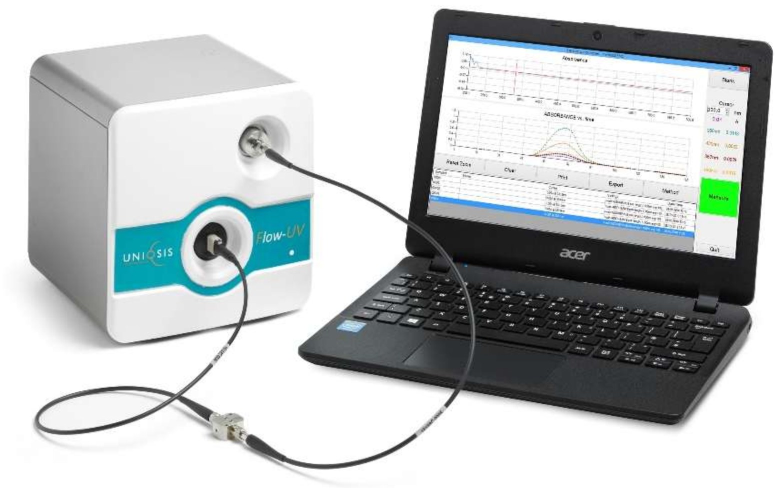
FlowUV

Versatile UV-Vis spectrophotometer

The **FlowUV** from Asynt is a low cost, full-spectrum inline UV-Vis spectrophotometer designed for both flow chemistry and batch applications.

Little knowledge of spectroscopy is required as Asynt can offer an integrated and optimised hardware solution for each application, while the firmware and software ensure that the user interface is quick to learn and easy to use for both expert and novice operators.



An overview of features

The integrated design of the FlowUV UV/Visible fibre optic coupled spectrometer conserves bench space by housing all power supplies, electronics, optics and light sources in one attractively styled cover. The instrument includes a powerful Xenon flash lamp, which is controlled by the electronics and synchronised with the detector. Full wavelength scans take 50mS and the intuitive software provides many interesting features. The digital I/O facility allows the software to be externally triggered or provides a trigger to other devices.

The spectrometer can be supplied with conventional Cuvette holders, reflectance probes, dip probes or a range of flow cells. Flow cells are particularly applicable to flow chemistry applications for in-line monitoring or accurately triggered collections.

The pulsed Xenon source has a range of 190-1050 nm with a near-IR option available. A big advantage of this instrument is the ability to monitor up to five different wavelengths at the same time.

For those new to spectrometers, or for people used to using conventional bench-top spectrometers, solid state spectrometers such as the FlowUV may be a new option.

We explore the differences and advantages of traditional spectrometers vs the FlowUV in this guide.

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1. Comparing fibre-optic coupled spectrometers with traditional bench-top spectrometers

1.1. Conventional Spectrometers.

First, we'll explore how a traditional bench-top spectrometer works. Many people will be familiar with these devices. The image below shows the complexity of the internal workings of these spectrometers.

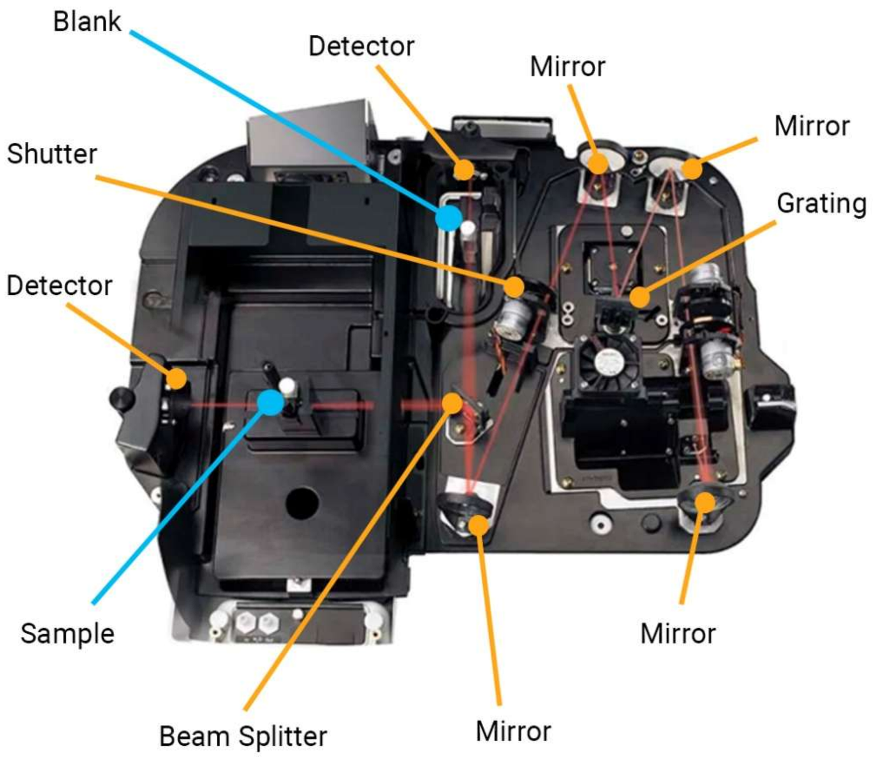

Image 1: *What's inside a conventional bench-top spectrometer?*

1.2. Mechanical parts:

In a conventional, bench-top spectrometer, measurements are made using the movement of intricate parts. These delicate parts must be carefully handled and require regular calibration.

Frequent calibration is required, firstly, due to the wear and tear of the mechanical parts and secondly, the optics gradually become contaminated due to the forced air cooling of the lamp assembly.

1.3. Illumination system:

A traditional spectrometer uses two lamps to cover the UV/vis wavelength range. The first lamp that covers the visible light spectrum, is based on an incandescent tungsten filament with a halogen filled quartz glass envelope. This lamp has a service life of around 3,000 hours.

The second lamp is a type of arc lamp, it is filled with deuterium gas. It has a life of approximately 2,000 hours. Both lamps illuminate the sample via apertures, mirrors and diffraction gratings. These surfaces are a magnet for the dust in the air and the dust eventually builds up and bakes into the surface of the optical parts requiring their replacement.

1.4. Light tight sample compartment:

A light tight seal is required around the sample chamber to prevent any extraneous light entering the optics of the spectrometer and corrupting the measurement of the sample.

1.5. Instrumentation heating the sample:

The heat generated from the hot lamps does eventually reach the sample compartment and that has a likely effect of changing the optical properties of the sample under test. To attempt to overcome this issue, manufacturers place a temperature controlled thermal cell, usually, as a high-cost option, into the sample compartment.

1.6. Time required to take a measurement:

Due to the mechanical nature of the conventional spectrometer, measurements across a wavelength range takes a long time. In image 1, note the stepper motor that needs to rotate the grating, over an 800nm range, that would require 800 steps (without returning to home to re-zero) each step taking around half a second. An entire spectrum from this type of spectrometer is likely to take around six minutes!

When switching between light sources at around 350nm, a set of filters is rotated and a mirror inside the lamp assembly switches from the deuterium lamp to the tungsten lamp, it is this mirror in particular that becomes damaged over time from dirt, heat and UV exposure and that in turn reduces the amount of light produced by both lamps leading to a costly service call-out.

1.7. Placement and handling:

As the mechanical spectrometer is made from moving parts, it is very sensitive to temperature and vibration. It is also very sensitive to any form of handling during transit or installation. Much care is required to keep a very constant temperature and a clean, dry environment free of sunlight.

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1.8. Location of sample:

Removing a sample from the system being investigated can be fraught with difficulties, there could be high temperatures and pressures, a radioactive environment, a potentially explosive atmosphere or other conditions that a human would encounter danger when performing a sample analysis. If the sample itself is volatile or poses other dangers to life, the mere transport, storage and disposal of sample becomes very involved.

2. FlowUV - A Fibre Optic Coupled (FOC) spectrometer

We next explore how a solid-state fibre optic coupled spectrometer works. As we progress, you'll see the advantages of these devices.

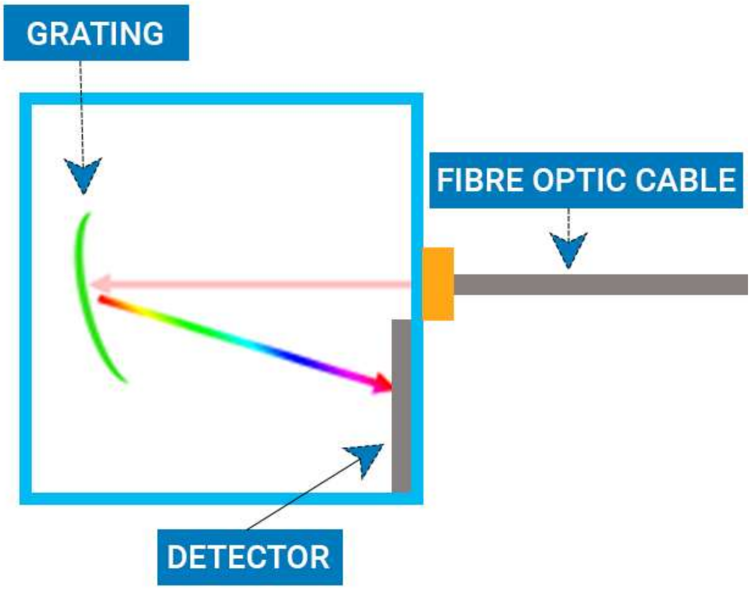

Image 1: *What's inside a solid-state, FOC spectrometer?*

2.1. Mechanical parts:

There are no moving parts in a FOC spectrometer. There are no parts to wear, no parts to need recalibration.

2.2. Illumination system:

A xenon arc flash lamp is integrated into the spectrometer and delivers light to the sample using a fibre optic cable. This lamp covers the entire UV-Vis spectrum and does not require filters or shutters.

The lamp has a life of approximately 100 million flashes, one flash is one spectrum, plenty enough for a lifetime of use.

No heat is produced inside the unit by this lamp and thus does not require a fan for cooling.

2.3. Light tight sample compartment:

As the light enters the spectrometer via an optical fibre, there is no need for a light tight sample compartment.

2.4. Instrumentation heating the sample:

As the sample is not held within the body of the spectrometer, there is no chance of the spectrometer affecting the temperature of the sample.

2.5. Time required to take a measurement:

Due to the lack of moving parts and the rapid response time of the detector, an entire wavelength spectrum can be read within a few milliseconds.

Such a short measurement time for a full spectrum, allows the tracking of quite complex materials and inter-relationships to be achieved in real time. The speed of reading opens the door to real-time process control such as correcting mixtures or indicating readiness of a product for dispensation.

2.6. Location of sample:

The sample can be remote from the spectrometer, for example, within a fume cabinet, or a flow cell can be added to an industrial reactor to measure the sample in-situ. The link from the light source, through the sample and back to the spectrometer is purely light, no electricity, perfect for hazardous environments.

3. Comparing "Home-Made" Spectrometer Options

3.1. Components:

There are several companies that can supply the individual components to enable the user to construct a bespoke spectrometer of their own e.g. the Ocean Optics range of solid-state, fibre coupled spectrometers is comprised of individual modules.

To build a working system, a good degree of knowledge is required about both spectroscopy and the individual modules supplied. These modules give the customer several choices of grating, optical resolutions, light sources and sample holders. Most users purchase the Visible/NIR options which only require a tungsten light source. These versions cannot be used in the UV region and therefore will be low cost. In addition, the end-user is obliged to purchase a standard software package to control the spectrometer and view spectra captured by the spectrometer. Updates to the software and firmware are also charged for separately.

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3.2. Potential issues:

There is a second-hand user market for these individual units and while tempting for some customers, the lack of technical support could be an issue for purchasers, not to mention the uncertainty of the history and functionality of any part of the system.

3.3. Assurances:

The FlowUV spectrometer is offered as a working unit with all the modules built into a single case, except for the flow cells and sample holders.

4. Advantages of the FlowUV

You can see from the comparisons that a solid-state fibre-optic-coupled spectrometer such as the FlowUV has many advantages over more conventional spectrometers. From the longevity of the lamp, robustness with no moving parts, remote sample location and the speed of data capture these instruments make a logical switch away from older, traditional spectrometers.

To help you further explore the advantages we've outlined these below:

4.1. Portability

The instrument has a small footprint of only 18 x 18cms and weighs just over 3kg. It is extremely robust with no moving parts making it suitable for most applications. It can be placed in any laboratory, no need for a dedicated analytical suite, and is suitable for field measurements or anywhere portability is required.

4.2. Remote Measurements

The use of fibres allows the spectrometer to be physically separated from the sampling accessories, enabling measurements in difficult-to-reach or hazardous locations. Examples include measuring in a fume cupboard, or even in a glove box. Fibres can be several metres long. The spectrometer can be used safely in ATEX and other hazardous areas.

4.3. Versatility

The modular nature allows for the interchangeability of probes and accessories, which can be tailored to specific applications such as reaction and environmental monitoring, industrial process control, and biomedical diagnostics. Fast data collection allows real-time measurements on flowing samples which is ideal for the growing area of flow chemistry.

4.4. Immersion Probes

Often called dip probes, fibre coupled devices take the instrument to the sample. Offered with a wide range of sample path lengths and inert materials, dip probes can be used to

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directly measure samples in situ (beakers or even large vats). Micro versions can be used on just a few microlitres.

Dip probes are not compatible with traditional spectrometers because of the effects of ambient light

4.5. Flow Cells

From microlitres to several millilitres, flowcells can be coupled by fibre optic patch cords. Available in a wide range of materials and path lengths. Special versions available for high temperatures and pressures. Once again, we have the advantage that flow cells are placed outside the instrument and therefore there is no size restriction.

4.6. Standard and special cuvette holders

Fibre coupled cuvette holders allow samples to be measured in a wide range of sizes and path lengths. The convenience of being able to place the holder on an open bench will be appreciated by most end users. This cannot be done with a traditional spectrometer.

5. Conclusion

We believe the FlowUV offers advantages that traditional UV-Vis spectrometers simply cannot offer.

Whether you are a beginner or an expert, the easy-to-use software and range of cells and probes offered provides a complete solution for both flow and batch applications.

If you'd like to discuss how the FlowUV would benefit your work, or require any further information, please contact us via the details below.

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