Claims

What is claimed is:

1. A thermal spray system for producing coatings on a substrate from a liquid suspension comprising:

a thermal spray torch for generating a plasma;

a liquid suspension delivery subsystem for delivering a flow of the liquid suspension with sub-micron particles; and

a nozzle assembly for delivering the plasma from the thermal spray torch to the liquid suspension to produce a plasma effluent, the nozzle assembly adapted for producing an inert gas shroud substantially surrounding said plasma effluent;

wherein the inert shroud is configured to substantially retain entrainment of the sub-micron particles in the plasma effluent and substantially inhibit gases from entering and reacting with the plasma effluent.

2. The thermal spray system of claim 1, wherein the shroud extends from the nozzle assembly to the substrate surface.

3. The thermal spray system of claim 1, wherein the shroud is a laminar flowing shield.

4. The thermal spray system of claim 1, wherein the shroud has an axial distance less than a distance from the nozzle to the substrate surface.

5. The thermal pray system of claim 4, wherein the shroud diverges in a direction towards the substrate.

6. The thermal pray system of claim 4, wherein the shroud converges in a direction towards the substrate.

7. The thermal spray system of claim 1, wherein the liquid suspension delivery subsystem comprises an injector adapted to produce an inert or reactive gas sheath surrounding the flow of the liquid suspension.

8. The thermal spray system of claim 1, wherein the liquid suspension system is configured external to the nozzle.

9. The thermal spray system of claim 1, wherein the liquid suspension system is configured internal to the nozzle.

10. The thermal spray system of claim 1, wherein the liquid suspension system is configured internal to the nozzle so as to deliver an axial flow of the liquid suspension.

11. The thermal spray system of claim 8, wherein the liquid suspension system further comprises a gas assist stream proximate to and contemporaneously with the liquid suspension system.

12. A method of producing coatings on a substrate using a liquid suspension with sub-micron particles dispersed therein, the method comprising the steps of:

generating a plasma from a thermal spray torch;

delivering a flow of liquid suspension with sub-micron particles dispersed therein to the plasma or in close proximity thereto to produce a plasma effluent stream;

surrounding the flow of the effluent stream with an inert gas shroud to produce a shrouded effluent;

retaining the sub-micron particles entrained within the shrouded effluent; and

directing the shrouded effluent with the sub-micron particles contained therein towards the substrate to coat the substrate.

13. The method of claim 12, further comprising the step of substantially preventing entrainment of gases into the shrouded effluent.

14. The method of claim 12, further comprising the step of fragmenting droplets of the liquid suspension across the shroud.

15. The method of claim 12, further comprising the steps of:

selectively removing the shroud at a predetermined axial distance away from the substrate surface;

introducing ambient gases at the predetermined axial distance and downstream thereof;

oxidizing a portion of the sub-micron particles.

16. The method of claim 15, further comprising the step of converging the shroud at the predetermined axial distance.

17. The method of claim 15, further comprising the step of diverging the shroud away from the effluent stream to allow the introduction of ambient gases at the predetermined axial distance.

18. The method of claim 12, further comprising the step of surrounding the liquid suspension with a gas sheath.

19. The method of claim 18, further comprising the step of introducing a stream of gas injected proximate to and contemporaneously with the suspension injection.

20. The method of claim 18, wherein the sub-micron particles have an average particle size of 10 microns lower.

21. A coating deposited on the substrate prepared according to the process of claim 12.

Claims

1. A coating deposited on the substrate prepared according to the following process:
using a liquid suspension with sub-micron particles dispersed therein;
providing a substrate to be coated;
generating a plasma from a thermal spray torch;
delivering a flow of liquid suspension with sub-micron particles dispersed therein to the plasma or in close proximity thereto to produce a plasma effluent stream;
surrounding the flow of the effluent stream with an inert gas shroud to produce a shrouded effluent;
retaining the sub-micron particles entrained within the shrouded effluent; and
directing the shrouded effluent with the sub-micron particles contained therein towards the substrate to coat the substrate.