CLAD HARDFACING APPLICATION ON DOWNHOLE CUTTING TOOLS

BACKGROUND

1. Field of the Invention

[0001] The present disclosure relates generally to the recovery of subterranean deposits and more specifically to methods and systems for milling materials in a well.

2. Description of Related Art

[0002] Wells are drilled at various depths to access and produce oil, gas, minerals, and other naturally-occurring deposits from subterranean geological formations. Hydrocarbons may be produced through a wellbore traversing the subterranean formations. The wellbore may be relatively complex and include, for example, one or more lateral branches extending at an angle from a parent or main wellbore. Forming lateral wellbores typically involves first creating a window in a casing or other metal tubing lining the main wellbore. A window mill or other milling tool may be used initiate and form the window. After the window is created, a drill bit may be passed through the window to form the lateral wellbore.

[0003] In additional to milling windows for lateral wellbore formation, milling tools may be used for many other downhole tasks, some of which include downhole cleaning functions, removal of plugs, debris removal, casing restoration, and other functions. Milling tools typically are used to cut through metallic objects or other materials that have been delivered into the wellbore. While milling tools may include hardened cutters or inserts to improve cutting performance and wear resistance, the hardened cutters often break free from the milling tools during use thereby causing quicker wear of the tool.

SUMMARY

[0003a] According to an aspect, there is provided a downhole milling tool comprising: a mill body; a plurality of mill blades radially extending from the mill body; and a cladding material coupled to at least one of the mill blades, wherein the coupling between the cladding material and the at least one of the mill blades includes a metallurgical bond.

[0003b] According to another aspect, there is provided a downhole milling tool for cutting non-geological materials in a well, the downhole milling tool comprising: a body having an elongated and substantially cylindrical wall defining an inner passage extending through a portion of the body; the body having a coupling end capable of being coupled to a working string to rotate the body; a plurality of blades extending radially outward from the body, each blade extending along a length of the body and being oriented substantially parallel to a

longitudinal axis of the body or being arranged in a spiral or helical configuration on the body; and a laser-deposited cladding material coupled to the plurality of blades, wherein the coupling between the cladding material and the at least one of the mill blades includes a metallurgical bond.

[0003c] According to an yet another aspect, there is provided a method of improving the wear resistance of downhole milling tool, the method comprising: coupling a cladding material to a blade of the downhole milling tool, wherein the coupling between the cladding material and the at least one of the mill blades includes a metallurgical bond.

CLAIMS

We claim:

Claim 1. A downhole milling tool comprising:

a mill body;

a plurality of mill blades radially extending from the mill body; and

a cladding material coupled to at least one of the mill blades, wherein the coupling between the cladding material and the at least one of the mill blades includes a metallurgical bond.

Claim 2. The downhole milling tool of claim 1, wherein the cladding material has a hardness of approximately 60 HRC.

Claim 3. The downhole milling tool of claim 1, further comprising:

a plurality of cutting inserts coupled to the cladding material.

Claim 4. The downhole milling tool of claim 3, wherein the coupling between the plurality of cutting inserts and the cladding material includes a metallurgical bond.

Claim 5. The downhole milling tool of claim 3, wherein a hardness of the plurality of cutting inserts is greater than a hardness of the cladding material.

Claim 6. The downhole milling tool of claim 3, wherein the plurality of cutting inserts have a hardness of approximately 60 HRC.

Claim 7. The downhole milling tool of claim 1, further comprising:

a plurality of cutting inserts coupled to the cladding material;

wherein each cutting insert is substantially cylindrical in shape and includes a scalloped cutting surface.

Claim 8. The downhole milling tool of claim 1, further comprising:

a plurality of cutting inserts coupled to the cladding material;

wherein each cutting insert is substantially cylindrical in shape and includes a cutting surface; and

wherein the cutting surface of at least one of the cutting inserts is located a distance from the at least one of the mill blades greater than a distance from the at least one of the mill blades to an outer surface of the cladding material.

Claim 9. The downhole milling tool of claim 1, further comprising:

a plurality of cutting inserts coupled to the cladding material;

wherein the cutting inserts are formed at least in part from tungsten carbide.

Claim 10. The downhole milling tool of claim 1, further comprising:

a plurality of cutting inserts coupled to the cladding material;

wherein the cutting inserts include crushed carbide elements that are size-screened with a mesh size of about 3/16 inch to about 1/4 inch.

Claim 11. The downhole milling tool of claim 1, further comprising:

a plurality of cutting inserts coupled to the cladding material;

wherein the cutting inserts include crushed carbide elements that are size-screened to ensure that each crushed carbide element includes a dimension between a first amount and a second amount;

wherein the first amount is approximately 3/16 inch; and

wherein the second amount is approximately 1/4 inch.

Claim 12. A downhole milling tool for cutting non-geological materials in a well, the downhole milling tool comprising:

a body having an elongated and substantially cylindrical wall defining an inner passage extending through a portion of the body; the body having a coupling end capable of being coupled to a working string to rotate the body;

a plurality of blades extending radially outward from the body, each blade extending along a length of the body and being oriented substantially parallel to a longitudinal axis of the body or being arranged in a spiral or helical configuration on the body; and

a laser-deposited cladding material coupled to the plurality of blades, wherein the coupling between the cladding material and the at least one of the blades includes a metallurgical bond.

Claim 13. The downhole milling tool of claim 12, wherein the cladding material is deposited on each of the plurality of blades in a substantially uniform thickness.

Claim 14. The downhole milling tool of claim 12, further comprising:

a plurality of cutting inserts coupled to the cladding material;

wherein each cutting insert is substantially cylindrical in shape; and

wherein the cladding material is deposited on each of the plurality of blades in a substantially uniform thickness.

Claim 15. The downhole milling tool of claim 12, further comprising:

a plurality of cutting inserts coupled to the cladding material;

wherein the cutting inserts include crushed carbide elements;

wherein at least a portion of the cutting inserts extend outward from the cladding material; and

wherein the cladding material is deposited on the blades in a non-uniform thickness.

Claim 16. The downhole milling tool of claim 1, wherein the downhole milling tool is one of a window mill, a watermelon mill, and a lead mill.

Claim 17. A method of improving the wear resistance of downhole milling tool, the method comprising:

coupling a cladding material to a blade of the downhole milling tool, wherein the coupling between the cladding material and the blade includes a metallurgical bond.

Claim 18. The method of claim 17, further comprising:

coupling cutting inserts to the cladding material such that at least a portion of the cutting inserts protrude from the cladding material.

Claim 19. The method of claim 18, wherein the coupling the cladding material to the blade and coupling the cutting inserts to the cladding material further comprises:

delivering the cladding material in a powder form adjacent the blade; and

melting the powder using a laser.