ingestion of siliceous debris into engines has been commonly reported. Similar to the contaminants due to fuel impurities, at elevated temperatures, these airborne deposits adhere, melt and degrade the thermal barrier coating system via a repeated freeze-thaw action and, to a certain extent, direct chemical reaction with thermal barrier coating constituents. The interactions that can accelerate the failure of thermal barrier coatings and underlying components include destabilization of the ceramic yttria-stabilized zirconia topcoat, accelerated oxidation and hot corrosion of the underlying metallic bond coat and superalloys.

Thus in order to protect thermal barrier coatings from both thermomechanical and thermochemical degradation of molten deposits, melt ingression into the porous yttria-stabilized zirconia topcoat should be completely suppressed. However, currently, there is no practice or method for improving the performance of thermal barrier coating after it is coated on super alloy.

There is a need to provide a method of treating a thermal barrier coating that overcomes, or at least ameliorates, one or more of the disadvantages described above.

There is a need to provide a system for treating a thermal barrier coating.

Summary

According to the present disclosure, there is provided a method for treating a substance having a thermal barrier coating in contact with an alloy substrate comprising the step of irradiating the thermal barrier coating while the alloy substrate is maintained at a substantially constant temperature.

According to a first aspect, there is provided a substance having a thermal barrier coating in contact with an alloy substrate comprising the step of irradiating said thermal barrier coating while said alloy substrate is maintained at a substantially constant temperature, wherein before the irradiating step, the step of pre-heating said substance.

Claims

1. A method for treating a substance having a thermal barrier coating in contact with an alloy substrate comprising the steps of:

pre-heating said substance; and

irradiating said thermal barrier coating while said alloy substrate is maintained at a substantially constant temperature.

2. The method of claim 1, comprising the step of contacting said thermal barrier coating with a microwave absorber.

3. The method of claim 2, wherein said microwave absorber is a carbon-based absorber or composites thereof.

4. The method of any one of the preceding claims, comprising the step of placing said alloy substrate in a receptacle that is a thermal insulator.

5. The method of claim 4, wherein said thermal insulator is selected from the group consisting of ceramics, glass and plastics.

6. The method of claim 1, wherein said pre-heating step is undertaken at a temperature in the range of 25°C to 900°C.

7. The method of any one of the preceding claims, wherein said irradiating step is undertaken at a temperature in the range of 25°C to 1500°C.

8. The method of any one of the preceding claims, wherein said irradiating step is undertaken for a time period in the range of 1 minute to 5 hours.

9. The method of any one of the preceding claims, wherein said irradiating step is undertaken at a frequency in the range of about 0.3 GHz to about 300 GHz.

10. The method of any one of the preceding claims, wherein said irradiating step is undertaken at a pulse repetition frequency where the pulses per second is in the range of 10 to 200.

11. A system for treating a substance having a thermal barrier coating in contact with an alloy substrate, the system comprising an enclosed chamber for receiving said substance, said enclosed chamber comprising heating means and radiation generating components.

12. The system of claim 11, further comprising a receptacle for receiving said substance.

13. The system of claim 12, wherein said receptacle is a thermal insulator.

14. The system of any one of claims 11 to 13, wherein said heating means pre-heat said substance to a temperature in the range of 25°C to 900°C.

15. The system of any one of claims 11 to 14, wherein said radiation generating component is a magnetron tube for generating microwaves.

16. A substance comprising an alloy substrate in contact with a radiation treated thermal barrier coating.

17. The substance of claim 16, wherein said thermal barrier coating has a hardness of more than 5 GPa.

18. The substance of claim 16 or 17, wherein said thermal barrier coating has a surface that is substantially resistant to ingress of particulate matter.

19. The substance of claim 18, wherein said particulate matter is calcium-magnesium-alumino-silicate particles.

20. The substance of any one of claims 16 to 19, wherein the porosity of said thermal barrier coating is less than 15%.