Why is a good PID lamp important? … and how to get the best out of it.

OPTICS + ANALYTICS

This technical note explains PID lamp spectra and how PID lamps age over time, what is best practice for ensuring long term stability, and why PID lamp quality is important.

Purity of Spectrum

Purity of the spectrum is important for good lamp operation. The presence of secondary lines due to contaminants can affect the intensity of the primary lines, lamp intensity and lifetime. The emission spectrum of a 10.6 eV lamp in figure 1 shows the relative intensity of the two lines at 10.0 and 10.6 eV, together with the absence of any interference and a stable baseline.

However, contamination of the lamp can occur at higher wavelengths mainly due to hydrocarbons. Whilst this does not interfere with the VUV lines in terms of detection of VOCs, the contamination absorbs some of the energy from those lines, resulting in decreased sensitivity and a shorter life time. The spectrum in figure 2 shows the difference between a Heraeus lamp and a competitor's in the UV/visible range. Reasons for long term spectral purity of Heraeus lamps are discussed later in the high quality materials section.
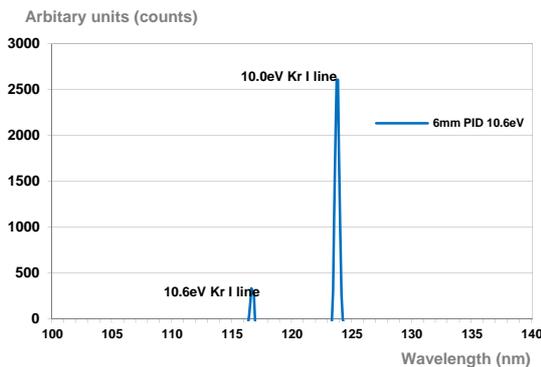

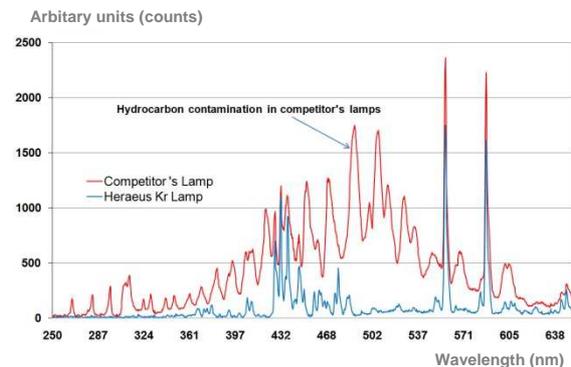*Fig. 1: Vacuum UV Wavelength scan of a 6mm Krypton 10.6eV PID Lamp*

Fig. 2: Scan of Kr filled PID lamps showing spectral purity in the UV-Vis region, Heraeus Kr lamp against a competitor's Kr lamp

Long term stability and calibration

Both 10.6eV and 9.6eV lamps were powered continuously in the PID-A1 (miniPID). Sensitivity to isobutylene was checked at regular intervals and the results are shown in figures 3 and 4 below.

Fig. 3: 10.6eV PID lamps
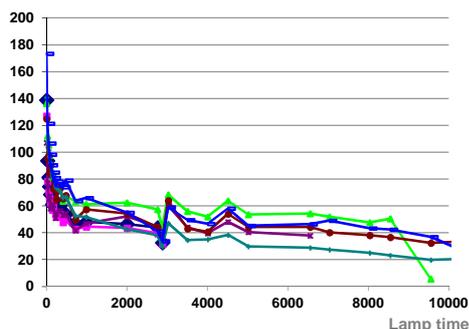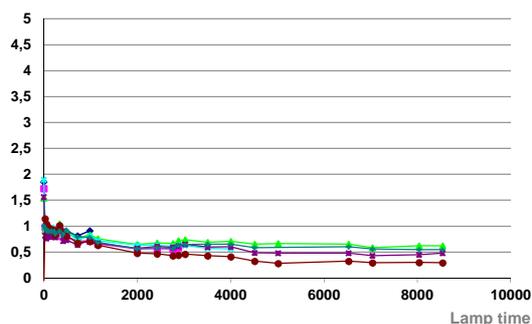

Fig. 4: 9.6eV PID lamps

Both lamps show the same trend: an initial stabilisation time, then long term stability. This makes sense: as the lamp is initially operated, the combined glass, window, glass seal, gas and getter all need to stabilise. This stabilisation time is undertaken by the lamp and PID suppliers, so you should receive a lamp with PID that is already stabilised.

Calibration period requires knowledge of both the environment (temperature, humidity, competing gases) and the target gas concentration. The recommended procedure is to set the PID system operating, then check calibration after one month and recalibrate if required. After this initial calibration, the calibration period can be extended: the calibration interval depends on the required accuracy, the environmental conditions and criticality of the measurement for health and safety.

Maintenance of output intensity

Cleanliness of the electrode stack

Use of the PID in a dirty environment will frequently lead to loss of sensitivity due to contamination of the electrode stack. Therefore, if the sensitivity has decreased significantly, then first run the PID in clean air for at least 24 hours to scrub the electrode stack and clean any residues from the lamp window. It is useful to switch off the pump for several hours to improve cleaning efficiency.

Cleanliness of the lamp

The cleanliness of the PID lamp crystal window is extremely important to ensure high photon output and good detector sensitivity. Even a very thin film of deposited hydrocarbons can absorb VUV photons. Therefore, it is important to maintain a clean window surface, especially when working with higher contamination levels in the atmosphere. In terms of best practice for normal routine cleaning, the use of laboratory grade Methanol is recommended, applied using a clean soft lens tissue, cotton wool or cloth and ensuring the surface is dry before reinserting the lamp into the sensor.

In extreme conditions where the concentrations of incident VOC's are high, some photo attachment of hydrocarbons can occur that cannot be removed with Methanol. Under these circumstances a polishing

Fig. 5: Cleaning the lamp crystal window

compound is recommended, such as high purity Alumina (Aluminium Oxide - Al_2O_3) of less than 5 microns particle size mixed with methanol or a fine diamond polish such as Kemet 1-W-C2. This can be applied using a cotton bud in a circular motion. The Alumina or diamond paste then needs to be removed with a soft cloth before finishing with another clean with Methanol as described above and see figure 5.

Another window surface cleaning technique that can be used without removing the lamp from the sensor is "ozone scrubbing". This can be achieved by running the sensor/lamp firstly in clean air and then reducing the pump speed. The oxygen in the sample cell is photoionised to form Ozone, which can react with hydrocarbon deposits on the lamp window and in some cases detach them from its surface. Keeping a low flow rate then ensures that these deposits are removed over time from the sampling system.