Description

Image

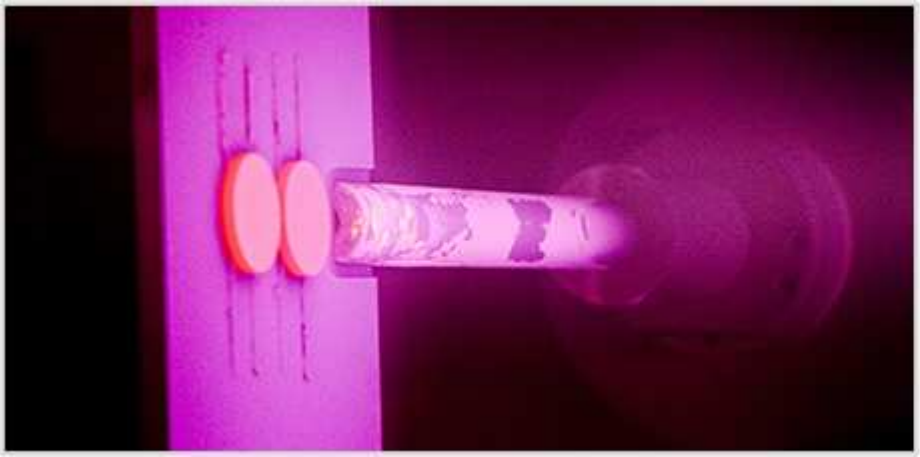

Image caption

(1) Inside the Plasma Spray-Physical Vapor Deposition, or PS-PVD, ceramic powder is introduced into the plasma flame, which vaporizes it and then condenses it on the (cooler) workpiece to form the ceramic coating © NASA/Marvin G. Smith at Wikimedia Commons [Public domain] (2) Physical vapor deposition used in darts © Stevepb at Pixabay [Public domain]

The process

Mirrors used to be made by a complex process involving silver dissolved in mercury. Today they are made by PVD METALLIZING, a process in which a thin coating of metal - usually aluminum - is deposited from a vapor onto a component. The vapor is created in a vacuum chamber by direct heating or electron beam heating of the metal, from which it condenses onto the cold component, much like steam from a hot bath condensing on a bathroom mirror. In PVD metallizing there is no potential difference between bath and component. In ION PLATING the vapor is ionized and accelerated by an electric field (the component is the cathode, and the metallizing source material is the anode). In sputtering, argon ions are accelerated by the electric field onto a metal target, ejecting metal ions onto the component surface. By introducing a reactive gas, compounds can be formed (Ti sputtering in an atmosphere of N_2, to give a hard coating of TiN, for instance).

Process schematic

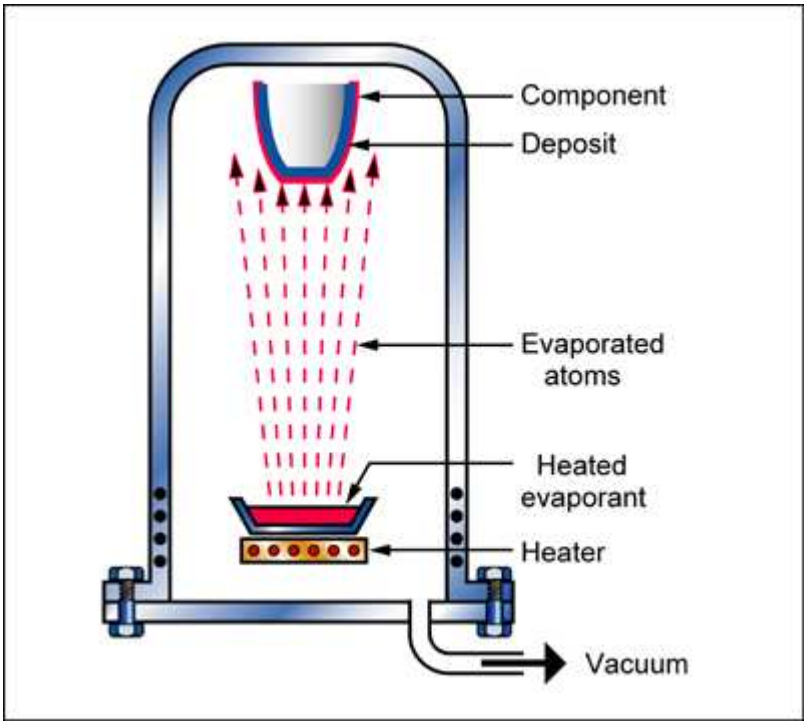

Figure caption

Metallizing, or Physical Vapor Deposition (PVD) coating

Material compatibility

Ceramics	✓
Composites	✓
Foams	✓
Glasses	✓
Metals - ferrous	✓
Metals - non-ferrous	✓
Polymers - thermoplastics	✓
Polymers - thermosets	✓

Function of treatment

Corrosion protection (aqueous)	✓
Corrosion protection (gases)	✓
Corrosion protection (organics)	✓
Hardness	✓
Wear resistance	✓
Thermal conduction	✓
Electrical conduction	✓
Magnetic properties	✓
Decoration	✓
Color	✓

Reflectivity	✓
Surface texture	✓

Economic compatibility

Relative tooling cost	low
Relative equipment cost	high
Labor intensity	low

Physical and quality attributes

Surface roughness (A=v. smooth)	A			
Curved surface coverage	Average			
Coating thickness	0.025	-	25	µm
Coating rate	0.1	-	1	µm/s
Surface hardness	200	-	1e3	Vickers
Processing temperature	350	-	400	℃

Process characteristics

Discrete	✓
Continuous	✓

Supporting information

Design guidelines

Metallizing is widely used to give a reflective metallic finish on bulk and film polymers, metal, glass and ceramic.

Technical notes

Clean surfaces are essential. Aluminum, copper, nickel, zirconium and other metals can be deposited.

Typical uses

Automotive trim, household appliances and kitchenware, door and window hardware, bathroom fixtures, printed circuit boards.

The economics

The capital cost is high, the tooling cost low. For aesthetics, PVD metallizing is preferred to electroplating for polymers and ceramics because of its speed, quality and absence of unpleasant chemicals.

The environment

High volume production, good quality and cleanliness - particularly the absence of unpleasant chemicals - makes this an attractive process from an environmental standpoint.

Links

MaterialUniverse

Reference