Test&Measurement

YOKOGAWA

Case Study

MicroPhotons accelerates Precision Gas Spectrometry in the MWIR spectrum

Precision Making

筱晓光子
Microphotons Technology

Test&Measurement

MicroPhotons

MicroPhotons has established a position as a highly trusted supplier of advanced optical technology. Based in Shanghai, with subsidiary offices in Beijing, Hong Kong and Vancouver (Canada), MicroPhotons has two main lines of business.
As a distributor, it supplies a wide range of optical products, backed by a specialist technical support service, to meet the needs of optical systems manufacturers.

The product lines it supplies include semiconductor lasers, fiber grating filters, fiber amplifiers, and further passive and active optical components and devices. MicroPhotons also operates as a specialist design consultancy and system integrator, helping manufacturers to implement optical technologies in applications such as spectrometry and gas analysis and detection. Its innovations have resulted in the awarding of more than 10 patents.

To support this work, MicroPhotons maintains an advanced optical laboratory equipped with start-of-the-art benchtop instruments. When a client's design project called for accurate measurement of optical systems in the mid-wavelength infrared (MWIR) portion of the spectrum, MicroPhotons faced a challenge: existing measurement techniques were costly and cumbersome. Yokogawa equipment provided an opportunity to innovate and achieve much higher test productivity and performance.

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The Challenge

Background

Customers of MicroPhotons develop highly sensitive gas detection equipment used in settings such as factories and processing plants, including semiconductor fabrication plants. Here, the equipment monitors the release of pollutant gases such as carbon monoxide (CO), carbon dioxide (CO_2) and nitrous oxide (NO). Such equipment can also be used for monitoring air quality in cities.

Gas absorption spectrometry is a scientific technique which takes advantage of the optical properties of gases in the MWIR wavelength band: many gases of interest absorb light at a specific wavelength. Gas detection equipment can be configured from a laser tuned to emit in a narrow emission bandwidth at the wavelength at which the gas of interest absorbs light.

A reference measurement can quantify the optical power received in a reference medium, such as clean air. When measured in a medium such as polluted air containing a quantity of the gas under observation, some light will be absorbed and the received optical power will be lower than the reference value. The value of the absorption peak allows the accurate detection and identification of a specific gas.

Existing technologies for detecting gas absorption rates require the use of liquid nitrogen to cool the emitters. By replacing the super-cooled emitters with a super-continuum light source, MicroPhotons could perform its gas absorption measurements at room temperature.
This alternative method was both much more convenient and intuitive, and promised to save a large amount of test time. But this approach required very high measurement accuracy in the optical spectrum analyzer (OSA) used to characterize

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the light source. In addition, the gases to be monitored had absorption peaks at wavelengths across the whole MWIR spectrum, from 1.9μm to 5.5μm. But most OSAs are designed for use in telecoms systems, which only require measurement of wavelengths up to 2μm.

The Challenge

MicroPhotons’ challenge was to produce a test set-up that would produce accurate measurements across the entire wavelength range of interest. To assess the effectiveness of its new approach, MicroPhotons planned to compare its measurements with absorption spectrum data available in SpectraPlot (a free web application for the simulation of spectroscopic data). But at the same time, productivity was an important parameter for consideration, and so MicroPhotons wanted a measurement system that would be quick to set up and operate.

The Solution

Application requirements

The MicroPhotons application called for a single measurement instrument covering the entire MWIR band from 1.9µm to 5.5µm. By using a single instrument, MicroPhotons could dramatically reduce its test time and effort, avoiding the need to set up and calibrate more than one measurement instrument when testing equipment for the detection of gases with absorption peaks ranging from 2.33µm (for carbon monoxide (CO)) to 5.26µm (for nitrous oxide(NO)).

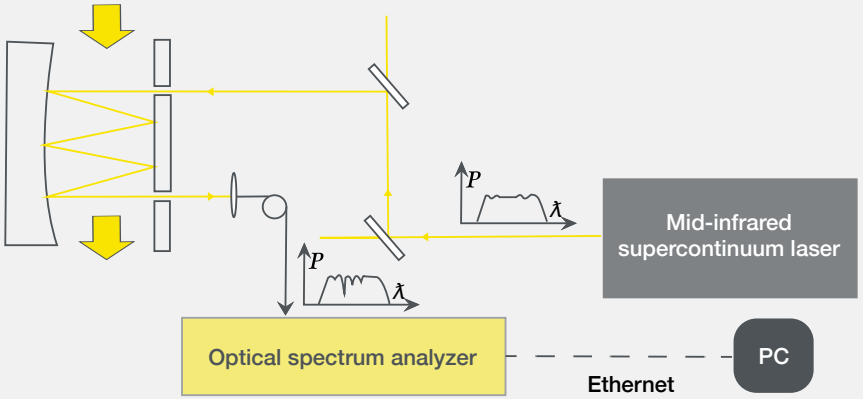
And by eliminating the use of cumbersome liquid nitrogen-cooled emitters, MicroPhotons could also save time and cost and improve test productivity.

Measurement solution

MicroPhotons' choice of instrument for gas detection and identification applications was the AQ6377 OSA from Yokogawa.

Across the 1.9µm to 5.5µm range, the AQ6377 is the only OSA that is capable of analyzing the entire wavelength spectrum. In Tunable diode laser absorption spectroscopy (TDLAS) applications, the AQ6377 has enabled MicroPhotons to precisely characterize laser emitters, including their side modes, with high accuracy.

In gas detection applications based on the use of a super-continuum light source operating at a range between 2µm and 4µm, MicroPhotons achieved the required very high accuracy of measurement by using the AQ6377.



Formula	Substance
CO	Carbon Monoxide
CO_2	Carbon Oxide
NO	Nitrous Oxide
C2H2	Acetylene
C2H6	Ethan
C3H8	Propane
NH3	Ammonia

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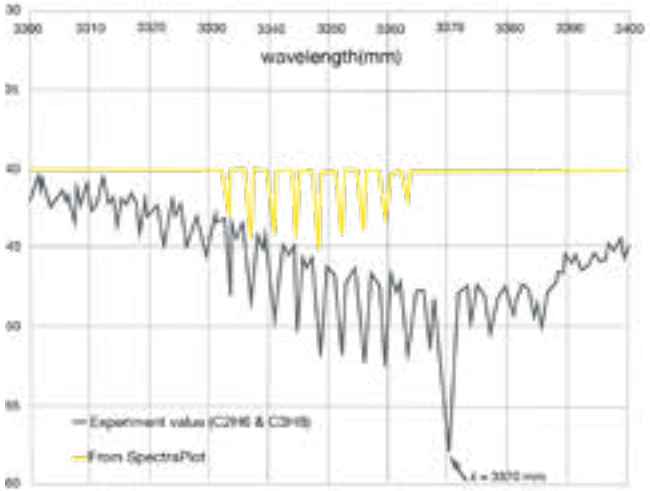
Results

AQ6377 accurately characterizes MWIR light sources in gas detection equipment

According to Mr Wang, CEO of MicroPhotons, the AQ6377 OSA has provided outstandingly accurate measurement of the emissions of both tunable lasers and the super-continuum light source. This accuracy was proved by a measurement exercise performed after characterization of the super-continuum light source using the AQ6377.

Mr Wang says that MicroPhotons ran measurements of the absorption of emissions from the characterized super-continuum light source. He says: 'We measured the absorption spectra of a range of gases including C2H2, C2H6, C3H8, and NH3.



AQ6377 Optical Spectrum Analyzer

The AQ6377 is the latest version of the Yokogawa AQ6300 series of OSAs. It offers extended wavelength coverage into the MWIR region from 1.9µm to 5.5µm. Its long wavelength range makes the AQ6377 ideal for environmental sensing and medical applications.

- **Accuracy** – The AQ6377 achieves wavelength measurement accuracy of ±0.5nm
- **Close-in dynamic range of 50dB** – Thanks to the sharp spectral characteristics of the AQ6377's monochromator, signals in close proximity can be clearly separated and accurately measured
- **Flexibility** – Thanks to the sharp spectral characteristics of the AQ6377's monochromator, signals in close proximity can be clearly separated and accurately measured

The measurement results very closely tracked the data provided by the SpectraPlot online tool, which provides a reference for the optical characteristics of gases. This gave us great confidence that the measurement output from the AQ6377, on the basis of which we characterized the light source, is extremely accurate and repeatable over its very broad measurement bandwidth.'

For more information on MicroPhotons, visit
http://www.microphotons.com/index.html

For more information on the AQ6377, visit
tmi.yokogawa.com

About Yokogawa Test&Measurement

Yokogawa has been developing measurement solutions for over 100 years, consistently finding new ways to give R&D teams the tools they need to gain the best insights from their measurement strategies. The company has pioneered accurate power measurement throughout its history and is the market leader in digital power analyzers.

Yokogawa instruments are renowned for maintaining high levels of precision and for continuing to deliver value for far longer than the typical shelf-life of such equipment. Yokogawa believes that precise and effective measurement lies at the heart of successful innovation and has focused its own R&D on providing the tools that researchers and engineers need to address challenges great and small.

Yokogawa takes pride in its reputation for quality, both in the products it delivers – often adding new features in response to specific client requests – and the level of service and advice provided to clients, helping to devise measurement strategies for even the most challenging environments.

The guaranteed accuracy and precision of Yokogawa instruments results from the fact that Yokogawa has its own European standards laboratory at its European headquarters in The Netherlands.

This facility is the only industrial (i.e., non-government or national) organization in the world to offer accredited power calibration at frequencies up to 100 kHz. ISO/IEC17025 accreditation (RvA K164) demonstrates the international competence of the laboratory.

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