MULTI-LAYER COATING AND RELATED METHODS OF APPLICATION

BACKGROUND

Downhole oil and gas tools are often subject to harsh, corrosive or otherwise extreme downhole environments. Accordingly, metal pre-treatments, final treatments, finishings and coatings may be applied on downhole tool surfaces as protection.

SUMMARY OF THE INVENTION

In one aspect, embodiments disclosed herein relate to a downhole tools including a circumferential band comprising a plurality of axially adjacent weld beads forming a wear resistant surface along a particular axial length of an outer surface of the tool and at least one circumferential wear-resistant multi-layer coating applied axially adjacent the band on either end, the wear-resistant multi-layer coating including a first layer, exhibiting a first color, applied directly onto the outer surface of the tool, and a second layer, exhibiting a second color different from the first color, applied directly onto the first layer, wherein when the second layer wears or is removed by a certain amount, the first color of the first layer is revealed as an indication of the degree of wear.

In another embodiment a downhole tool is disclosed comprising a circumferential band comprising a plurality of axially adjacent weld beads forming a wear resistant surface along a particular axial length of an outer surface of the tool. The tool may have at least one circumferential wear-resistant multi-layer coating applied axially adjacent the band on either end. The coating comprises a first layer, applied directly onto the outer surface of the tool; a first color layer, exhibiting a first color, applied to said first layer; a second layer, exhibiting a second color different from the first color, applied directly onto the first color layer. When the second layer

wears or is removed by a certain amount, the first color of the first color layer is revealed as an indication of the degree of wear.

In other aspects, embodiments disclosed herein relate to a method of applying a wear-resistant multi-layer coating a portion of a circumferential wear band located along a particular axial length of an outer surface of a downhole tool, the wear band comprising a plurality of axially adjacent weld beads, the method including applying a first layer, the first layer exhibiting a first color, directly onto the outer surface of the downhole tool axially adjacent the band on either end, and applying a second wear-resistant layer, the second layer exhibiting a second color different from the first color, directly onto at least a portion of the wear band, wherein when the second wear-resistant layer wears or is removed by a certain amount, the first color of the first layer is revealed to indicate the degree of wear.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 illustrates one embodiment of a multi-layer coating on a downhole tool.

Figure 2 illustrates a cross-section view of multi-layer coatings on a downhole tool.

Figure 3 illustrates an embodiment using a build coat.

DETAILED DESCRIPTION

A multi-layer coating applied on various downhole tools, or any tools in any industry that may experience wear, and methods of applying the multi-layer coating on surfaces using, for example, thermal application methods such as spray, is disclosed. For example, downhole oil and gas drilling tool applications may include tools, e.g.,

What is claimed is:

1. A downhole tool comprising:

a circumferential band comprising a plurality of axially adjacent weld beads forming a wear resistant surface along a particular axial length of an outer surface of the tool; and

at least one circumferential wear-resistant multi-layer coating applied axially adjacent the band on either end, the wear-resistant multi-layer coating comprising:

a first layer, exhibiting a first color, applied directly onto the outer surface of the tool; and

a second layer, exhibiting a second color different from the first color, applied directly onto the first layer,

wherein when the second layer wears or is removed by a certain amount, the first color of the first layer is revealed as an indication of the degree of wear.

2. The downhole tool of claim 1, wherein the first layer comprises a thickness of at least one millimeter.

3. The downhole tool of claim 1, wherein the first layer is a material selected from the group consisting of an aluminum alloy composition, an aluminum oxide composition, and an aluminum bronze composition.

4. The downhole tool of claim 3, wherein the aluminum bronze composition comprises about 3% to about 12% aluminum by weight.

5. The downhole tool of claim 3, wherein the aluminum bronze composition comprises alloying agents selected from the group consisting of iron, nickel, manganese, silicon, chromium oxide silica, and titanium dioxide ceramics.

6. The downhole tool of claim 1, wherein the first layer is a non-magnetic material.

7. The downhole tool of claim 1, wherein the second layer comprises a thickness of at least five millimeters.

8. The downhole tool of claim 1, wherein the second layer is a material selected from the group consisting of Inconel, stainless, molybdenum, tungsten carbide, tungsten carbide alloys, chromium carbides, chromium oxide silica, and titanium dioxide ceramics.

9. The downhole tool of claim 1, wherein the multi-layer coating is configured to be applied to the surface of the drill collar by thermal spraying methods.

10. The downhole tool of claim 1, wherein the tool is configured as an imaging-while-drilling or logging-while-drilling drill collar.

11. The downhole tool of claim 1, wherein a thickness of the first layer is less than a thickness of the second layer.

12. The downhole tool of claim 1, wherein a thickness of the second layer is at least approximately five times a thickness of the first layer.

13. The downhole tool of claim 1, wherein the at least one circumferential multi-layer coating is applied on at least a portion of the band axially adjacent the end of the band.

14. The downhole tool of claim 1, wherein the tool is configured as a mandrel.

15. A downhole tool comprising:

a circumferential band comprising a plurality of axially adjacent weld beads forming a wear resistant surface along a particular axial length of an outer surface of the tool; and

at least one circumferential wear-resistant multi-layer coating applied axially adjacent the band on either end, the coating comprising:

a first layer, applied directly onto the outer surface of the tool;

a first color layer, exhibiting a first color, applied to said first layer;

a second layer, exhibiting a second color different from the first color, applied directly onto the first color layer,

wherein when the second layer wears or is removed by a certain amount, the first color of the first color layer is revealed as an indication of the degree of wear.

16. A method of applying a wear-resistant multi-layer coating on at least a portion of a circumferential wear band located along a particular axial length of an outer surface of a downhole tool, the wear band comprising a plurality of axially adjacent weld beads, the method comprising:

applying a first layer, the first layer exhibiting a first color, directly onto the outer surface of the downhole tool axially adjacent the band on either end; and

applying a second wear-resistant layer, the second layer exhibiting a second color different from the first color, directly onto at least a portion of the wear band,

wherein when the second wear-resistant layer wears or is removed by a certain amount, the first color of the first layer is revealed to indicate the degree of wear.

17. The method of claim 16, wherein applying the first or second layers further comprises melting metal in a stream of oxyacetylene flame, electric arc, or plasma arc, and spraying metal droplets on the outer surface of downhole tool at high velocities with a compressed-air spray gun.

18. The method of claim 16, further comprising cleaning and roughening the outer surface of the downhole tool prior to applying the first layer.

19. The method of claim 16, wherein applying the second layer further comprises mixing a coating of tungsten carbide with a polymer or fluoropolymer in a given volume percent ratio, forming a cloth-like sheet, and applying the cloth-like sheet directly onto the first layer.