Gas plasma as a tool to effectively clean, activate, or functionalize glass.

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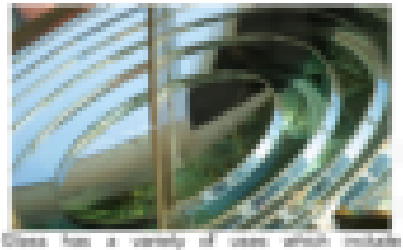


Glass has a variety of uses which include microscope slides and optic lenses. For different applications, the cleanliness and preparation of glass is extremely important. Some of these applications include: optical lens cleaning and activation prior to IR coating or anti-scratch coating, optics cleaning for laser applications, glass slide cleaning prior to microarray use or nitrocellulose coating, and glass bonding such as glass to glass, and glass to metals or polymers. Gas plasma can be used to clean glass on the molecular level, chemically activate, and functionalize the surface of glass.

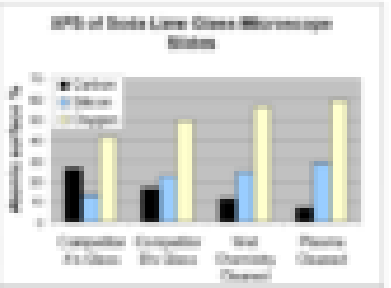
What is plasma?

Plasma is a state of matter just as a solid, liquid or gas. Add enough energy to a gas and it becomes ionized into the plasma state. Chemically it is a highly reactive environment that is used to change the properties of surfaces without affecting the bulk material.

Plasma processing is capable of removing organic contamination at the molecular level subsequent to machining, tooling and wet chemical processing steps. Plasma cleaning acts on surfaces in a conformal fashion, not only for substrates of complex geometries but also on textured surfaces with "rough" topographies.

Precision plasma surface cleaning

Using x-ray photoelectron spectroscopy, elemental surface atomic species were measured on soda lime glass microscope slides as a function of different grades of microscope slides. High signals from carbon indicate high levels of organic contamination, where as high signals from silicon and oxygen indicate a clean surface.



Bar chart showing relative atomic percentages of carbon and silicon as a function of different microscope slide glass, performed at PVA TePla America.

From the graph above it is clear that the highest signals from silicon and oxygen, and the lowest signal from surface carbon come from the plasma treated surface. Competitor A and Competitor B's glass both claimed to be premium and ultra clean, but from the results, it is clear that the microscope slide that was plasma cleaned showed the lowest level of surface contamination. The glass slide which was wet chemistry cleaned, went through the following steps: sonication, acid wash, overnight base wash, double distilled H_2O wash, and N_2 gas dry. The plasma cleaned glass slide was treated with plasma for 10 min.

Gas plasma has another advantage over wet chemistry in that only gases are used. This means that chemicals never need to be disposed of which can be costly and can pose environmental risks. Also, the results from gas plasma are highly reproducible, where as sonicators, used with chemicals to clean glass, accumulate organics and debris which can affect the accuracy of cleaning. Once glass has been plasma cleaned, there is no window for shelf lifetime.

Plasma surface activation

By raising the surface energy of glass, the surface becomes readily available to adhere to cells and bio molecules, which is important in the life sciences. In addition, once the surface activation is increased, functional groups can be deposited via a PECVD-like process.