# Vacuum Ultraviolet Spectroscopy

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A variety of materials have spectral signatures in the vacuum ultraviolet (VUV) region of 10–200 nm. VUV spectroscopy is useful for biomedicine, semiconductor testing and other applications. Because the spectral response of standard silicon charge-coupled device (CCD) detectors drops off rapidly at wavelengths as long as 400 nm, and because oxygen and water absorb in the VUV spectral band, maintaining sufficient signal outside a vacuum is not possible. Nitrogen purging of the spectrometer helps to mitigate water and oxygen absorption in the VUV, but spectrometers with a vacuum purging feature require custom configuration and are too expensive and unwieldy for many common applications.

## Testing the Maya2000 Pro Miniature Fibre Optic Spectrometer

The Maya2000 Pro Spectrometer *(Figure 1)* delivers high quantum efficiency and high dynamic range and is responsive in the deep UV (~185-300 nm). The Extra-Deep UV option extends spectral measurements to 153 nm. The spectrometer features a 101.6-mm focal length optical bench with a compact crossed Czerny-Turner design and a back-thinned CCD detector that offers superior UV and VUV performance. To minimise signal attenuation inside the optical path, the spectrometer bench is purged with nitrogen, achieving a robust signal for VUV experiments at wavelengths as low as 153 nm.


*Figure 1. The Maya2000 Pro spectrometer is responsive in the deep UV with options to measure down to 153 nm*

## Experimental Conditions

To test performance, a Maya2000 Pro was configured with a high resolution, UV-enhanced 2400g/mm holographic diffraction grating and a 5 µm slit. The back-thinned detector (Hamamatsu S10420-1106) features a peak quantum efficiency of 75%, with UV quantum efficiencies as high as 50%. A custom magnesium fluoride (MgF2) glass window is placed over the detector for improved transmission over VUV wavelengths.

The test sample for the experiment was a VUV deuterium lamp with a VUV-grade optical window, coupled directly to the spectrometer. We enclosed the source and spectrometer and purged the region with standard laboratory-grade nitrogen.

## Results

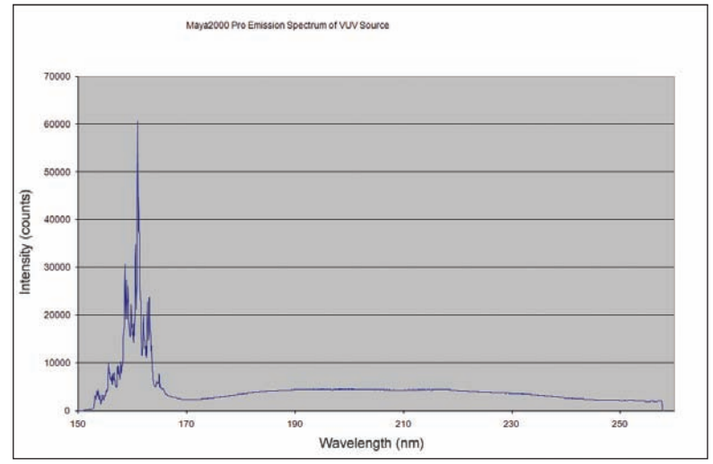


*Figure 2. The sharply defined spectral peaks at wavelengths as low as 153 nm as measured using the Maya2000 Pro*

Integration time for the measurement was 50 ms. The resultant emission spectrum shows sharply defined spectral peaks at wavelengths as low as 153 nm, with a strong central peak around 161 nm *(Figure 2)*. The system operated with a spectral resolution of 0.1 nm and a signal-to-noise ratio of 450:1.

The system was also used to measure a solution containing carbon, hydrogen/deuterium, nitrogen, oxygen, sulphur, chlorine, bromine, silicon and fluorine chromatographically separated into a column and placed in a vacuum chamber with a helium plasma mixture. VUV spectral features were clearly apparent in the spectrum, suggesting a wide variety of short-wavelength applications is achievable.

## Conclusions

The results demonstrate that the reliable and economical Maya2000 Pro can be easily extended to VUV applications. If you have spectroscopy experiments or applications in the VUV, look no further than the Maya2000 Pro as your short-wavelength, affordable, robust solution.