Surface technology (2)
Thermal spraying

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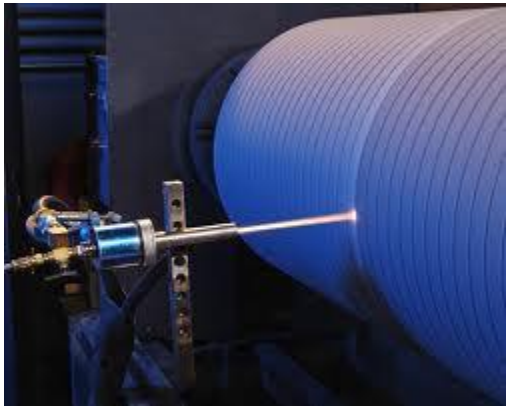
What is Thermal spraying?

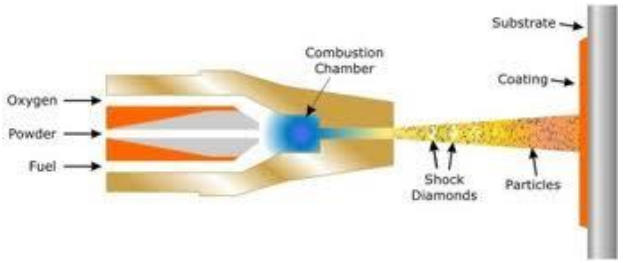
thermal spraying*, a group of coating processes in which finely divided metallic or nonmetallic materials are deposited in a molten or semimolten condition to form a coating. The coating material may be in the form of powder, ceramic-rod, wire, or molten materials.*

What is Thermal spraying?

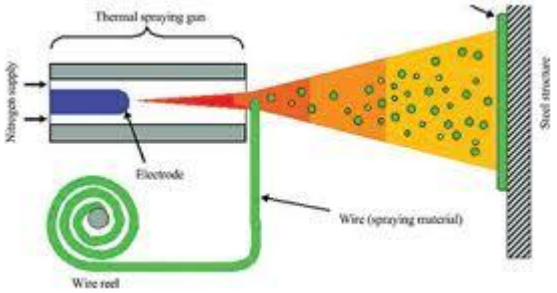
In addition to using chemical means to plasticize the in-put consumables electrical currents are also used. Typically, electrical energy is used to create a heat source into which powder, and more recently wires, are fed, melted/plasticized and conveyed onto the surface to be coated. Major, commercially employed electrical methods, used to construct coatings include non-transferred arc plasma, RF plasma, and wire arc. Based upon the two heat sources a "family tree" of thermal spray methods can be constructed as noted below.



Methods



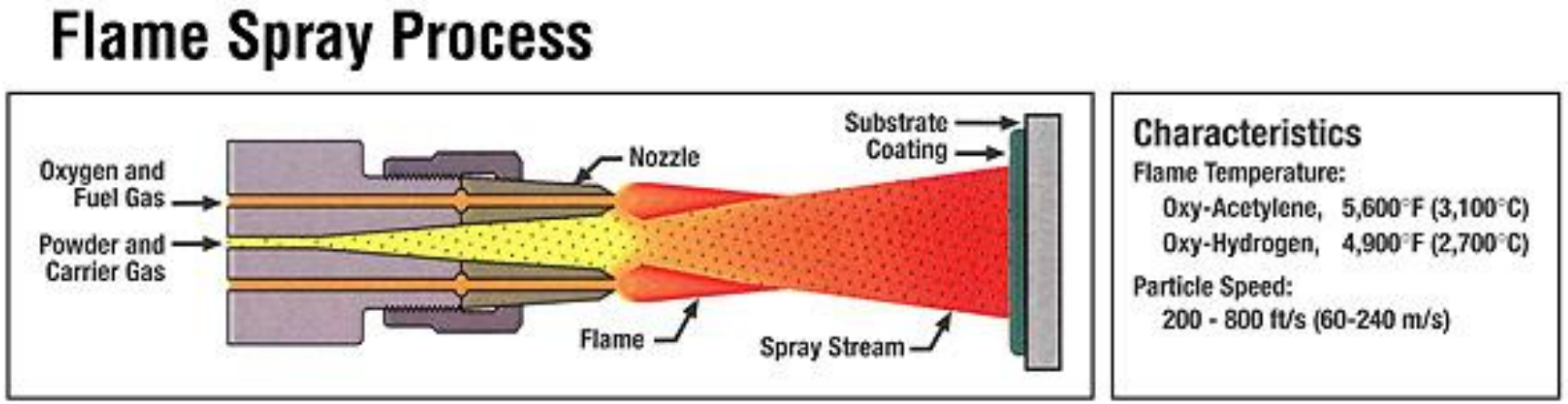
- Molten Metal Flame Spray
- Ceramic Rod Flame Spraying
- Cold Spray
- Detonation Flame Spraying
- Electric Arc Spraying
- High Velocity Oxy/Fuel Spraying (HVOF)
- Nontransferred Plasma Arc Spraying
- Powder Flame Spray
- RF Plasma Spraying
- Wire Flame Spraying



Methods

Molten Metal Flame Spray

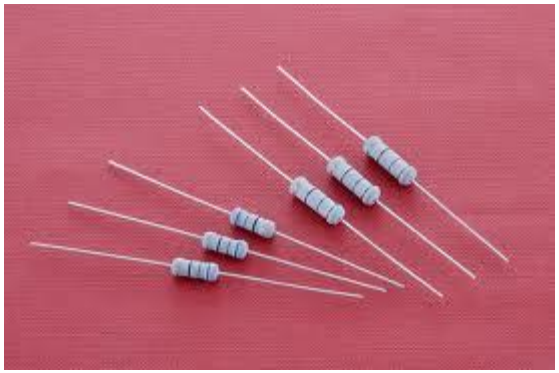
molten metal flame spraying, a thermal spraying process variation in which the metallic material to be sprayed is in the molten condition.



Methods

Ceramic Rod Flame Spraying

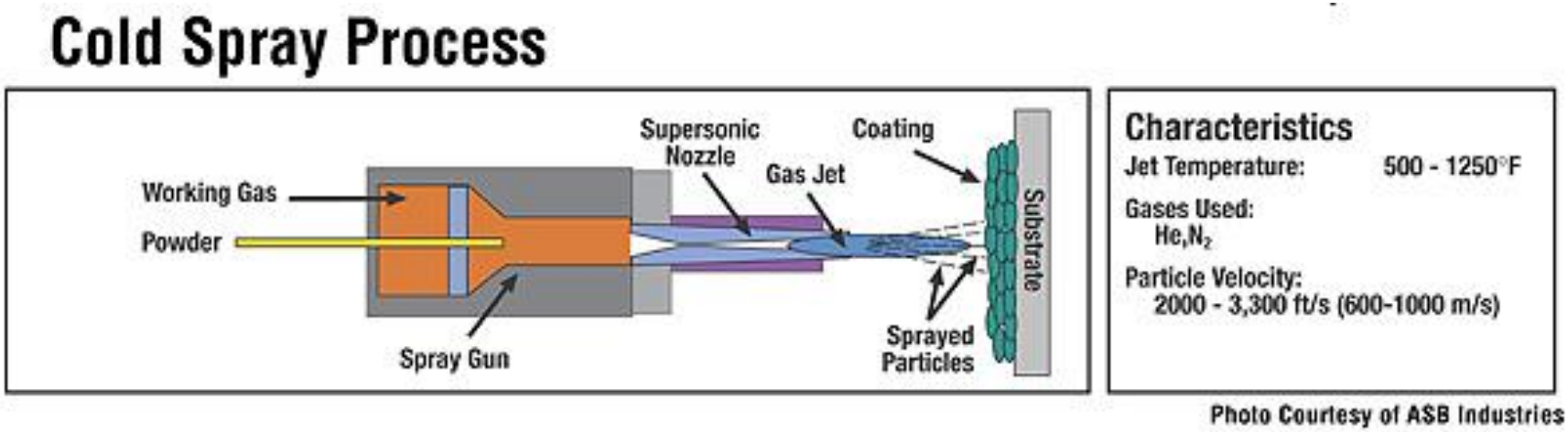
ceramic rod flame spraying, a spraying process in which material to be sprayed is in ceramic rod form.



Methods

Cold spray

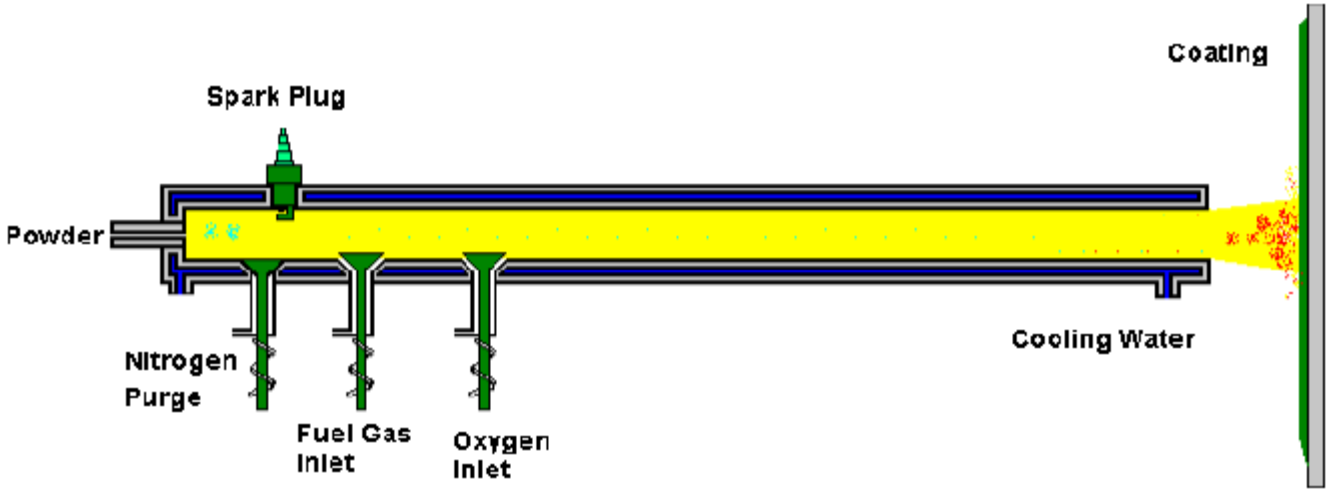
cold spray, a kinetic spray process utilizing supersonic jets of compressed gas to accelerate near-room temperature powder particles at ultra high velocities. The unmelted particles, traveling at speeds between 500 to 1,500 m/sec plastically deform and consolidate on impact with their substrate to create a coating.



Methods

Detonation Thermal Spraying Process

The Detonation gun basically consists of a long water cooled barrel with inlet valves for gases and powder. Oxygen and fuel (acetylene most common) is fed into the barrel along with a charge of powder. A spark is used to ignite the gas mixture and the resulting detonation heats and accelerates the powder to supersonic velocity down the barrel. A pulse of nitrogen is used to purge the barrel after each detonation. This process is repeated many times a second. The high kinetic energy of the hot powder particles on impact with the substrate result in a build up of a very dense and strong coating.

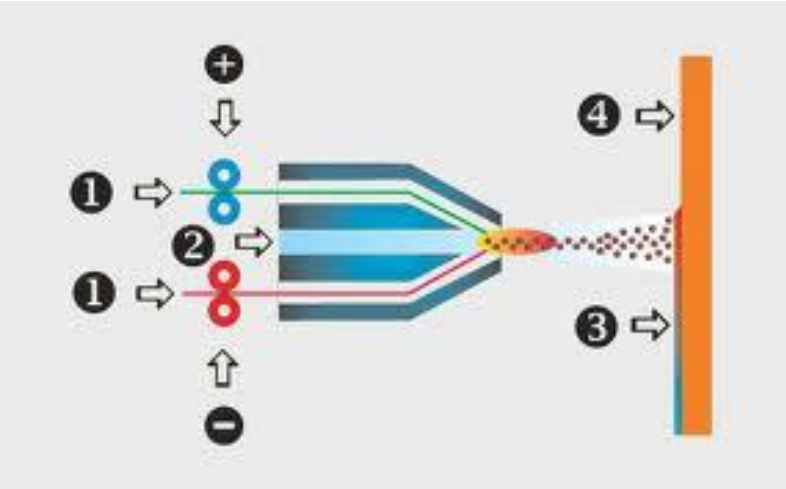


Methods

Electric Arc Spraying

electric arc spraying, a thermal spray process in which an arc is struck between two consumable electrodes of a coating material. Compressed gas is used to atomize and propel the material to the substrate. (1)

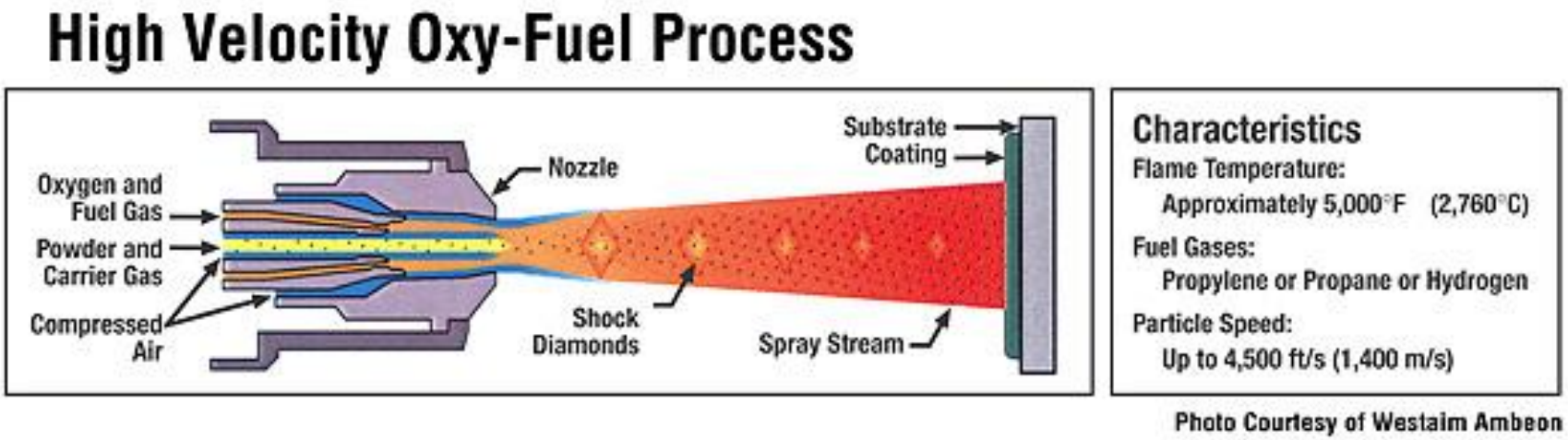
The electric arc spray process utilizes metal in wire form. This process differs from other thermal spray processes in that there are no external heat sources as in any the combustion gas/flame spray processes. Heating and melting occur when two electrically opposed charged wires, comprising the spray material, are fed together in such a manner that a controlled arc occurs at their intersection. The molten metal is atomized and propelled onto the prepared workpiece by jets of compressed air or gas.



Methods

High Velocity Oxy/Fuel Spraying (HVOF)

The technique was referred to as High Velocity Oxy-Fuel (HVOF). The process utilizes a combination of oxygen with various fuel gases including hydrogen, propane, propylene, hydrogen and even kerosene. In the combustion chamber, burning by-products are expanded and expelled outward through an orifice where at very high velocities. Often times they produce "shock diamonds" exiting the spray gun as in the graphic below.



Methods

Nontransferred Plasma Arc Spraying

plasma spraying, a thermal spray process in which a nontransterred arc is a source of heat that ionizes a gas which melts the coating material and propels it to the workpiece. Plasma is an ionized gaseous cloud composed of free electrons, positive ions, neutral atoms and molecules. Because of its unique properties some have referred to it as the "fourth state of matter". Plasma is generated whenever sufficient energy is imparted to a gas to cause some of it to ionize

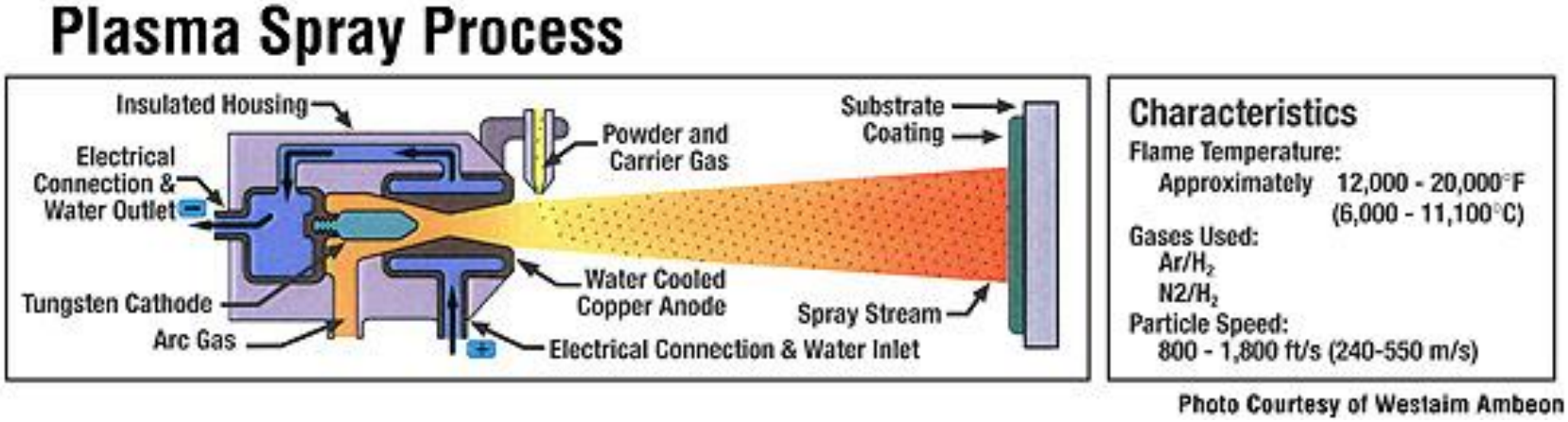
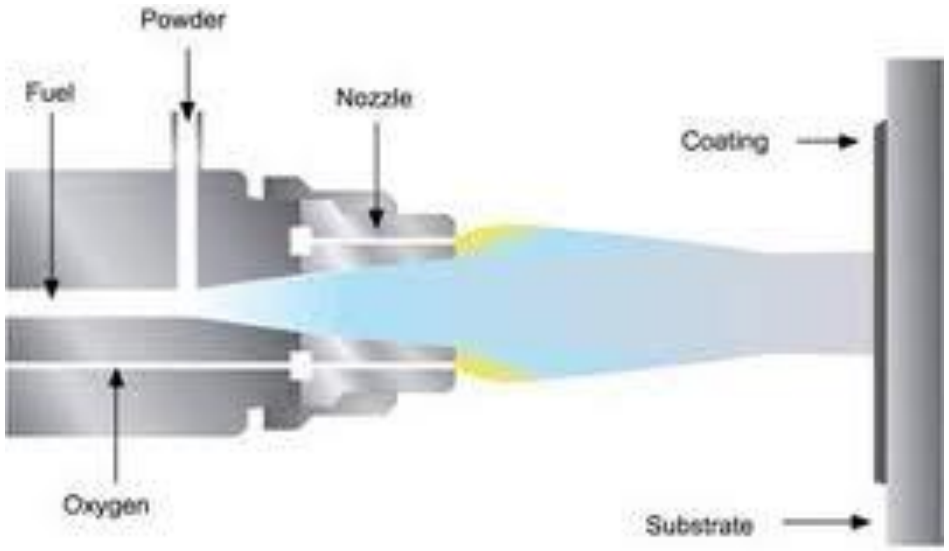


Photo Courtesy of Westaim Ambeon

Methods

Powder Flame Spray

Powder flame spraying, a thermal spray process in which the material to be sprayed is in powder form.
Powder flame spraying is probably the simplest of all the spray processes to describe - feed a powder through the center bore of a nozzle where it melts and is carried by the escaping oxy-fuel gases to the work piece. Unfortunately, this approach yields coatings high in oxides and with void contents approaching 20 volume percent (v/o).



Methods

RF Plasma Spraying

RF plasma, a system in which the torch is a water-cooled, high frequency induction coil surrounding a gas stream. On ignition a conductive load is produced within the induction coil, which couples to the gas, ionizing it to produce a plasma.