FTIR engine C15511-01

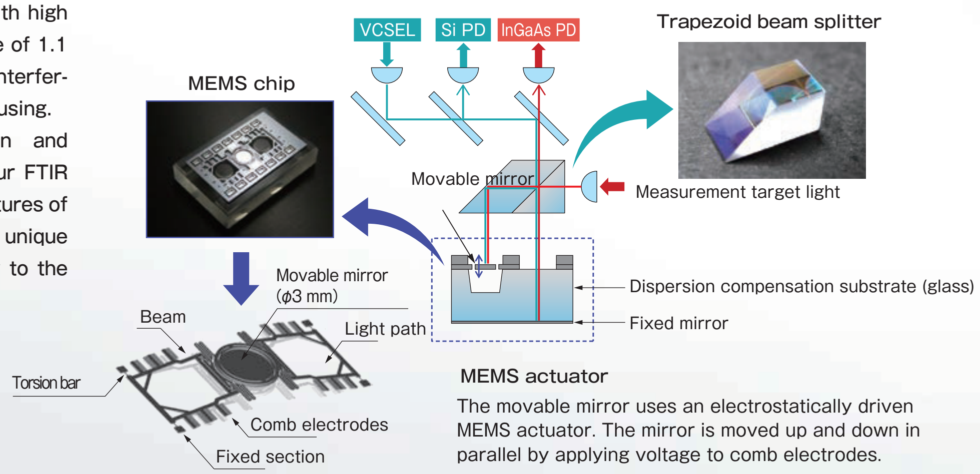
Enables infrared spectroscopic analysis on the spot. Palm size Fourier transform spectrometer

Molecules each have unique vibrations, thereby absorbing infrared light of a specific wavelength. Infrared spectroscopic analysis, which utilizes this characteristic to analyze the components contained in substances, is used in a variety of fields from scientific research to industry. FTIR, which uses infrared spectroscopic analysis, is normally the stationary type, which requires analysis to be done by bringing samples to a laboratory or specialized institution. For this reason, Hamamatsu Photonics has developed "C15511-01", a palm-sized FTIR engine that supports near infrared light with a wavelength from 1.1 μm to 2.5 μm.
Its compact size means it can be incorporated into portable analytical instruments, so it is expected to realize real-time infrared spectroscopic analysis at the location of the measurement subject.

Compactness and high accuracy achieved with MEMS technology

The "FTIR engine C15511-01" is a compact Fourier transform infrared spectroscopic module with high sensitivity to near infrared light in the range of 1.1 μm to 2.5 μm, and it fits a Michelson optical interferometer and control circuit in a palm-sized housing. Generally FTIR features high resolution and high-speed measurement. We have made our FTIR engine more compact while retaining the features of the Fourier transform by applying our unique MEMS technology and mounting technology to the optical interferometer.

[Optical system of FTIR engine]



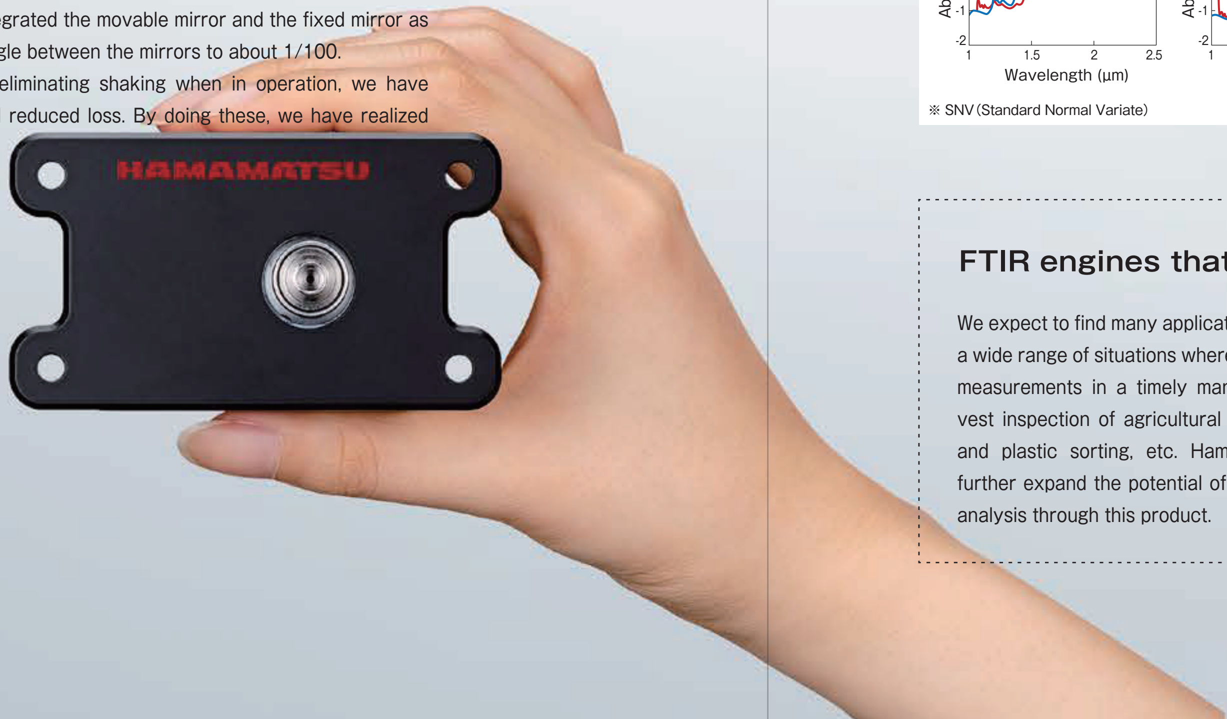
MEMS actuator

The movable mirror uses an electrostatically driven MEMS actuator. The mirror is moved up and down in parallel by applying voltage to comb electrodes.

● Features

Detection performance comparable to previous stationary type devices

To eliminate the decrease in incident light level caused by miniaturization, we used our unique MEMS technology to develop a movable mirror with a diameter of 3 mm that composes the MEMS actuator, then improved it so that the reflected light can be used efficiently.
Using our mounting technology cultivated over many long years, we have integrated the movable mirror and the fixed mirror as a MEMS chip, thereby making it compact and reducing error in the relative angle between the mirrors to about 1/100.
By optimizing the structure and drive method of the MEMS actuator and eliminating shaking when in operation, we have suppressed the spread of infrared light inside the optical interferometer and reduced loss. By doing these, we have realized detection performance comparable to previous stationary type devices.



Realizes high wavelength reproducibility

Optical interference occurs when the light being measured (incident light) is split by a beam splitter, reflected by a movable mirror and a fixed mirror, and combined again. Interference light intensity, which changes depending on the position of the movable mirror, is detected by a photodetector (InGaAs PIN photodiode), then the signal is subjected to arithmetic processing (Fourier transform) to obtain an optical spectrum. By measuring the position of the movable mirror in the interferometer using a photodetector (Si PIN photodiode) and semiconductor laser (VCSEL), it is possible to obtain a optical spectrum with high wavelength reproducibility.

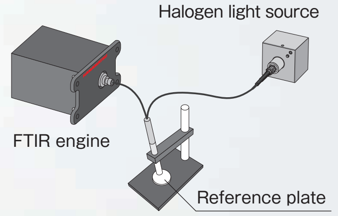
Measurement examples using FTIR engine

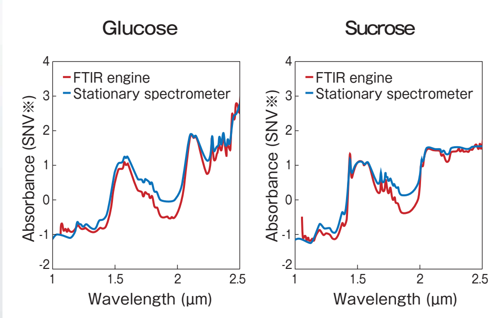
In the near infrared region of 1.1 μm to 2.5 μm, many substances have unique absorption spectra, and these are applied to infrared spectroscopic analysis in various fields.
There are two measurement methods for infrared spectroscopic analysis using FTIR engines: "reflection measurement" and "transmission measurement". Using these measurement methods, we measured the spectra of sugar (glucose, sucrose) and alcoholic beverages (beer, sake, brandy).

Reflection measurement

Absorbance comparison of sugar

Comparing the reflection measurement results of sugar powder samples (glucose, sucrose) from the FTIR engine and from the stationary spectrometer, we found it was possible to accurately measure even minute peak patterns with the FTIR engine, similar to spectra obtained with the stationary spectrometer.



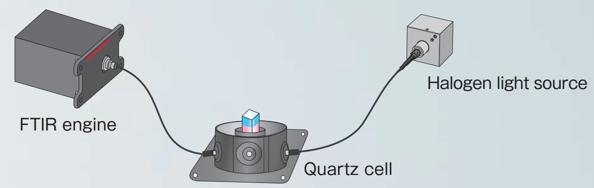


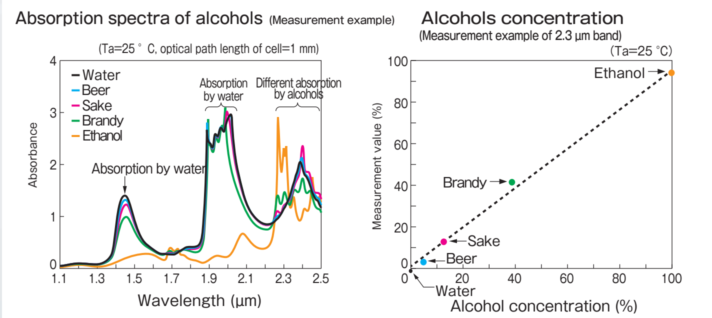
※ SNV (Standard Normal Variate)

Transmittance measurement

Comparison of absorbance of alcoholic beverages and estimation of alcohol concentration

In the near infrared region of 1.1 μm to 2.5 μm, there is absorption by the OH group of water (1.45 μm band, 1.9 μm band) and absorption by the CH group of alcoholic beverages (2.1 μm to 2.5 μm). With transmission measurement results, we were able to obtain characteristic spectra in the absorption bands of water and alcoholic beverages. In addition, with the results of estimating the alcohol concentration from absorbance in the 2.3 μm band, we confirmed that the estimated values and numerical values of components contained in the beverage matched, and that high accuracy measurement is possible.





Note: Makes a calibration curve based on ethanol measurement results

Measurement: Hamamatsu Central Research Laboratory

FTIR engines that greatly expand the potential of spectroscopic analysis

We expect to find many applications for FTIR engines in a wide range of situations where it was difficult to make measurements in a timely manner, including pre-harvest inspection of agricultural products, soil analysis, and plastic sorting, etc. Hamamatsu Photonics will further expand the potential of infrared spectroscopic analysis through this product.