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 pre-heating said alloy substrate at a pre-heating temperature; and irradiating said thermal barrier coating at an irradiation temperature while said alloy substrate is maintained at a substantially constant temperature, wherein the pre-heating temperature is different from the irradiation temperature.

Advantageously, the method may be able to substantially decrease the amount of particulate matter (such as calcium-magnesium-almino-silicate) penetration into the thermal barrier coating. This may extend the useful lifetime and reduce the service and maintenance costs for coated parts. In addition, the structure of the thermal barrier coating may not change significantly after irradiation treatment. The thermal barrier layer may not suffer from cracks.

Advantageously, the method may ensure uniform heating of the thermal barrier coating layer only, without heating the underlying alloy substrate portion. This can avoid overheating of the underlying alloy substrate and thereby prevent reduction in its mechanical and thermal properties.

Advantageously, the method may be able to selectively heat up the thermal barrier coating only.

Advantageously, the method may increase the hardness of the thermal barrier coating.

Advantageously, the method may increase the density of the thermal barrier coating. This may result in a graded density where the thermal barrier coating is denser than the underlying layer (such as the thermally grown oxide layer or the bond coat). This may avoid the need to employ an additional step of depositing a denser thermal barrier coating on top of a porous one which could be complicated and possess a larger coefficient of thermal expansion mismatch and lower strain tolerance due to the denser structure. This leads to a decrease in the time and temperature required for densification of the thermal barrier coating as compared to conventional furnace annealing.

There is provided 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 the substance, the enclosed chamber comprising heating means and radiation generating components.

Advantageously, the system may allow for selective heating of the thermal barrier coating only. In the system, both the underlying alloy substrate portion and the thermal barrier coating may be heated to different temperatures accordingly to match their coefficient of thermal expansion mismatch as only the thermal barrier coating is affected by radiation while the alloy substrate portion is not. Hence, this may ensure that the stress due to coefficient of thermal expansion mismatch between the thermal barrier coating and alloy substrate is minimized.

There is provided a substance comprising an alloy substrate in contact with a radiation treated thermal barrier coating.

Advantageously, the quality of the thermal barrier coating may be enhanced to substantially resist penetration of particulate matter such as calcium-magnesium-almino-silicate particles.

Advantageously, the hardness of the thermal barrier coating may be higher than a conventional thermal barrier coating that is not subjected to radiation treatment.

Advantageously, the density of the thermal barrier coating may be higher (that is, less porous) than a conventional thermal barrier coating that is not subjected to radiation treatment.

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 alloy substrate at a pre-heating temperature; and

irradiating said thermal barrier coating at an irradiation temperature while said alloy substrate is maintained at a substantially constant temperature, wherein said pre-heating temperature is different from said irradiation 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 temperature is in the range of 25°C to 900°C.

7. The method of any one of the preceding claims, wherein said irradiation temperature is 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.