[0048] The method of any preceding clause wherein the rejuvenated protective diffusion coating has a coating microstructure and a coating chemistry matching a first-time diffusion coating of the component prior to service in a turbine.

[0049] The method of any preceding clause further comprising inspecting the component for the presence of the contaminant, the method including alternating the subjecting the surface to laser beam pulses to remove the contaminant and the inspecting the component until all of the contaminant is removed from the component.

[0050] The method of any preceding clause wherein the laser beam pulses have an energy of equal to or less than 1 millijoule/pulse.

[0051] The method of any preceding clause wherein the laser beam pulses have a pulse length of 20 nanoseconds to 100 nanoseconds.

[0052] The method of any preceding clause wherein the laser beam pulses, upon impacting the surface of the component, provide a laser spot beam having a diameter of 75 μm to 95 μm.

[0053] The method of any preceding clause wherein the laser beam pulses provide an energy density in a range of 17,600 to 17,700 mJ/cm^2.

[0054] The method of any preceding clause wherein a laser emitting the pulsed laser beam has a frequency of 10 kHz to 250 kHz.

[0055] The method of any preceding clause wherein a laser emitting the pulsed laser beam has an output power of 50W to 1000 W.

[0056] A method for rejuvenating a superalloy component that has undergone service in a turbine at an elevated temperature, the superalloy component having a diffusion coating comprising an additive layer on a surface of the component and a diffusion zone in the surface of the component, the method comprising: removing a contaminant from the component by subjecting the component to laser beam pulses to remove the contaminant from the component such that the contaminant is removed without damaging or removing the diffusion zone of the diffusion coating creating an exposed portion of the diffusion zone or an exposed portion of the additive layer; applying an aluminide coating to the exposed portion of diffusion zone or the exposed portion of additive layer; and diffusion heat treating at a preselected elevated

temperature to form a rejuvenated protective aluminide coating on the superalloy component.

[0057] The method of any preceding clause wherein the rejuvenated protective aluminide coating has a coating microstructure and a coating chemistry matching the diffusion coating prior to having undergone service in a turbine.

[0058] The method of any preceding clause wherein the diffusion coating is an aluminide coating.

[0059] The method of any preceding clause wherein the laser beam pulses have (i) an energy of equal to or less than 1 millijoule/pulse, (ii) a pulse length of 20 nanoseconds to 100 nanoseconds, or (iii) provide an energy density in a range of 17,600 to 17,700 mJ/cm^2.

[0060] The method of any preceding clause further comprising, prior to applying the aluminide coating, selectively removing at least a portion of the additive layer by further subjecting the component to the laser beam pulses.

[0061] The method of any preceding clause further comprising, prior to applying the aluminide coating: inspecting the component to determine if removal of the contaminant and the portion of the additive layer is complete; and alternating the subjecting the component to the laser beam pulses and the inspecting the component until it is determined that the removal is complete.

[0062] The method of any preceding clause wherein subjecting the component to the laser beam pulses to remove the contaminant and to selectively remove at least a portion of the additive layer includes controlling one or more parameters of the laser beam pulses.

[0063] The method of any preceding clause comprising optionally, removing at least a portion of the additive layer using laser beam pulses.

[0064] The method of any preceding clause comprising optionally, repairing the coated superalloy component.

[0065] This written description uses examples to describe the disclosure, including the best mode, and also to enable any person skilled in the art to practice the disclosure, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the disclosure is defined by the claims, and may include other examples that occur to those skilled in the art. Such

CLAIMS:

1. A method for the removal of a contaminant from a coated superalloy component having a diffusion coating comprising an additive layer on a surface of the component and a diffusion zone in the surface of the component, the method comprising:

subjecting the surface of the coated superalloy component having the contaminant thereon to laser beam pulses having an energy of equal to or less than 1 millijoule (mJ)/pulse and a pulse duration of 20 to 100 nanoseconds to selectively remove the contaminant from the component while retaining the diffusion zone of the diffusion coating.

2. The method of claim 1, wherein the diffusion coating is an aluminide diffusion coating.

3. The method of claim 1, wherein the contaminant comprises one or more of hot corrosion products, oxides, dirt, dust, or combinations thereof.

4. The method of claim 1, wherein subjecting the surface of the component to laser beam pulses creates an exposed portion of the diffusion zone, an exposed portion of the additive layer, or both.

5. The method of claim 4, further comprising applying a diffusion coating material to the exposed portion of the diffusion zone or the exposed portion of the additive layer to form a rejuvenated protective diffusion coating on the component.

6. The method of claim 5, wherein the rejuvenated protective diffusion coating has a coating microstructure and a coating chemistry substantially matching a first-time diffusion coating of the component prior to service in a turbine.

7. The method of claim 1, further comprising inspecting the component for the presence of the contaminant, the method including alternating the subjecting the surface to laser beam pulses to remove the contaminant and the inspecting the component until all of the contaminant is removed from the component.

8. The method of claim 1, wherein the laser beam pulses, upon impacting the surface of the component, provide a laser spot beam having a diameter of 75 μm to 95 μm.

9. The method of claim 1, wherein the laser beam pulses provide an energy density in a range of 17,600 to 17,700 mJ/cm^2.

10. The method of claim 1, wherein a laser emitting the pulsed laser beam has a frequency of 10 kHz to 250 kHz.

11. The method of claim 1, wherein a laser emitting the pulsed laser beam has an output power of 50W to 1000 W.

12. A method for rejuvenating a superalloy component that has undergone service in a turbine at an elevated temperature, the superalloy component having a diffusion coating comprising an additive layer on a surface of the component and a diffusion zone in the surface of the component, the method comprising:

removing a contaminant from the component by subjecting the component to laser beam pulses having an energy of equal to or less than 1 mJ/pulse and a pulse duration of 20 to 100 nanoseconds to selectively remove the contaminant from the component while retaining the diffusion zone of the diffusion coating thereby creating an exposed portion of the diffusion zone or an exposed portion of the additive layer;

applying an aluminide coating to the exposed portion of diffusion zone or the exposed portion of additive layer; and

diffusion heat treating at a preselected elevated temperature to form a rejuvenated protective aluminide coating on the superalloy component.

13. The method of claim 12, wherein the rejuvenated protective aluminide coating has a coating microstructure and a coating chemistry substantially matching the diffusion coating prior to having undergone service in a turbine.

14. The method of claim 12, wherein the diffusion coating is an aluminide coating.

15. The method of claim 12, wherein the laser beam pulses (i) provide an energy density in a range of 17,600 to 17,700 mJ/cm^2, or (ii) provide a laser spot beam having a diameter of 75 μm to 95 μm.

16. The method of claim 12, wherein a laser emitting the pulsed laser beam (i) has a frequency of 10kHz to 250 kHz, or (ii) has an output power of 50W to 1000W.

17. The method of claim 12, further comprising, prior to applying the aluminide coating, selectively removing at least a portion of the additive layer by further subjecting the component to the laser beam pulses.

18. The method of claim 17, further comprising, prior to applying the aluminide coating:

inspecting the component to determine if removal of the contaminant and the portion of the additive layer is complete; and

alternating the subjecting the component to the laser beam pulses and the inspecting the component until it is determined that the removal is complete.

19. The method of claim 17, wherein subjecting the component to the laser beam pulses to remove the contaminant and to selectively remove at least a portion of the additive layer includes controlling one or more parameters of the laser beam pulses.