LASER 2000

Optical Products for the Pharmaceutical Industry

- *In-house Cleaning Validation*
- *Mid-IR Liquid Chromatography*
- *Chemical Imaging*

Proud Partner of

PMTC
Advanced Technology Solutions in Pharmaceutical Manufacturing

LASER 2000

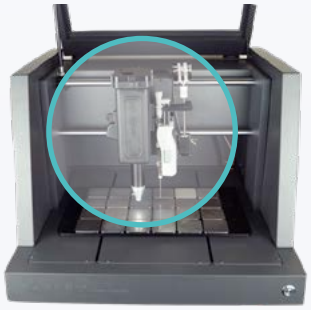
Laser 2000 is a value added reseller of innovative photonic products.

We understand our customers' applications and requirements to develop the best solutions for real-world problems in their industries. This brochure will explore our range of novel optical approaches to cleaning validation and bioreactor monitoring, where processes can be improved to increase productivity and maximise profit, whilst maintaining GMP.

Cleaning Validation

Pages: **4 & 5**

PHOTON SYSTEMS



TraC Handheld Detector

Handheld, non-contact detector which can be used for cleaning validation of process manufacturing equipment, avoiding cross contamination.

- ***Enables in-house cleaning validation***
- ***Detects trace contaminants down to µg/cm²***
- ***Gives accurate measurements in a fraction of the time, compared to swabbing***
- ***The device remains on site, in keeping with GMP***
- ***Maximises efficiency and minimises downtime***

ChemCal Chemical Printer and Mapper

Chemical printer, used for calibrating optical detectors.

- ***Printable in-house calibration for a wide range of chemicals and active pharmaceutical ingredients (APIs)***

Laser

High Performance Liquid Chromatography

DRS DAYLIGHT SOLUTIONS

Pages: **6 – 9**

ChemDetect Liquid Analyser

A high performance mid-IR liquid analyser which can be easily integrated into current HPLC equipment or used for bioreactor monitoring.

- ***Greater sensitivity, compared to FTIR***
- ***High data collection rate (10 Hz)***
- ***Wide, dynamic wavelength range***
- ***Proprietary low-noise detectors***

Spero Mid-IR Microscope

Wide-field mid-IR microscope which can be used in applications ranging from chemical imaging of APIs in tablets and powders through to label-free digital pathology for drug development.

- ***Much faster results than with point scanning techniques***
- ***Non-destructive label- and stain-free imaging***
- ***High speed IR hyperspectral imaging***

2000 provides a range of scientific optical products for use in the pharmaceutical industry

Other Products to Consider for Pharmaceuticals

Pages: **10 & 11**

- *Add-on module for super-resolution single-molecule localisation microscopy*
- *Super-resolution confocal imaging system*
- *Ultra-compact femtosecond lasers for biophotonics*

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Handheld Trace Chemical Detector for Cleaning Validation

TraC

TraC is a miniature handheld instrument for measuring trace chemical contaminants on surfaces, with a particular focus on cleaning validation and process control for pharmaceutical product manufacturing.

The TraC sensor has a ppb limit of detection for many chemical and biological materials on surfaces as well as small concentrations of chemical and microbial material in liquids. It also has a large depth of focus.

Weighing less than 2 lbs, TraC can operate for over 24 hours on an internal battery without recharge. It can be used in product quality control or equipment cleaning validation to inspect manufactured products and production surfaces. When fitted with liquid samplers, flow cells, or windows, it allows you to look directly into mixing and bioreactor growth chambers.

Real-time,

Find Out More: **www.laser2000.co.uk/TraC**

Problem

Swabbing is time-consuming and may require repeat attempts, reducing productivity. Inaccessible areas may be missed, and it may be difficult to ensure that swabbing is always carried out correctly. Lengthy waits for results increase downtime.

Solution

The TraC is a handheld device, allowing easy access to difficult areas. It detects trace contaminants in real time, eliminating the need for swabbing and giving immediate, accurate results. The whole cleaning validation process can be carried out in-house, minimising downtime and increasing efficiency. The device does not need to leave the facility, in line with EU GMP guidelines.

Features

- Real-time optical scanning
- High sensitivity
- High selectivity
- Non-contact
- Non-destructive

Benefits

- Enables in-house cleaning validation
- Detects trace contaminants down to µg/cm²
- Gives accurate measurements in a fraction of the time, compared to swabbing
- The device remains on site, in keeping with GMP
- Maximises efficiency and minimises downtime

Applications

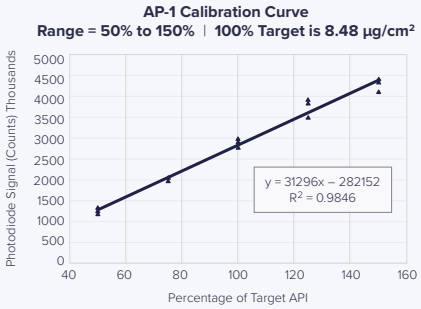
- Pharmaceutical cleaning validation
- Process monitoring

Ensuring Good Manufacturing Practice

Calibrating the TraC Detector with ChemCal

ChemCal can be used to calibrate the TraC trace chemical detector over a wide range of chemicals and chemical concentrations, and enables the automated generation of a chemical concentration curve.

ChemCal can handle as many as twenty different chemicals, which can be laid down on both smooth and irregular surfaces in a variety of nanodroplet patterns, which are interleaved or overlaid to suit the chemical detection application. Colloidal dispersions, such as microbial dispersions, can also be accurately deposited.



The ChemCal chemical mapper has a number of advantages over techniques such as spin coating, inkjet printing, spray coating, and ultrasonic piezo printing. It can deposit highly accurate concentrations of materials in both uniform and non-uniform concentrations or gradients to simulate situations in which trace contamination detectors are employed.

high-sensitivity, in-house pharmaceutical cleaning validation

Chemical Printer and Mapper

ChemCal

The ChemCal chemical printer is an instrument with two functions. The first function is to generate precisely known concentrations of single or multiple chemical compounds on smooth or irregular surfaces. This provides well defined chemical targets for calibrating detectors used for measuring the type and concentration of trace chemical contaminants on surfaces. The second function of the ChemCal is to calibrate the TraC trace chemical detector over a wide range of chemicals and chemical concentrations. The ChemCal enables the automated generation of a chemical concentration curve.

PHOTON SYSTEMS

Find Out More: **www.laser2000.co.uk/ChemCal**

Features

- ***Calibrate TraC for a wide range of chemicals and concentrations***
- ***Produce chemical maps on single substrate or arrays of substrates, including quartz microbalance crystal arrays***

Benefits

- ***Printable in-house calibration for a wide range of chemicals and active pharmaceutical ingredients (APIs)***

Application

- ***Calibration of optical detectors for cleaning validation***

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Liquid Analyser for Mid-IR Liquid Chromatography

ChemDetect

The ChemDetect Liquid Analyser is a compact, intelligent, and easy-to-use spectrometer specifically designed for detection of low concentration (ppm) analytes in standard HPLC liquid columns. The longer path length, combined with broad source tunability and a proprietary detection architecture enables unprecedented sensitivity, selectivity, and speed for measurements of mixtures and separated flows.

The ChemDetect is an excellent tool for R&D scientists or manufacturing process engineers. It delivers raw spectral data or model calibrated analyte concentration outputs. It is also equipped with a software development kit which enables easy integration of the ChemDetect into complex laboratory or process control systems.

Mid-IR liquid chromatography is Get more information and

Find Out More: **www.laser2000.co.uk/ChemDetect**

Problem

FTIR based instruments are limited to short path length (<10 µm) ATR measurements, limiting sensitivity. Furthermore, the ability to carry out continuous sampling is also limited.

Solution

ChemDetect uses high brightness quantum cascade laser technology, allowing it to operate in the more preferred direct transmission measurement mode at long path lengths (>100 µm) for both aqueous and solvent based solutions, thus increasing sensitivity. The high brightness QCLs overcome the water absorption problem that limits FTIR based measurements, allowing for real time online analysis.

Sensitivity, Selectivity, and Specificity

Features

- *Small volume liquid analysis*
- *Online, real-time analysis*
- *Parts-per-million sensitivity*
- *Multi-analyte determination*
- *Quantitative and qualitative measurements*

Benefits

- *Greater sensitivity, compared to FTIR*
- *High data collection rate (10 Hz)*
- *Wide, dynamic wavelength range*
- *Proprietary low-noise detectors*

Applications

- *Process monitoring*
- *Gas / liquid phase analysis*
- *HPLC*
- *Drug discovery*
- *API and excipient optimisation and down-selection*
- *Chemical detection / identification*
- *Protein analysis*

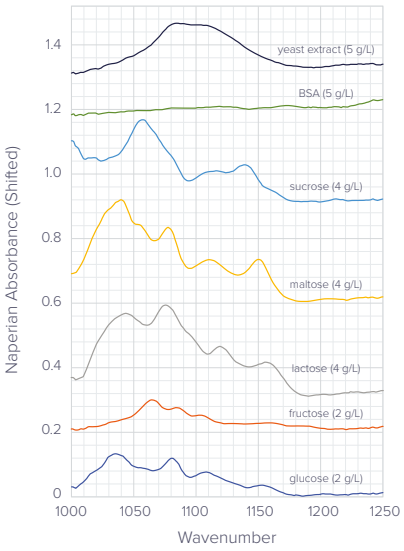
QCLs in Chromatography

There are two main advantages in using QCLs compared to an incandescent light source such as a globar in an FTIR spectrometer.

Firstly, when using FTIR, the sample cells must have a very large optical throughput of around 1 cm, meaning that the sample volume in the cell can be quite large and take significant time to completely clear out with introduction of a new analyte. This is a limitation when coupling to a liquid chromatography column. However, when using a QCL, the laser beam can be focused to a small point, allowing the clear aperture of the sample cell to be reduced to 1 mm, making small sample cells a possibility.

Secondly, the optical path through the liquid can be increased to 130 µm. This is made possible by the high power of the laser beam, since significant signal is still present even after losing several orders of magnitude of power to water absorption. The longer absorption path means that a QCL based system can be ten times more sensitive to analytes. Such an increase would require 100 times more averaging for an FTIR system, which can be prohibitively long in many measurement situations.

Reference Spectra Recorded with ChemDetect



finally here.
more detail, in the infrared.

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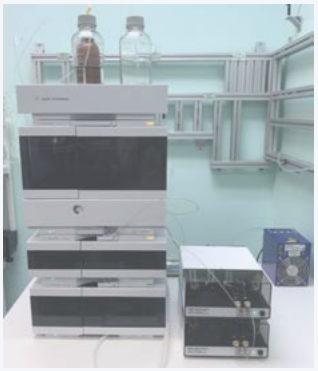
Bioreactor Monitoring Example

(Extract from DRS Daylight Solutions' paper "Bioreactor Monitoring: A New Application for the ChemDetect™ Liquid Analyser")

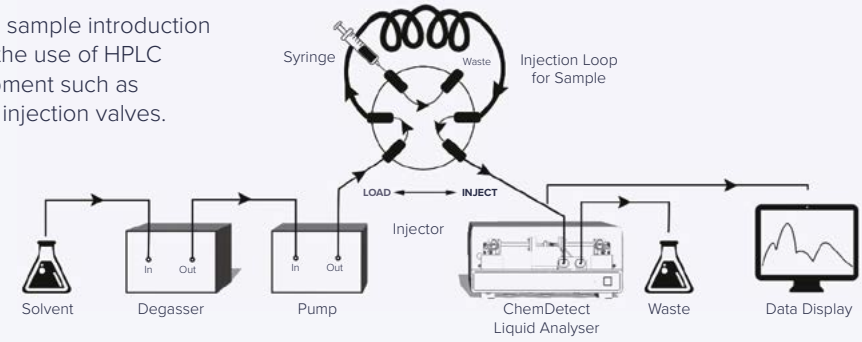


Summary

The ChemDetect Analyser is coupled to a novel micro flow cell that allows repeatable quantitative spectroscopic determination of liquid components. The system is calibrated to determine concentrations of relevant chemicals used in bioreactor feedstocks. Exercise of a test protocol for characterising bioreactor feedstocks is carried out. It is found that the ChemDetect is sensitive to the relevant chemicals at better than 50 mg/L concentration over two decades of concentration measurements for 90 second measurements. The analyser can also differentiate between mixtures of analytes, and was characterised to be stable to less than 4% drift over three days without calibration.

A significant challenge for liquid spectroscopy is sample introduction and repeatability. This is accomplished through the use of HPLC (high-performance liquid chromatography) equipment such as carefully controlled pumps, fluid degassers, and injection valves. The fluid delivery and sample injection system is shown in the diagram to the right.

This system allowed reliable, repeatable introduction of sample to the flow cell, and eliminated problems with bubbles and sample changeover that were seen with the larger sample cells from FTIR-based equipment.



HPLC (High-performance Liquid Chromatography) Fluid Delivery and Sample Injection System

Conclusion

The ChemDetect Liquid Analyser and new flow cell have demonstrated the ability to analyse relevant components of bioreactor feedstocks. For example, glucose sensitivity and accuracy is shown to be better than 50 mg/L. Compare this to the level of accuracy required for commercial blood glucose monitors (+/- 150 mg/L). Linearity, reproducibility, and selectivity among relevant components is excellent. Any systematic differences between measured and prepared sample concentrations might be due either to sensor linearity or issues in sample preparation. Further tests would be required to determine the cause. Nonetheless, these trends are consistent, and could be calibrated out from the sensor if necessary.

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Ultrafast, Wide-field Mid-IR Microscope

Spero-QT | Spero-LT

The all-new Spero-QT microscope is the second-generation platform in this new class of instruments and represents yet another breakthrough in IR spectroscopy, with high-performance, label-free chemical imaging. The Spero-QT system has the wide-field, high-resolution attributes of its predecessor but with the capability to produce twice the data in one-tenth of the time, while achieving unprecedented signal-to-noise ratios.

The Spero-LT offers the same high-performance speed and resolution but is economically configured to address a wide range of materials and life sciences research applications while fitting within tight budget constraints.

High performance, label-free chemical imaging in

In a class of their own, the Spero microscopes are the world's first and only fully integrated, wide-field spectroscopic microscopy and imaging platforms based on Daylight's broadly tunable mid-infrared quantum cascade laser technology.

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Features

- *Easy-to-use ChemVision software included*
- *No cryogenic cooling needed*
- *Small footprint*

Benefits

- *Much faster results than with point scanning techniques*
- *Non-destructive label- and stain-free imaging*
- *High speed IR hyperspectral imaging*

Applications

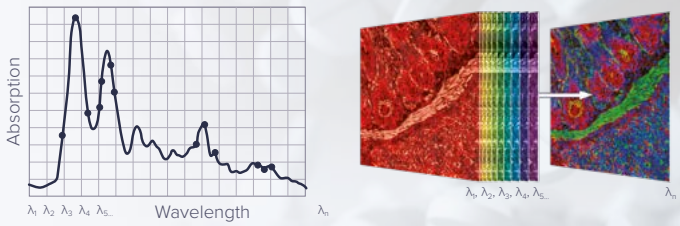
- *Drug discovery*
- *API and excipient optimisation and down-selection*
- *Chemical detection and identification*
- *Liquid and microfluidic analysis*
- *Chemical reaction monitoring*
- *Materials inspection*
- *Protein analysis*

Mid-IR Chemical Imaging (MIR-CI) for Quantitative Analysis of APIs in Pharmaceutical Blends

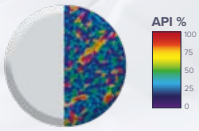
The Spero is a small desktop hyperspectral microscope, which combines laser-based vibrational spectroscopy in the mid-infrared and wide field of view imaging, with high resolution (approx. 5 microns).

Fast hyperspectral scan speeds (>7 M spectral points per second) allow live video-rate IR imaging which enables the visualisation of the distribution of compounds or crystallisation processes. With easy-to-use ChemVision software included, multiple file formats are available which integrate into standard chemometric software packages.

Hyperspectral Image Cube



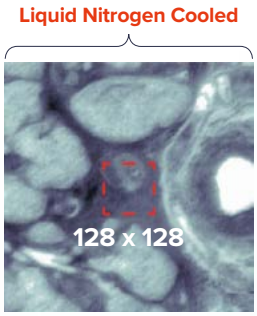
A high-resolution spectrum is collected simultaneously at every image pixel position (230,400 pixels per FOV) in about 35 seconds.



the infrared

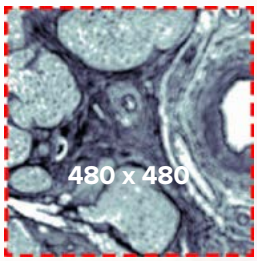
Unrivalled Mid-IR Spectroscopy

Spero-QT Field of View



FPA FTIR
1.1 µm pixel

Spero-QT Microscope
Detector Field of View



QCL-IR
1.3 µm pixel

Find Out More: **www.laser2000.co.uk/Spero**

⊖ *Problem*

FTIR and other point scanning techniques can be prohibitively slow for both research and industrial applications.

⊕ *Solution*

The Spero provides more data, and much faster, than FTIR. The mid-IR range (850 wavenumbers) is imaged in around 30 seconds to form a hyperspectral data cube.

⊖ *Problem*

Tissue preparation for pathology involves many steps and may require multiple stains / tags. There may be a requirement to analyse fresh frozen tissue for interoperative diagnoses.

⊕ *Solution*

IR imaging is a non-destructive technique, both label- and stain-free. It can be used to image paraffin-embedded samples and sections of fresh frozen tissue.

LASER 2000

Add-on Module for Super-resolution Single-molecule Localisation Microscopy

PRISM AWARDS WINNER

SPINDLE®

Find Out More: **www.laser2000.co.uk/SPINDLE**

Problem

Most super-resolution systems do not allow for extended depth 3D imaging and require purchase of expensive dedicated microscopy systems.

Solution

The SPINDLE add-on module enables unprecedented precision-depth imaging, and its modular design ensures that this advanced capability is available at an affordable price point.

Realise axial resolution of 10-20 nanometres, lateral resolution of 25 nanometres, plus extended depth imaging of up to 20 microns in a single shot. Enabling super-resolution image capture across a large depth of field ensures more data can be collected faster and with lower photo-toxicity. In addition to 3D nano-scale imaging, the SPINDLE also enables 3D particle tracking across multiple planes.

The SPINDLE is already enabling new discoveries in fields including cancer, virology, and immunology. The ability to see and track inter- and intra-cellular activity offers new opportunities to accelerate drug development, with the ability to see and track how drug compounds really work.

Get more data, better results, and your bandwidth for microscopy

Super-resolution Confocal Imaging System

RCM

Upgrade any microscope to a confocal system at an affordable level or purchase the complete system with Nikon Ti2 frame. Compared to standard confocal imaging, the RCM achieves both considerable resolution improvement (1.4x) and higher sensitivity and SNR (3x).

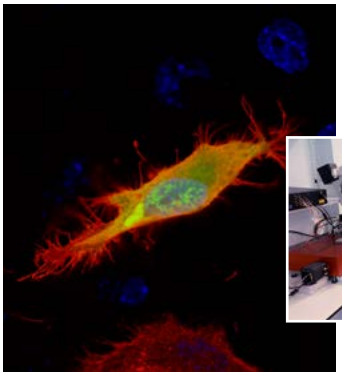
Find Out More: **www.laser2000.co.uk/RCM**

Problem

While super-resolution microscopy is desirable, a new microscope may be prohibitively expensive. An old microscope may be left unused whilst newer confocal microscopes are over-subscribed.

Solution

The RCM brings new functionality to your old microscope, enabling super resolution microscopy and increasing your bandwidth.



Schedule a Demo Day

Ultra-compact Femtosecond Lasers for BioPhotonics

ALCOR Series

Offering fixed wavelength at 920 nm and/or 1064 nm, the ALCOR Series produces high average power (~2 W) with ultrashort femtosecond pulses (down to <100 fs) at high repetition rate (80 MHz standard, others optional).

Laser 2000 can provide custom two-photon microscope solutions tailored to your needs. Working with a leading consultant and utilising products from our suppliers, we can provide a cost effective flexible system tailored to solve your exact requirements.

Applications

- ***Multi-photon imaging and excitation***
- ***Neuroscience***
- ***Optogenetics***
- ***Coherent anti-Stokes Raman spectroscopy***
- ***Fluorescent lifetime imaging***

Find Out More: **www.laser2000.co.uk/ALCOR**

Problem

Traditional Ti:Sapphire lasers can be large and complex, with a wider wavelength range than is actually required.

Solution

ALCOR Series lasers focus on the wavelengths that matter, in an ultra-compact, robust format.

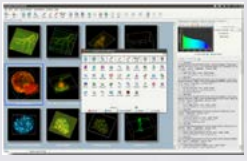
maximise and nanoscopy

You may also be interested in...

Optical Filters, Filter Cubes, and Motorised Filter Wheels

Light Sources and Lasers for Microscopy and Raman

Deconvolution, Visualisation, and Analysis Software



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PMTC
Advanced Technology Solutions in Pharmaceutical Manufacturing

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