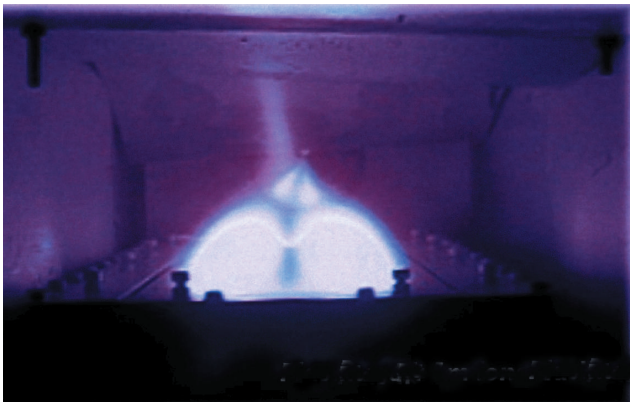
COATING TECHNOLOGY – PROCESSES



Plasma test 1m long cathode.

Pilkington has long been a pioneer in the development and commercialization of glass coatings. Historically the company has used and developed many different technologies, but for a coating technology to be applied commercially to glass it must meet several criteria. It must be:

- Compatible with the properties of glass
- Able to form uniform thickness films over large areas
- Able to vary the thickness of these films accurately
- Able to produce final product at rates which make it economically viable
- Be safe to operate & environmentally friendly

This restricts the number of useful technologies. Those which the Group uses today are:

- Vacuum processes also known as Physical Vapour Deposition or PVD
- Chemical Processes also known as Chemical Vapour Deposition or CVD

Pilkington has been active in developing both technologies for products in its major markets.

PVD Plasma Vapour Deposition

The basic process is simple - ions formed in a gas plasma are accelerated on to a target causing target material to be ejected and deposited onto the substrate.

The plasma is formed from argon or other sputter gases introduced in to the vacuum and is controlled using a magnetic field. By varying the targets, gases and voltages a variety of materials ranging from pure metals and oxides to mixed oxide/ nitrides can be commercially deposited.

By combining different materials, coatings can be formed which selectively absorb and reflect different wavelengths of light.

Magnetron Sputtering

The invention of “planar magnetrons” in 1971 allowed coatings to be sputtered in vacuum at much higher rates. This combined with the fact that sputtering could be achieved in any desired direction meant coatings could be sputtered downwards on to a moving glass substrate. This enabled a laboratory process to be scaled to a continuous coating process capable for use in the commercial production of large area coated glasses.

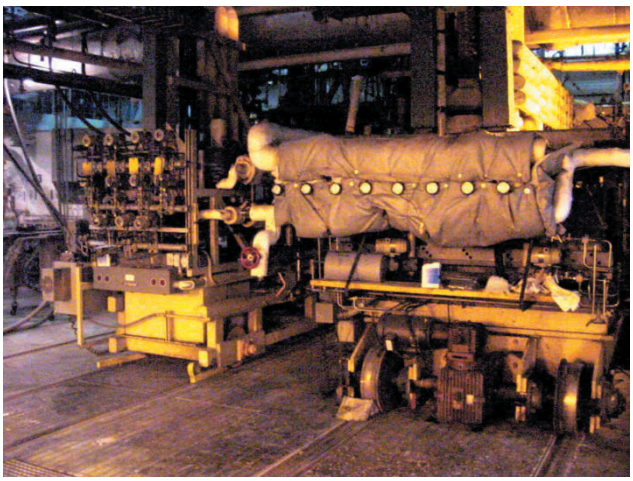
Multi-layer coatings using different materials are needed for the highest optical performance. Computer modelling now means the optical properties of coatings containing seven or more layers can be predicted, with only minimal experimental trials needed before full scale production. High performance solar control coatings can be produced, based on ultra-thin metallic silver layers sandwiched between oxide layers, which combine high near-infrared heat reflection with high visible transmission.

Today sputtering is the most important flat glass coating process in use. Worldwide many million square meters per year of float glass are coated by sputtering, a volume which is increasing steadily.

Chemical Vapour Deposition (CVD)

In this process, a gaseous chemical mixture is brought in contact with the hot glass substrate (approximate temperature range: 900°F – 1350°F) and a pyrolytic reaction occurs at the surface of the substrate leading to the deposition of a coating which bonds to the glass.

The application of this principle in a float glass manufacturing environment is complex and took many years of continuous development and refinement. From a relatively simple graphite system capable of depositing a single layer, the technology has evolved over the past 25 years into a state-of-the-art multiple coating process.



Chemical vapour deposition equipment

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