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Tech Feature

## Gas Purging Keeps UV Systems Healthy

Photochemical deposition of organic films is a significant cause of performance loss in ultraviolet systems; when feasible, it can be reduced or eliminated with inert gas purging.

BY DR. ADAM NEEB AND DAVID HILY McPHERSON INC.

Ultraviolet photons are highly energetic – enough to break bonds and ionize molecules. They can efficiently reduce silver salts to photographic emulsions and damage DNA by disrupting thymine bases. UV spectroscopy yields insight into high-energy processes in planetary atmospheres, stars and fusion reactions. Also, UV light's short wavelength means less diffraction, enabling higher-resolution microscopes and lithography systems. Excimer UV (EUV), 19-120 nm lithography is expected to revolutionize microelectronics by pushing minimum line widths to the atomic level.

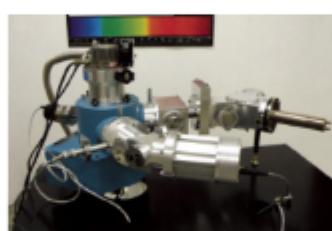


Figure 1. Ultraviolet light can be used to study chemical reactions and measure light intensity. An inert gas purging tube directs low-pressure gases, as well as reflective coatings and sensors, to the instrument.

But making and measuring light below 200 nm demands special experimental considerations and presents a unique set of challenges. EUV measurements require high-vacuum chambers, expensive all-reflective optics and exotic windowing light sources – virtually every material is completely opaque to these highly energetic photons.

For EUV measurements (20-200 nm), demands are less stringent. Flexible reflective optics replace silica, and the vacuum-etching components of air bearings, wave optics, and fiber bundles must be designed or treated from the experimental apparatus. However, the high energy that makes UV light so interesting can cause a serious problem that plagues even the best and most precise UV-measurement systems – the photochemical formation of organic films on optical surfaces with subsequent degradation of performance.

Millions of dollars have been spent to search for solutions to the film-formation problem – what is an alternative to a ground-based instrument in a clean room for use in space, which of course cannot be readily serviced. Engineering solutions include in situ UV-curve cleaning, oxygen cleaning of optics and a laundry list of other techniques (laser optics, in situ mirror cleaning, addition of contaminants, etc.) absolutely none of which are both effective and inexpensive.

For superior dual spectroscopic experiments or process-critical QC instruments, this presents a serious problem. To control the growth of organic films in UV and excimer, UV measurements can

ing from chamber walls, samples and perhaps the user's fingertip. Over time, these films cause increasing, wavelength-dependent loss of performance. Further, the growth rate and optical properties of these films depend strongly on the type and quantity of contaminants, and on the intensity and wavelength of the UV light source.

Degradation due to photochemical film deposition can be reversed by cleaning the optics, but for delicate surfaces such as gratings, this simply may not be possible. Furthermore, the process of erasing and re-coating mirrors, along with repolishing lenses, is expensive and time-consuming and takes the instrument offline.

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## Gas Purging Keeps UV Spectrophotometers Healthy

Measuring in the far-UV (FUV) 120-220 nm presents unique challenges. The high energy that makes UV light interesting can cause photochemical formation of organic films on optical surfaces. These films cause increasing, wavelength-dependent loss of performance. To control the growth of organic films, UV measurements can be made in an inert gas atmosphere (typically nitrogen) rather than under vacuum. Nitrogen gas in UV spectrophotometers reduces contaminant desorption and photopolymerization, without decreasing optical performance.

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