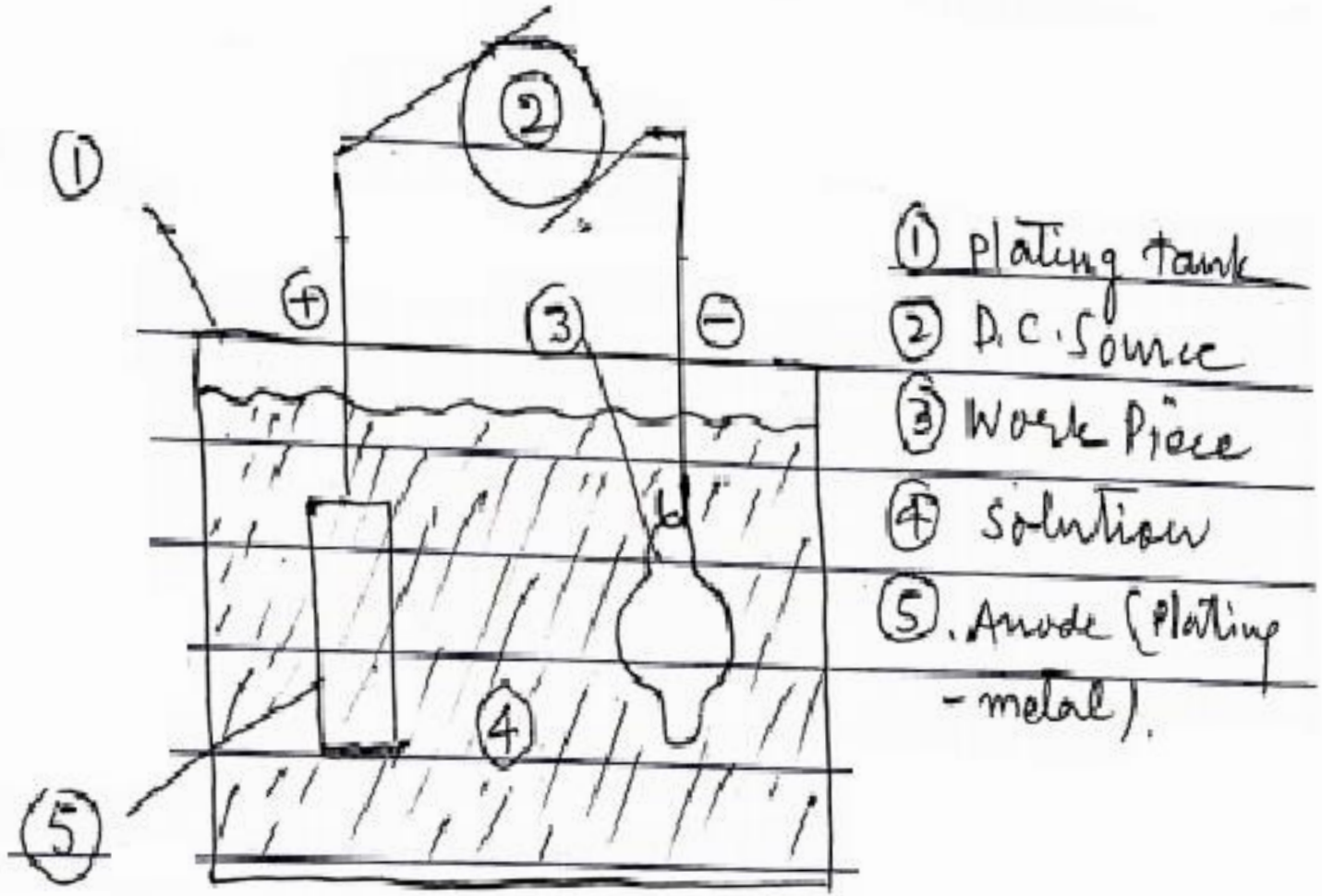
Modern manufacturing processes and management ME-504

Unit 2

Coating and Deposition processes: Plating and related process, physical vapour deposition, chemical vapour deposition, organic coating

Electroplating: Electroplating is the most popular means of applying metallic coatings on the surfaces of metals and sometimes on non metals. This is done for protection against corrosion or against wear and abrasion, for appearance, to re-work worn parts by increase in size, to make pieces easy to solder and to stop off areas on steel parts from being carburized during heat treatment.


1
2
+
3
−
4
5
1 plating tank
2 D.C. Source
3 Work Piece
4 solution
5. Anode (Plating - metal).

Common plating metals are chromium, nickel Copper, Zinc, ~~Cadmium~~ Cadmium, and tin. The more precious metals – Silver, gold, platinum and rhodium are also applied by plating.

Surface to be plated must be buffed smooth to eliminate scratches and unevenness. The work is then cleaned in suitable cleaning solution

to remove grease dirt buffing compound etc. After rinsing, the part is ready for plating.

The four essential elements of a plating process are the cathode anode, electrolyte, and direct current. They are shown in fig. The current leaves the anode which is a bar of plating metal, and migrate through the electrolyte (water solution of salts of the metal to applied) to the cathode, or part to be plated. As the ions are deposited on the cathode; they give up their charge and are deposited on metal or the cathode. Parts to be plated should be deigned with generous fillets and radii instead of sharp corner, since current concentrations occur at sharp points resulting in excessive deposit.

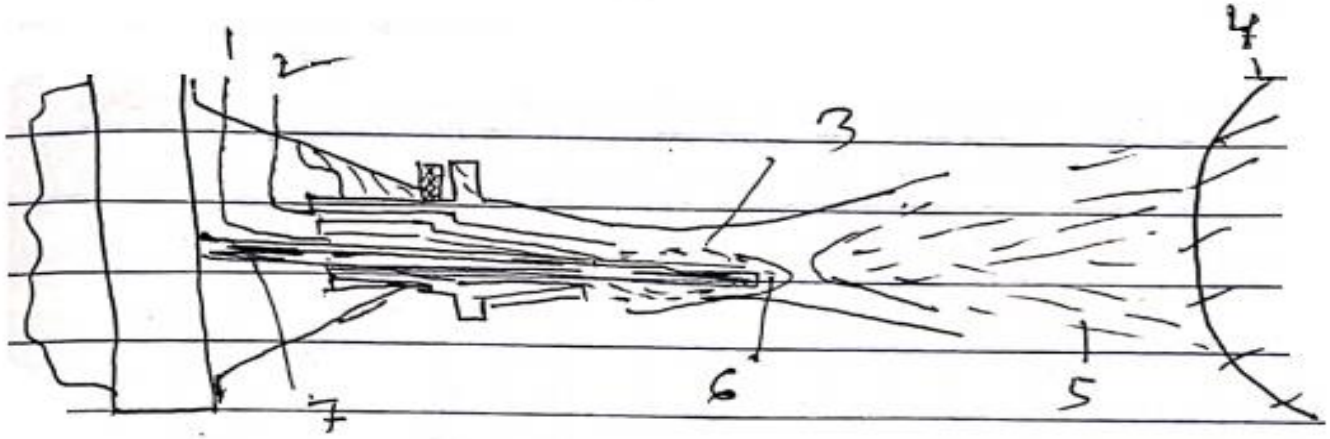
(2) Hot Dipping :- (Galvanizing) A protective coating may be applied on metal pieces by dipping them into certain molten metals like Zinc tin or alloy of lead and Tin. Dipping is an economical way of putting on a heavy and enduring coating.

To obtain an even coating on small objects such as nuts & bolts, pins, and washers, the objects are centrifuged after being taken from the molten bath until the coating is hard.

Zinc dipping or hot galvanizing is widely used on steel as an effective protective layer against corrosion. The parts are first cleaned and fixed in a solution of Zinc chloride and Hcl

③ **Metal Spraying:** Metal spraying is basically intended to confer some physical property on a surface. The appearance of poor surfaces on casting can be improved by metal spraying, sprayed metal can be decorative, like aluminium or bronze or cast iron. Some can even be coloured.

Metal spraying is done by melting a metal in an oxy-gas flame and blowing it from the nozzle



1, Oxy-fuel gas 2, Compressed air, 3; Flame
4. Work Piece, 5 **Automized Spray** 6, Melting
7. Wire.

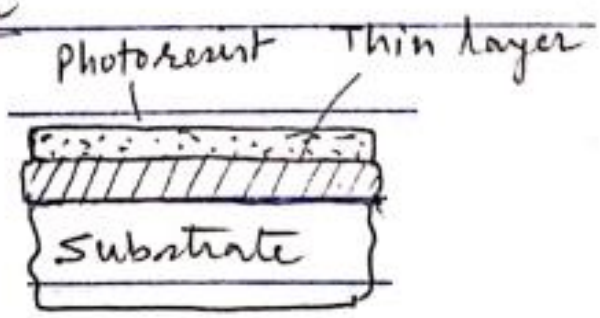
of a Spray gun. In most of the guns the metal in the form of wire is fed by powered rollers to the flame, but some gun uses powder or granulated metal. The process uses compressed air to atomize fully the molten metal or oxides and project them against a prepared surface, where they are embeded, giving good mechanical adhesion. This is illustrated in fig 1. The surface must be roughened first and be free from dirt oil & greare. The compressed air helps cool the work pieces, so that the coatings may be applied successfully not only to metals but to glass, wood, asbestos and certain plastics. Gun may be operated by hand or machine

Metallization: Metallisation is an interesting application of the oxy-accetylene flame. This Technique essentially consists in laying deposits which vary both in nature and in Thickness, on the widest variety of parts.

Principle: The material to be deposited is melted in a flame and subsequently pulverised and sprayed in fine droplets on the part to be Coated. The equipment used is a gun. It comprises a special torch, coupled with a Compressed air pulverising device and a system of feeding the product.

Any product can be sprayed: metal ceramic plastics, on to any metal and under certain conditions on to many non-metallic supports; wood, plaster, plastics etc, Metallised surfaces laid in a thin layer of from 40 to 200 µm (zinc and aluminium) provide a much stronger and longer lasting protection against corrosion than any other more or less composite film.

Deposition



As indicated in fig. a thin layer has to be deposited on the substrate. There are a number of metallic methods for deposition of a crystalline layer on the substrate. The common method are epitaxy, sputtering, oxidation, chemical vapour deposition, anodic bonding etc.

Chemical vapour deposition (CVD) that is typically carried out at temperature greater than 1000°C. In molecular beam epitaxy (MBE), The process is carried out in ultra high vacuum. And it is based on

Physical Vapour deposition:

Physical vapour deposition (PVD), sometimes (especially in single-crystal growth contexts) called physical vapor transport (PVT), describe a variety of vacuum deposition methods which can be used to produce thin films and coatings. PVD is characterized by a process in which the material goes from a condensed phase to a vapour phase and then back to thin film condensed phase. The most common PVD processes are sputtering ( ) and evaporation. PVD is used in the manufacture of items which require thin films for mechanical, optical, chemical or electronic functions. Examples includes, semiconductor devices such as thin film solar panels, Aluminized PET

film for food packaging and balloons & Titanium nitride coated cutting tools for metal working. Besides PVD tools for fabrication, special smaller tools (mainly for scientific purpose) have been developed.

Material during deposition gets waste on fixturing on to the parts are held.

Applications: PVD Coatings are generally used to improve hardness, wear resistance and oxidation resistance. Thus such coatings are used in a wide range of applications such as:

- Aerospace
- Automotive
- Dies & moulds for all manner of material processing
- cutting tools
- Firearms
- optics
- watches
- Jewellary
- Thin films (window Tint, food Packaging etc)
- Metal (aluminium, copper, bronze etc)

Organic Vapour phase deposition: For the growth of Thin film of optically non-linear organic salts, The components react to form a polycrystalline thin film on substrates of glass and gold. Excess reactants and reaction products are purged from the system by The carrier gas. The component reacts to form a polycrystalline thin film on substrates of glass or gold. Excess reactants and reaction products are purged from the system by the carrier gas. As an example, we demonstrate the growth of polycrystalline, optically non-linear thin film of 4-dimethylamino-N-methyl-4-stilbazolium tosylate (DAST) with 99% purity