Technical Note

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Choosing the Correct Xenon Bulb: Ozone Free or Ozone Generating?

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The Xe1 continuous xenon arc lamp can be operated with ozone free and ozone generating light bulbs. If the Xe1 is fitted with an ozone generating bulb, measures must be taken to extract the harmful ozone generated during operation of the lamp. A duct coupling that is fitted to the upper part of the xenon lamp housing can be supplied for this purpose.

Ozone is generated when oxygen is optically excited by light with wavelengths less than 190nm. Ozone generating xenon bulbs are manufactured with synthetic quartz envelopes that transmit light with low wavelengths and therefore ozone is generated in the surrounding air. Ozone free xenon bulbs are made from other UV-transmitting glasses that are specially made to cut off (absorb) light below 200nm to avoid ozone generation. However, the cut-off is not sharp; there is some absorption to about 260nm, thus reducing the amount of UV light available for sample excitation.

Edinburgh Instruments supply the ozone-free bulb as standard with the Xe1 continuous xenon arc lamp, however for customers who require lower excitation wavelengths ozone generating bulbs are available.

This technical note gives an overview of the wavelength dependence of excitation light for ozone free and ozone generating xenon bulbs; reference is also made to the effect of different gratings in the excitation monochromator.

Different Gratings in Excitation Monochromator

Figure 1 below show measurements using the reference detector of an FLS980 spectrometer including a double grating excitation monochromator and an ozone generating xenon bulb. The orange graph refers to the standard set of gratings for a double excitation monochromator (2 x 1200g/mm, ruled, blaze at 300nm), whereas the green graph is a measurement that uses an optional grating set (2 x 1800g/mm, holographic, optimised for 250nm). Both graphs are scaled, but the differences between them are representative.

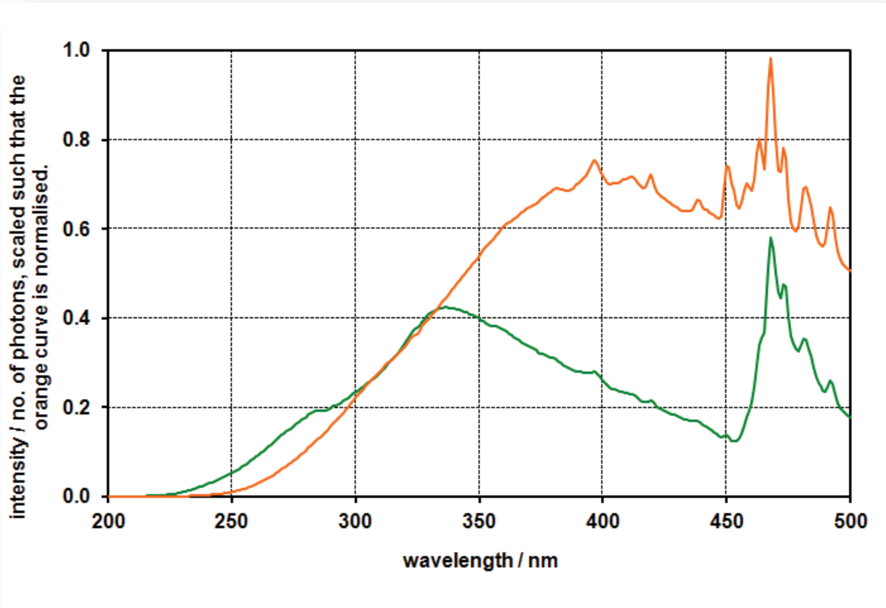

Fig. 1. Excitation correction curves for two different grating sets in a double excitation monochromator.
Orange: 1200 g/mm blazed at 300 nm
Green: 1800 g/mm blazed at 250 nm

It should be noted that the optional grating (1800g/mm, holographic, optimised for 250nm) in the measurement shown above is the standard grating in single grating excitation monochromators. Therefore, all measurements shown in this technical note using this grating should be representative for FLS980-stm spectrometers with single excitation monochromators.

Comparison between Ozone Free and Ozone Generating Bulbs

The measurements of figures 2 – 5 show the wavelength dependence of the number of photons available for sample excitation. All curves are normalised to the peak intensity in the 300nm to 400nm region. As the differences are small, in particular for the 1200g/mm, ruled, 300nm blazed gratings, figures 4 and 5 show the same data in logarithmic scale.

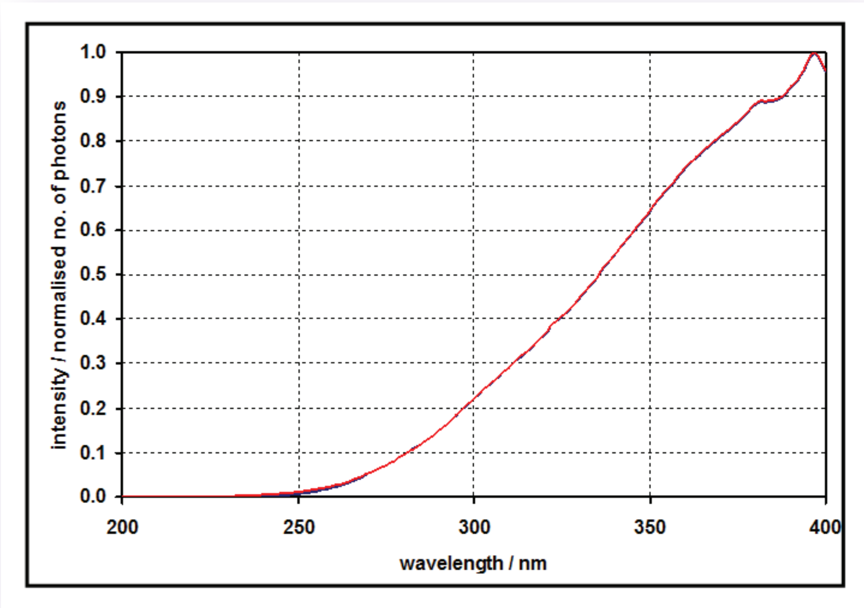

Fig. 2 Normalised excitation correction curves for a lamp fitted with an ozone free bulb (blue) and ozone generating bulb (red); the excitation monochromator is fitted with a 1200g/mm, ruled, 300nm blazed grating

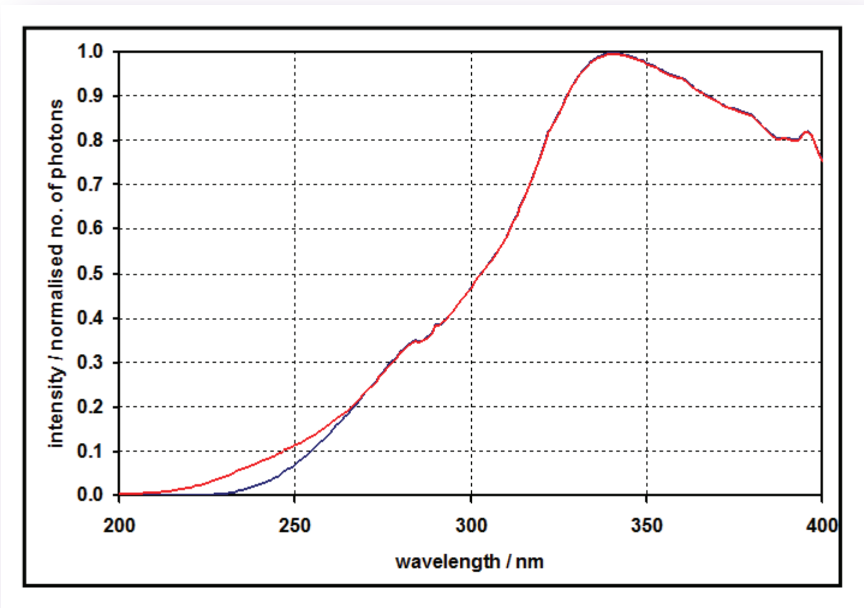

Fig. 3 Normalised excitation correction curves for a lamp fitted with an ozone free bulb (blue) and ozone generating bulb (red); the excitation monochromator is fitted with a 1800g/mm, holographic, 250nm optimised grating

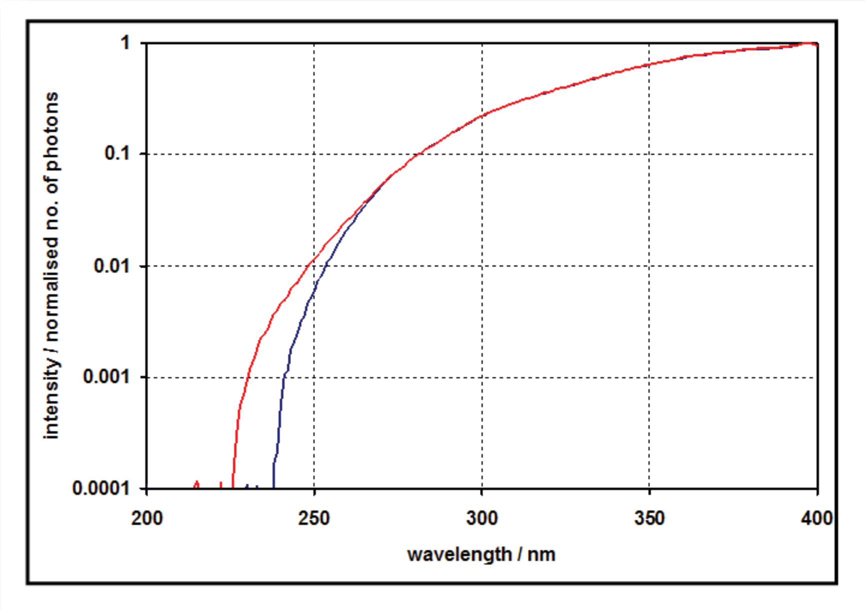

Fig. 4 Same data as in figure 2, but semi-logarithmic presentation

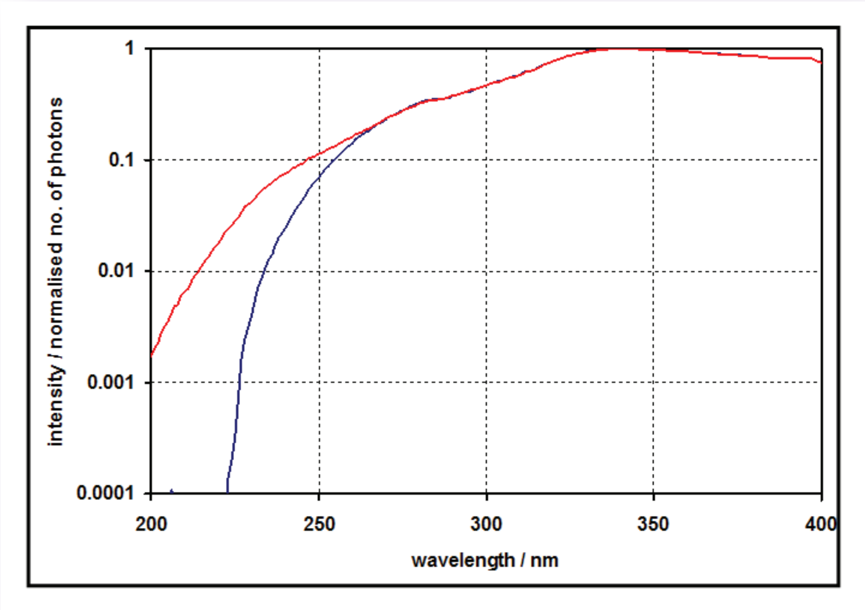

Fig. 5 Same data as in figure 3, but semi-logarithmic presentation

The data above shows that, provided a suitable set of gratings had been selected, the range of excitation extends down to 200nm with an ozone generating bulb fitted to the Xe1 xenon lamp. However, a reduction in the number of available photons for sample excitation when moving to shorter excitation wavelengths is unavoidable.

For routine measurements with excitation wavelengths as short as 200nm, a double excitation monochromator is preferred over a single monochromator, as the higher spectral "purity" of the light transmitted through a double monochromator is particularly important when selecting light in a spectral range of low intensity and a broad, orders of magnitude more intense continuum at longer wavelength must be efficiently suppressed.

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