Background

Physical vapor deposition (PVD) is fundamentally a vaporization coating technique, involving transfer of material on an atomic level. It is an alternative process to electroplating

The process is similar to chemical vapor deposition (CVD) except that the raw materials/precursors, i.e. the material that is going to be deposited starts out in solid form, whereas in CVD, the precursors are introduced to the reaction chamber in the gaseous state.

It incorporates processes such as sputter coating and pulsed laser deposition (PLD).

How Does Physical Vapor Deposition Work?

PVD processes are carried out under vacuum conditions. The process involved four steps:

- Evaporation
- Transportation
- Reaction
- Deposition

Evaporation

During this stage, a target (i.e. faucet), 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, ‘vaporizing’ them.

Transport

This process simply consists of the movement of ‘vaporized’ 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 and methane. In instances where the coating consists of the target material alone, this step would not be part of the process.

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.

What are PVD Coatings Used For?

PVD coatings are deposited for numerous reasons. Some of the main ones are:

- Improved hardness and wear resistance (Our Business)
- Reduced friction
- Improved oxidation resistance

The use of such coatings is aimed at improving efficiency through improved performance and longer component life. They may also allow coated components to operate in environments that the uncoated component would not otherwise have been able to perform.

Advantages of the Physical Vapor Deposition Process

- Materials can be deposited with improved properties compared to the substrate material
- Almost any type of inorganic material can be used as well as some kinds of organic materials
- The process is more environmentally friendly than processes such as electroplating

Disadvantages of the Physical Vapor Deposition Process

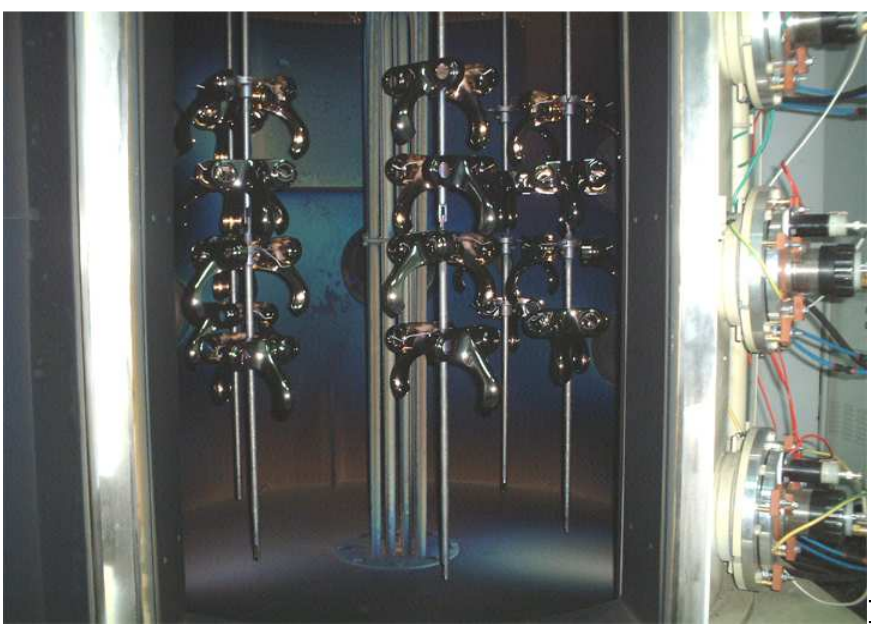
- It is a line of sight technique meaning that it is extremely difficult to coat undercuts and similar surface features
- High capital cost
- Some processes operate at high vacuums and temperatures requiring skilled operators
- Processes requiring large amounts of heat require appropriate cooling systems
- The rate of coating deposition is usually quite slow

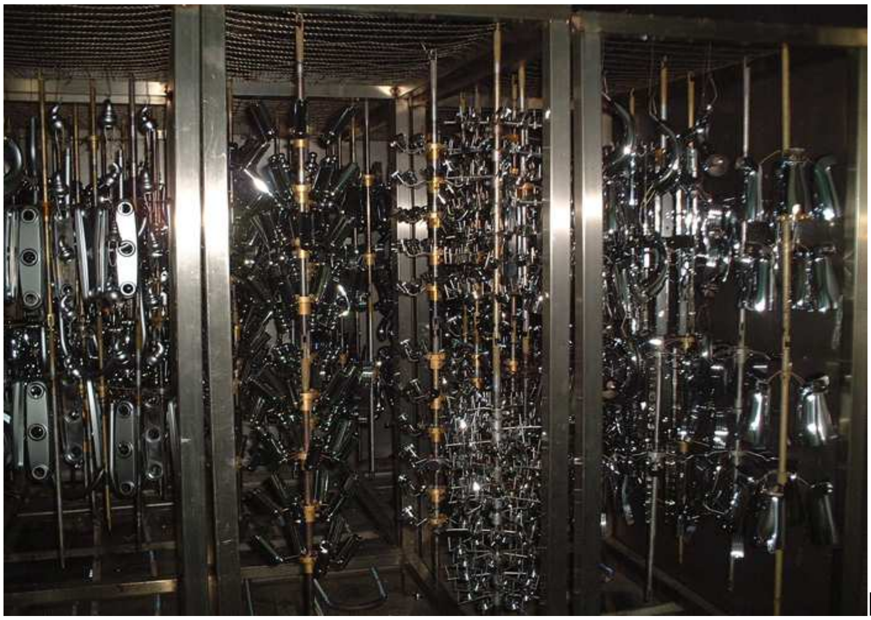
Applications

As mentioned previously, PVD coatings are generally used to improve hardness, wear resistance and oxidation resistance. Thus, such coatings use in a wide range of applications besides faucets and trim such as:

- Aerospace
- Automotive
- Surgical/Medical
- Dies and moulds for all manner of material processing
- Cutting tools
- Fire arms


PVD Chamber


Inside the PVD Chamber



Post-PVD Process Dry

Thickness Test