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; a laser-deposited cladding material coupled to at least one of the mill blades, wherein the laser-deposited cladding material has a hardness of approximately 60 HRC, wherein a first coupling between the laser-deposited cladding material and the at least one of the mill blades includes a metallurgical bond; and a plurality of cutting inserts coupled to the laser-deposited cladding material, wherein a second coupling between the plurality of cutting inserts and the laser-deposited cladding material 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; a laser-deposited cladding material coupled to each of the plurality of blades, wherein the laser-deposited cladding material has a hardness of approximately 60 HRC, and wherein a first coupling between the laser-deposited cladding material and each of the plurality of mill blades includes a metallurgical bond; and a plurality of cutting inserts coupled to the laser-deposited cladding material, wherein a second coupling between the plurality of cutting inserts and the laser-deposited cladding material includes a metallurgical bond.

[0003c] According to an yet another aspect, there is provided a method of improving the wear resistance of a downhole milling tool, the method comprising: laser-depositing a cladding material to a blade of the downhole milling tool to form a metallurgical bond between the cladding material and the blade, and wherein laser-depositing the cladding material hardens the cladding material to a hardness of at least 60 HRC, and forming a second metallurgical bond between a plurality of cutting inserts and the cladding material such that the plurality of cutting inserts protrude from the cladding material.

CLAIMS

We claim:

1. A downhole milling tool comprising:

a mill body;

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

a laser-deposited cladding material coupled to at least one of the mill blades, wherein the laser-deposited cladding material has a hardness of approximately 60 HRC, wherein a first coupling between the laser-deposited cladding material and the at least one of the mill blades includes a metallurgical bond; and

a plurality of cutting inserts coupled to the laser-deposited cladding material, wherein a second coupling between the plurality of cutting inserts and the laser-deposited cladding material includes a metallurgical bond.

2. The downhole milling tool of claim 1, wherein a first hardness of the plurality of cutting inserts is greater than a second hardness of the laser-deposited cladding material.

3. The downhole milling tool of claim 1, wherein the plurality of cutting inserts has a hardness of approximately 60 HRC.

4. The downhole milling tool of claim 1, wherein each cutting insert of the plurality of cutting inserts is substantially cylindrical in shape and includes a scalloped cutting surface.

5. The downhole milling tool of claim 1,

wherein each cutting insert of the plurality of cutting inserts is substantially cylindrical in shape and includes a cutting surface; and

wherein the cutting surface of at least one of the plurality of cutting inserts is located a distance from the mill blade greater than a distance from the mill blade to an outer surface of the laser-deposited cladding material.

6. The downhole milling tool of claim 1, wherein the plurality of cutting inserts are formed at least in part from tungsten carbide.

7. The downhole milling tool of claim 1, wherein the plurality of cutting inserts includes crushed carbide elements that are size-screened with a mesh size of about 3/16 inch to about ¼ inch.

8. The downhole milling tool of claim 1,

wherein the plurality of cutting inserts includes 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 ¼ inch.

9. 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;

a laser-deposited cladding material coupled to each of the plurality of blades,

wherein the laser-deposited cladding material has a hardness of approximately 60 HRC, and wherein a first coupling between the laser-deposited cladding material and each of the plurality of mill blades includes a metallurgical bond; and

a plurality of cutting inserts coupled to the laser-deposited cladding material,

wherein a second coupling between the plurality of cutting inserts and the laser-deposited cladding material includes a metallurgical bond.

10. The downhole milling tool of claim 9, wherein the laser-deposited cladding material is deposited on each of the plurality of blades in a substantially uniform thickness.

11. The downhole milling tool of claim 9,

wherein each cutting insert of the plurality of cutting inserts is substantially cylindrical in shape; and

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

12. The downhole milling tool of claim 9,

wherein the plurality of cutting inserts includes crushed carbide elements;

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

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

13. 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.

14. A method of improving the wear resistance of a downhole milling tool, the method comprising:

laser-depositing a cladding material to a blade of the downhole milling tool to form a metallurgical bond between the cladding material and the blade, and wherein laser-depositing the cladding material hardens the cladding material to a hardness of at least 60 HRC; and

forming a second metallurgical bond between a plurality of cutting inserts and the cladding material such that the plurality of cutting inserts protrude from the cladding material.