OSRAM XERADEX® SEMI Applications

Photoinduced Surface Activation
Photoinduced Ablation of Plastics
Photoinduced Metallization

Radiation induced processes enable new, innovative and easy processes. The photoinduced processes like surface activation, plastic ablation or metallization are based on different process parameters. The following descriptions for each process are introductory guidelines for users. Depending on the application and the materials involved, the user must perform experiments to match optimum process parameters to the individual process situation.

- **Photoinduced Surface Activation**

The surface activation by XERADEX vacuum ultraviolet (VUV) radiation improves the adhesion of the surface and of the subsequent layers applied to this treated surface. The XERADEX ozone/VUV process makes it easy to adjust the surface wettability (hydrophilic or hydrophobic). Here, the surface is irradiated with the XERADEX lamp. The activation is effected by the interaction of the high energy VUV radiation and ozone with the surface.

As an example: a SiO_2 surface can be strongly adjusted hydrophilic within seconds – the contact angle or angle of wettability can be changed from 70° to 5°.

- **Photoinduced Ablation of Plastics**

In this process, plastic surfaces are irradiated in air at lower pressure (see table). The molecular bonds between the polymer chains are directly dissociated. The etch rate of this process strongly depends on the material and texture of the plastic material that is being irradiated. For example, the etch rates in 5 mbar air at an irradiation intensity of 30 mW/cm^2 at 172 nm are given for a few plastics:

PTFE (polytetrafluoroethylene):	1.0 µm/min.
PMMA (polymethylmethacrylate):	0.15 µm/min.
PI (polyimide):	0.05 µm/min.

These values should only be used for estimation, as etch rates are very process-dependent and must be determined with regards to specific parameters and materials.

- **Photoinduced Metallization**

The photoinduced metallization of a substrate is a non-heat process and applicable to all types of substrates – even plastics. The process itself consists of two steps. First, the substrate is precoated with a thin palladium layer (several nanometers) and then this palladium layer is reinforced with copper or gold, e.g., by conventional copper bath. Many different substrates, such as plastics, glasses or glass ceramics, e.g., Al_2O_3 can be metallized. Photoinduced metallization is a process conducted at room temperature, so the substrates are not thermally stressed.

The substrate to be metallized is placed in a liquid palladium acetate solvent in chloroform. This layer dries quickly, since chloroform is volatile. This palladium acetate layer is then irradiated at reduced pressure in a chamber with the XERADEX radiation (see table for pressures and irradiation times). Depending on the layer thickness and irradiation time, the palladium (II) acetate is completely decomposed to pure palladium. The substrate is now covered with a pure palladium layer and can be reinforced with any metal by conventional plating procedures.

The adhesion of the metallic layer depends on the substrate material and the thickness of the palladium layer. The adhesion, e.g., for Al_2O_3 substrate is between 1.5 – 15 N/mm^2.

Table: Parameters for Photoinduced Processes

	Surface Activation	Plastic Ablation	Metallization
Gas Atmosphere	Air	Air	Air
Pressure	100 –1000 mbar	1 – 10 mbar	1 – 10 mbar
Irradiation Distance	1 – 5 mm	5 – 20 mm	5 – 20 mm
Irradiation Time	0.5 – 5 min., depending on pressure	Depends on material and thickness	Several seconds to 3 minutes
Process Sequence	Process immediately after activation	Evacuation Irradiation	Precoat with palladium and continue with conventional metallization processes

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