Claims

1. A one-step method for creating a thin, fluid-tight, as-deposited coating without sealing the as-deposited coating, comprising:

providing a substrate;

providing a powder feedstock having a particle size ranging from 1 to 15 microns;

providing a thermal spray torch, said thermal spray torch comprising a combustion chamber with a comprising a nozzle downstream of the combustion chamber;

introducing a liquid fuel into the combustion chamber;

pre-mixing oxygen gas with an inert gas to produce diluted oxygen gas, wherein the pre-mixing occurs prior to the oxygen gas entering the combustion chamber, and wherein a flow ratio of the inert gas to the oxygen gas ranges from 8:92 to 50:50, wherein said inert gas is selected from the group consisting of nitrogen and argon, and wherein the pre-mixing of the oxygen gas with the inert gas excludes feeding air as a source of oxidant for the liquid fuel combustion;

introducing the diluted oxygen gas into the combustion chamber;

combusting the fuel with the diluted oxygen gas to generate a flame;

introducing the powder feedstock into the nozzle;

contacting the powder feedstock with the flame to produce substantially molten and semi-molten droplets; and

directing the substantially molten and semi-molten droplets to the substrate to form the thin, fluid-tight, as-deposited coating.

2. The one-step method of claim 1, wherein the fuel is selected from the group consisting of a hydrocarbon and hydrogen.

3. The one-step method of claim 1, wherein the pre-mixing of the oxygen gas with the inert gas is introduced at a flow rate that is sufficient to combust the fuel.

4. The one-step method of claim 1, wherein the inert gas is pre-mixed with the oxygen at a flow rate that is sufficient to create a flame temperature in the combustion chamber that is lower in comparison to a flame temperature generated by the oxygen without premixing the inert gas.

5. The one-step method of claim 1, wherein a total flow rate of the oxygen gas and the inert gas is 500-3000 scfh.

6. The one-step method of claim 1, wherein the powder feedstock is a tungsten carbide-based material.

7. The one-step method of claim 1, wherein the powder feedstock has a particle size about 4-12 microns.

8. The one-step method of claim 1, wherein the powder feedstock has a median particle size of 6-10 microns.

9. A one-step method for creating a thin, fluid-tight, as-deposited coating without sealing the as-deposited coating, comprising:

providing a substrate;

providing a powder feedstock having a particle size ranging from 1 to 15 microns;

providing a thermal spray torch, said thermal spray torch comprising a combustion chamber and said torch further comprising a nozzle downstream of the combustion chamber enclosed therein;

introducing a liquid fuel into the combustion chamber;

pre-mixing oxygen gas with an inert gas to produce diluted oxygen gas, wherein the pre-mixing occurs prior to the oxygen gas entering the combustion chamber, and wherein a flow ratio of the inert gas to the oxygen gas ranges from 8:92 to 50:50, wherein said inert gas is selected from the group consisting of nitrogen and argon, and wherein the pre-mixing of the oxygen gas with the inert gas excludes feeding air as a source of oxidant for the liquid fuel combustion;

directing the diluted oxygen gas into the combustion chamber;

combusting the fuel with the diluted oxygen gas to generate a flame within the combustion chamber;

controlling a flame temperature in the combustion chamber;

introducing the powder feedstock into the nozzle;

heating the powder feedstock to produce substantially molten or semi-molten droplets using the powder feedstock with the particle size ranging from 1 to 15 microns

directing the substantially molten and semi-molten droplets to the substrate to form the thin, fluid-tight, as-deposited coating.

10. The one-step method of claim 9, wherein the inert gas is nitrogen or argon and a total flow rate of oxygen with nitrogen or argon is 500-3000 scfh.

11. The one-step method of claim 9, wherein the powder feedstock comprises a tungsten carbide-based material or a chromium carbide-based material.

12. The one-step method of claim 9, wherein the powder feedstock is injected into the nozzle in a radial direction.

13. The one-step method of claim 9, wherein the powder feedstock has a median particle size of 6-10 microns.

14. The one-step method of claim 9, wherein the pre-mixing of the oxygen gas with the inert gas results in a flow ratio of the inert gas to the oxygen gas ranging from 10:90 to 30:70.

15. The one-step method of claim 9, wherein the pre-mixing of the oxygen gas with the inert gas results in a flow ratio of the inert gas to the oxygen gas ranging from 12:88 to 18:82.