Claims

1. An erosion and calcium-magnesium-aluminum-silicate (CMAS) resistant coating comprising:

at least one porous vertically cracked (PVC) coating layer providing coefficient of thermal expansion (CTE) mitigation is disposed over a thermal barrier coating (TBC) that includes a layer of MCrAlY, wherein M represents Ni, Co or their combinations; and

at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer deposited over the at least one PVC coating layer,

wherein the PVC coating layer includes a range of between 20 and 200 substantially vertical cracks per inch.

2. The coating of claim 1, wherein the at least one DVC layer is a top layer.

3. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises rare earth (Re) stabilized ZrO2 with rare earth oxide or Re stabilized HfO2 mixed with rare earth oxide.

4. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises Re stabilized ZrO2 with rare silicate or Re stabilized HfO2 mixed with rare earth silicate.

5. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises Re stabilized ZrO2 with rare aluminate or Re stabilized HfO2 mixed with rare earth aluminate.

6. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises Re stabilized ZrO2 with rare earth aluminate or silicate or Re stabilized HfO2 mixed with rare earth aluminate or silicate.

7. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises Re stabilized ZrO_2 with alkaline oxide or Re stabilized HfO_2 mixed with alkaline oxide.

8. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises Re stabilized ZrO_2 with gadolinium zirconate or Re stabilized HfO_2 mixed with gadolinium zirconate.

9. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises a mixture of a mixture of two or more of:

Re stabilized ZrO_2 with rare earth oxide or Re stabilized HfO_2 mixed with rare earth oxide;

Re stabilized ZrO_2 with rare earth silicate or Re stabilized HfO_2 mixed with rare earth silicate;

Re stabilized ZrO_2 with rare earth aluminate or Re stabilized HfO_2 mixed with rare earth aluminate;

Re stabilized ZrO_2 with rare earth aluminate or silicate or Re stabilized HfO_2 mixed with rare earth aluminate or silicate;

Re stabilized ZrO_2 with alkaline oxide or Re stabilized HfO_2 mixed with alkaline oxide; and

Re stabilized ZrO_2 with gadolinium zirconate or Re stabilized HfO_2 mixed with gadolinium zirconate.

10. The coating of claim 1, wherein the at least one dense vertically cracked (DVC) erosion and CMAS resistant coating layer comprises full thickness vertical cracks.

11. The coating of claim 1, wherein the at least one porous vertically cracked (PVC) coating layer comprises full thickness vertical cracks.

12. An erosion and CMAS resistant coating according to claim 1 arranged on a substrate.

13. The coating of claim 12, further comprising at least one bond coating layer disposed between the TBC and the substrate.

14. The coating of claim 12, wherein the substrate is a superalloy substrate.

15. A method of plasma spraying an erosion and CMAS resistant coating on an TBC coated substrate, comprising:

depositing at least one porous vertically cracked (PVC) thermal barrier coating layer providing coefficient of thermal expansion (CTE) mitigation onto the TBC coated substrate; and

depositing a dense vertically cracked (DVC) erosion and CMAS resistant coating material over the at least one PVC thermal barrier coating layer,

wherein the PVC thermal barrier coating layer includes a range of between 20 and 200 substantially vertical cracks per inch.

16. The method of claim 15, wherein the TBC coated substrate comprises at least one bond coating layer arranged between an TBC layer and the substrate.

17. The method of claim 15, wherein the plasma spraying comprises one of:

atmospheric plasma spraying (APS);

plasma spray - physical vapor deposition (PS-PVD); or

suspension plasma spray (SPS).