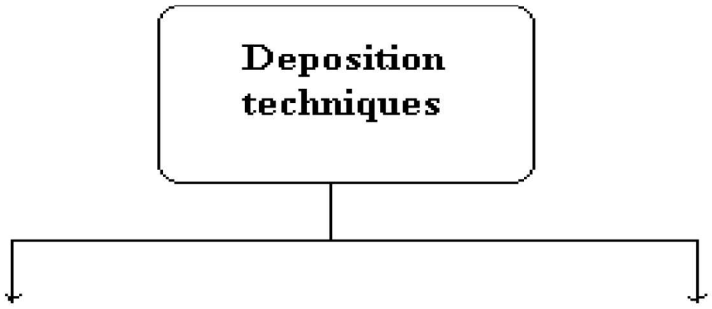
Thin-Film Coatings (μm)



Physical vapour methods

Sputtering

Co-evaporation

Ion implantation

Molecular beam epitaxy

Pulsed laser deposition

Chemical methods

Sol-gel

Solution route

Spray pyrolysis

Spin coating

Chemical vapour deposition
- Organometallic-CVD
- Metallo-organic - CVD
- Plasma Assisted-MOCVD

Classifications of thin-films based on their applications

Thin-film property category	Typical applications
Optical	Reflective/anti-reflective coatings Interference filters, Decoration (colour, luster), Memory discs (CDs), Waveguides
Electrical	Insulation, conduction, Semiconductor devices, Piezoelectric drivers
Magnetic	Memory discs/devices
Chemical	Barriers to diffusion or alloying Protecting against corrosion or oxidation Gas/liquid sensors
Mechanical	Tribological (wear resistant) coatings Hardness, Adhesion, Micromechanics
Thermal	Barrier layers, Heat sinks

Physical Vapor Deposition (PVD)

- PVD is a process to produce a metal vapor that can be deposited on conductive materials as a thin highly adhered pure metal or alloy coating.
- The process is carried out in a vacuum chamber at high vacuum (10^{-6} torr).
- Single or multi-layer coatings can be applied during the same process cycle.
- Additionally the metal vapor can be reacted with various gases to deposit Oxides, Nitrides, Carbides or Carbonitrides.

The coating method involves purely physical processes such as high temperature vacuum evaporation or plasma sputter bombardment rather than involving a chemical reaction at the surface to be coated.

- The parts to be coated are first cleaned. The cleaning process varies depending on the level of quality from the electroplater, substrate material and geometry.
- The parts are loaded into the vacuum chamber on custom fixtures designed to optimize the chamber load size and ensure coating uniformity.
- The vacuum chamber is evacuated to 10^{-6} torr (high vacuum) to remove any contaminants in the system.
- The vacuum chamber is backfilled with an inert gas argon and ionized, resulting in a glow discharge (plasma). This is the gas cleaning stage and prepares the parts for the initial metal deposition.

The process involved four steps:

- Evaporation.
- Transportation.
- Reaction.
- Deposition.

EVAPORATION

During this stage, a target, consisting of the material to be deposited is bombarded by a high energy source such as a beam of electrons or ions. This dislodges atoms from the surface of the target, 'vaporising' them.

TRANSPORT

This process simply consists of the movement of 'vaporised' atoms from the target to the substrate to be coated and will generally be a straight line affair.

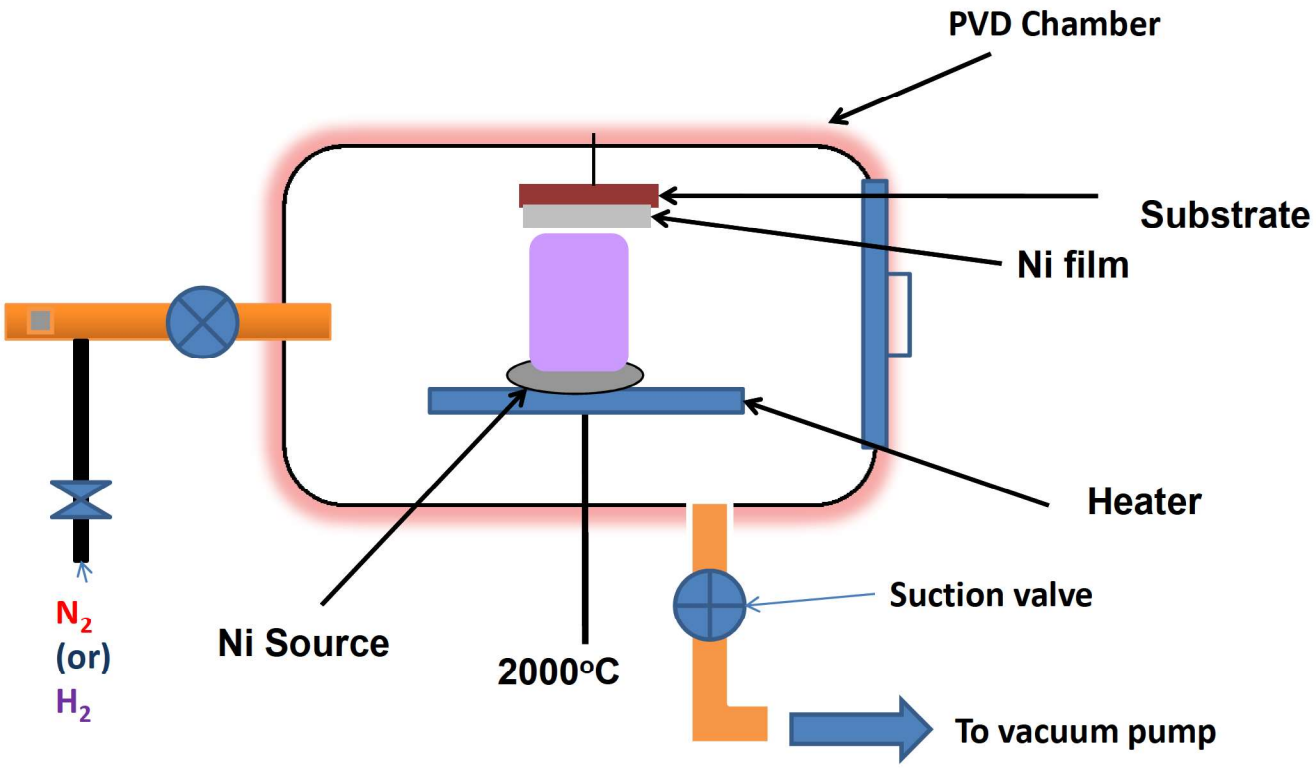
REACTION

In some cases coatings will consist of metal oxides, nitrides, carbides and other such materials. In these cases, the target will consist of the metal. The atoms of metal will then react with the appropriate gas during the transport stage. For the above examples, the reactive gases may be oxygen, nitrogen, acetylene or methane.

DEPOSITION

This is the process of coating build up on the substrate surface. Depending on the actual process, some reactions between target materials and the reactive gases may also take place at the substrate surface simultaneously with the deposition process.

Physical Vapor Deposition (PVD)



Titanium Nitride coated punches

Aluminium Titanium Nitride coated

Aluminium Chromium Titanium Nitride coated