplying the liquid jet at a sufficient pressure to remove the bond coating;
   b) providing relative motion between the bond coating and the liquid jet, characterized in that the liquid jet strikes the bond coating at a pressure of above about 137.9 MPa to remove the bond coating until the substrate material is exposed whereby the substrate material suffers essentially no damage.

14. A method as in claim 13 characterized in that the bond coat is produced using a method selected from the group consisting of plasma

spraying and vapor deposition.

15. A method as in claim 13 characterized in that the liquid pressure is from 137.9 MPa (20,000 psi) to 413.7 MPa (60,000 psi).

16. A method as in claim 13 characterized in using a nozzle as the means for directing the liquid stream.

17. A method as in claim 13 characterized in that the liquid is selected from the group consisting of all liquids which do not damage the substrate material, and which have a viscosity between 0.25 mPa s (centipoise) and 5.00 mPa s (centipoise) at 25 °C and 101.3 kPa (1 atm).

18. A method as in claim 13 characterized in that the liquid is selected from the group of water base liquids.

19. A method as in claim 13 characterized in that the liquid is water.

20. A method as in claim 13 characterized in that the angle between the liquid jet and the bond coating is between 20° and 70°; whereby the angle causes the liquid jet to clean away the bond coat fragments.

21. An article obtainable by the method of claim 1 said article having a bond coating whereby the bond coating is exposed after the removal of the abradable coating, wherein the substrate and the bond coating are essentially undamaged and reusable.

22. An article obtainable by the method of claim 1 said article having a bond coating, whereby the bond coating is exposed after the removal of the thermal barrier coating, wherein the substrate and the bond coating are essentially undamaged and reusable.

23. An article obtainable by the method of claim 1, said article having a bond coating, whereby the bond coating is exposed after the removal of the abrasive coating, wherein the substrate and the bond coating are essentially undamaged and reusable.

24. An article obtainable by the method of claim 1, said article having a bond coating whereby the bond coating is exposed after the removal of the hard face coating, wherein the substrate and the bond coating are essentially undamaged and reusable.

Patentansprüche

1. Verfahren zum Entfernen eines Decküberzugs von einem darunter gelegenen Verbindungsüberzug, der an einem Substrat haftet, unter Verwendung eines Flüssigkeitsstrahls, wobei der Flüssigkeitsstrahl eine Einrichtung hat zum Richten der Flüssigkeit, eine Einrichtung zum Erzeugen von ausreichendem Druck zum Entfernen des Überzugs, eine Einrichtung zum Erzeugen der Relativbewegung zwischen dem Überzug und dem Flüssigkeitsstrahl und eine Einrichtung zum Zuführen der Flüssigkeit, durch:
   a) Zuführen der Flüssigkeit mit einem ausreichenden Druck zum Entfernen des Überzugs;
   b) Erzeugen der Relativbewegung zwischen dem Überzug und dem Flüssigkeitsstrahl,
   dadurch gekennzeichnet, daß der Flüssigkeitsstrahl auf den Decküberzug mit einem Druck auftrifft, der ausreicht, um den Decküberzug zu entfernen, bis der Verbindungsüberzug freigelegt ist, wodurch der Verbindungsüberzug und das Substratmaterial im wesentlichen keine Beschädigung erleiden und wiederverwendet werden können.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Decküberzug aus der Gruppe von plasmagespritzten, flammgespritzten und gesinterten Überzügen ausgewählt wird.

3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Decküberzug ein abschleifbares Material ist.

4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Decküberzug eine Wärmesperre ist.

5. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Decküberzug ein abschleifbares Material ist.

6. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Decküberzug ein hartes Deckschichtmaterial ist.

7. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Flüssigkeitsdruck von 137,9 MPa (20000 psi) bis 413,7 MPa (60000 psi) reicht.

8. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß eine Düse als die Einrichtung zum Richten der Flüssigkeitsströmung benutzt wird.

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9. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Flüssigkeit aus der Gruppe von Flüssigkeiten, die alle Flüssigkeiten umfaßt, welche den Verbindungsüberzug nicht angreifen, ausgewählt wird und eine Viskosität zwischen 0,25 mPa s (Centipoise) und 5,0 mPa s (Centipoise) bei 25 °C und 101,3 kPa (1 atm) hat.

10. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Flüssigkeit aus der Gruppe ausgewählt wird, die aus Flüssigkeiten auf Wasserbasis besteht.

11. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Flüssigkeit im wesentlichen Wasser ist.

12. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Winkel zwischen dem Flüssigkeitsstrom und dem Decküberzug zwischen 20° und 70° liegt, wodurch der Winkel den Flüssigkeitsstrom veranlaßt, die Überzugsfragmente mit sich vorzunehmen.

13. Verfahren zum Entfernen eines Verbindungsüberzugs unter Verwendung eines Flüssigkeitsstrahls, wobei der Flüssigkeitsstrahl eine Einrichtung hat zum Richten des Flüssigkeitsstrahls, eine Einrichtung zum Erzeugen von ausreichendem Druck zum Entfernen des Verbindungsüberzugs, eine Einrichtung zum Erzeugen der Relativbewegung zwischen dem Verbindungsüberzug und dem Flüssigkeitsstrahl und eine Einrichtung zum Zuführen des Flüssigkeitsstrahls, durch:

a) Zuführen des Flüssigkeitsstrahls mit einem ausreichenden Druck zum Entfernen des Verbindungsüberzugs;

b) Erzeugen der Relativbewegung zwischen dem Verbindungsüberzug und dem Flüssigkeitsstrahl,

dadurch gekennzeichnet, daß der Flüssigkeitsstrahl auf den Verbindungsüberzug mit einem Druck von mehr als etwa 137,9 MPa auftrifft, um den Verbindungsüberzug zu entfernen, bis das Substratmaterial freigelegt ist, wodurch das Substratmaterial im wesentlichen keine Beschädigung erfährt.

14. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß der Verbindungsüberzug hergestellt wird, indem ein Verfahren benutzt wird, das aus der Gruppe ausgewählt wird, die aus Plasmaspritzen und Aufdampfen besteht.

15. Verfahren nach, Anspruch 13, dadurch gekennzeichnet, daß der Flüssigkeitsdruck von 137,9 MPa (20000 psi) bis 413,7 MPa (60000 psi) reicht.

16. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß eine Düse als die Einrichtung zum Richten des Flüssigkeitsstroms benutzt wird.

17. Verfahren nach Anspruch 13; dadurch gekennzeichnet, daß die Flüssigkeit aus der Gruppe ausgewählt wird, welche alle Flüssigkeiten umfaßt, die das Substratmaterial nicht beschädigen und die eine Viskosität zwischen 0,25 mPa s (Centipoise) und 5,0 mPa s (Centipoise) bei 25 °C und 101,3 kPa (1 atm) haben.

18. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß die Flüssigkeit aus der Gruppe ausgewählt wird, die aus Flüssigkeiten auf Wasserbasis besteht.

19. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß die Flüssigkeit Wasser ist.

20. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß der Winkel zwischen dem Flüssigkeitsstrahl und dem Verbindungsüberzug zwischen 20° und 70° liegt, wodurch der Winkel den Flüssigkeitsstrahl veranlaßt, die Verbindungsüberzugsfragmente mit sich vorzunehmen.

21. Gegenstand, der durch das Verfahren nach Anspruch 1 erzielbar ist, wobei der Gegenstand einen Verbindungsüberzug hat, wodurch der Verbindungsüberzug nach dem Entfernen des abschleifbaren Überzugs freiliegt, wobei das Substrat und der Verbindungsüberzug im wesentlichen unbeschädigt und wiederverwendbar sind.

22. Gegenstand, der durch das Verfahren nach Anspruch 1 erzielbar ist, wobei der Gegenstand einen Verbindungsüberzug hat, wodurch der Verbindungsüberzug nach dem Entfernen des Wärmesperrüberzugs freiliegt, wobei das Substrat und der Verbindungsüberzug im wesentlichen unbeschädigt und wiederverwendbar sind.

23. Gegenstand, der durch das Verfahren nach Anspruch 1 erzielbar ist, wobei der Gegenstand einen Verbindungsüberzug hat, wodurch der Verbindungsüberzug nach dem Entfernen des Abschleifüberzugs freiliegt, wobei das Substrat und der Verbindungsüberzug im wesentlichen unbeschädigt und wiederverwendbar sind.

24. Gegenstand, der durch das Verfahren nach Anspruch 1 erzielbar ist, wobei der Gegenstand einen Verbindungsüberzug hat, wodurch der Verbindungsüberzug nach dem Entfernen des harten Deckschichtüberzugs freiliegt, wobei das Substrat und der Verbindungsüberzug im wesentlichen unbeschädigt und wiederverwendbar sind.

Revendications

1. Un procédé pour éliminer un revêtement supérieur d'un revêtement de liaison sous jacent adhérant à un substrat, en utilisant un jet de liquide, ce jet de liquide comprenant un moyen pour diriger le liquide, un moyen pour créer une pression suffisante pour enlever le revêtement, un moyen pour fournir un mouvement relatif entre le revêtement et le jet de liquide, et un moyen pour fournir le liquide, qui comprend:
   a) fournir le liquide à une pression suffisante pour enlever le revêtement;
   b) réaliser un mouvement relatif entre le revêtement et le jet de liquide, caractérisé en ce que le jet de liquide heurte le revêtement supérieur jusqu'à ce que le revêtement de liaison soit exposé de sorte que le revêtement de liaison et la matière de substrat ne souffre pratiquement d'aucun dommage, et peuvent être réutilisés.

2. Procédé selon la revendication 1 caractérisé en ce que le revêtement supérieur est choisi dans le groupe comprenant les revêtements pulvérisés à l'arc plasma, pulvérisés à la flamme et frittés.

3. Procédé selon la revendication 1 caractérisé en ce que le revêtement supérieur est une matière abrasable.

4. Procédé selon la revendication 1 caractérisé en ce que le revêtement supérieur est une barrière thermique.

5. Procédé selon la revendication 1 caractérisé en ce que le revêtement supérieur est une matière abrasive.

6. Procédé selon la revendication 1 caractérisé en ce que le revêtement supérieur est une matière d'alliage d'apport.

7. Procédé selon la revendication 1 caractérisé en ce que la pression de liquide se situe entre 137.9 MPa (20,000 psi) et 413.7 MPa (60,000 psi).

8. Procédé selon la revendication 1 caractérisé en ce qu'on utilise une buse comme moyen pour diriger le courant de liquide.

9. Procédé selon la revendication 1 caractérisé en ce que le liquide est choisi dans le groupe de liquides consistant en tout liquide qui ne dégrade pas le revêtement de liaison et a une viscosité entre 0,25 mPa s (centipoise) et 5.00 mPa s (centipoise) à 25 °C et 101,3 kPa (1 atm).

10. Procédé selon la revendication 1 caractérisé en ce que le liquide est choisi dans le groupe consistant en liquide à base d'eau.

11. Procédé selon la revendication 1 caractérisé en ce que le liquide est essentiellement de l'eau.

12. Procédé selon la revendication 1 caractérisé en ce que l'angle entre le courant de liquide et le revêtement supérieur est entre 20 ° et 70 °; de sorte que l'angle a pour effet que le courant de liquide élimine par nettoyage tout fragment de revêtement.

13. Un procédé pour enlever un revêtement de liaison en utilisant un jet de liquide, ce jet de liquide comportant un moyen pour diriger le Jet de liquide, un moyen pour créer une pression suffisante pour enlever le revêtement de liaison, un moyen pour créer un mouvement relatif entre le revêtement de liaison et le jet de liquide, et un moyen pour fournir le jet de liquide, qui comprend:
   a) fournir le jet liquide à une pression suffisante pour éliminer le revêtement de liaison;
   b) créer un mouvement relatif entre le revêtement de liaison et le jet de liquide, caractérisé en ce que le jet de liquide heurte le revêtement de liaison à une pression supérieur à environ 137,9 MPa pour enlever le revêtement de liaison jusqu'à ce que la matière de substrat soit exposée de telle sorte que la matière de substrat ne subit essentiellement aucun dommage.

14. Procédé selon la revendication 13 caractérisé en ce que le revêtement de liaison est produit en utilisant un procédé choisi dans le groupe consistant en pulvérisation à l'arc plasma et dépôt de vapeur.

15. Procédé selon la revendication 13 caractérisé en ce que la pression du liquide est entre 137,9 MPa (20,000 psi) et 413,7 MPa (60,000 psi).

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16. Procédé selon la revendication 13 caractérisé en ce qu'on utilise une buse comme moyen pour diriger le courant de liquide.

17. Procédé selon la revendication 13 caractérisé en ce que le liquide est choisi dans le groupe consistant en tout liquide qui n'endommage pas la matière de substrat, et qui a une viscosité entre 0,25 mPa s (centipoise) et 5,00 mPa s (centipoise) à 25 °C et 101,3 kPa (1 atm).

18. Procédé selon la revendication 13 caractérisé en ce que le liquide est choisi dans le groupe des liquides à base d'eau.

19. Procédé selon la revendication 13 caractérisé en ce que le liquide est de l'eau.

20. Procédé selon la revendication 13 caractérisé en ce que l'angle entre le jet de liquide et le revêtement de liaison est entre 20 ° et 70 °; de sorte que l'angle a pour effet que le jet de liquide élimine par nettoyage les fragments de revêtement de liaison.

21. Article pouvant être obtenu par le procédé de la revendication 1, cet article comprenant un revêtement de liaison de sorte que le revêtement de liaison est exposé après l'enlèvement du revêtement abrasable, dans lequel le substrat et le revêtement de liaison ne sont essentiellement pas endommagés et réutilisables.

22. Un article pouvant être obtenu par le procédé de la revendication 1, cet article comprenant un revêtement de liaison de sorte que le revêtement de liaison est exposé après l'enlèvement du revêtement de barrière thermique de sorte que le substrat et le revêtement de liaison ne sont essentiellement pas endommagés et réutilisables.

23. Article pouvant être obtenu par le procédé de la revendication 1, cet article comprenant un revêtement de liaison de sorte que le revêtement de liaison est exposé après élimination du revêtement abrasif, de sorte que le substrat et le revêtement de liaison ne sont essentiellement pas endommagés et réutilisables.

24. Un article pouvant être obtenu par le revêtement de la revendication 1, cet article comportant un revêtement de liaison dans lequel le revêtement de liaison est exposé après enlèvement du revêtement d'alliage d'apport, de sorte que le substrat et le revêtement de liaison ne sont essentiellement pas endommagés et réutilisables.