

Mid-IR Spectrometer — Infrared absorption “finger-print” detection

Introduction

Mid-IR regime is proven to have rich absorption “finger-prints” of materials, demonstrated by benchtop measurement tools, such as Fourier Transform Infrared Spectrometer (FTIR). WOE has established the capability to design and build a portable absorption spectrometer in this regime. The primary objectives are rapid on-site identification of materials by users with minimal training.

Operation Principle

The principle of the spectrometer is based on reflection-based infrared spectroscopy as shown in Figure 1. The Mid-IR spectrometer consists of a) a light source and detector unit, b) a flexible sensor head, and c) a graphical user interface (GUI) for operating, control and processing of acquired data.

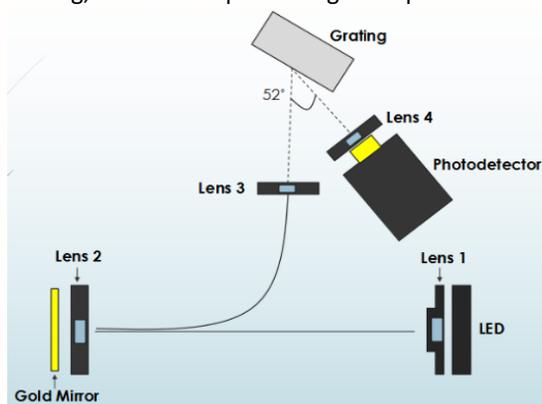


Figure 1. Mid-IR spectrometer principle

The key specifications of the Mid-IR spectrometer are listed below. Compared with similar portable products in the market, our developed device has wider spectral range.

Optical measurement unit		
Optical Specifications	Probe mode	Reflection based
	Rigid probe length	100 - 150mm
	Flexible fiber length	50cm - 100cm
	Spectral range	2.6 μ m - 4 μ m
Physical Specifications	Foot print (max)	35cm(L)
		15cm(W)
		15cm(H)
	Weight	< 1 Kg
Software		
GUI	ON/OFF measurement function	
	Display measurement curve	
	Output data in text format	
	Export data in USB port	

Table 1. Key specifications of Mid-IR spectrometer

The reflective fiber probe is made from chalcogenide glass. The main challenge its design is the efficient coupling in the illumination and collection beam as shown in Figure 2.

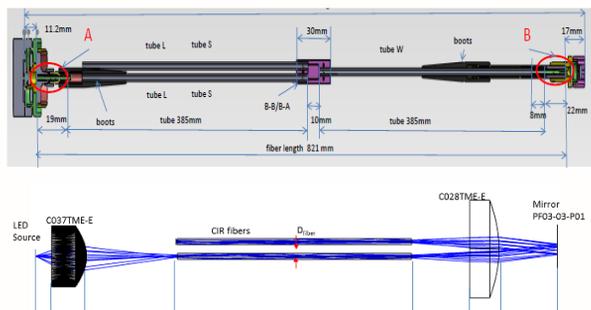


Figure 2. Layout and optical simulation of fiber probe

The overall measurement device and the fabricated fiber probe are shown in Figure 3. The detector is calibrated using NIST traceability testing target. The spectral coverage can be tuned by choosing alternative LEDs. The spectral resolution can be customized by choosing different stepper motors.

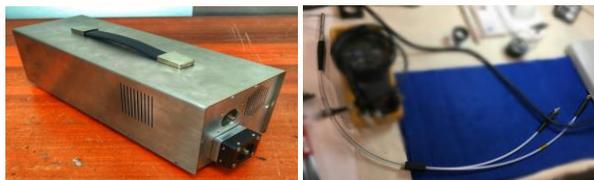


Figure 3. Spectrometer and its fiber probe

Applications

The portable Mid-IR spectrometer can be used in various applications, such as:

- Food quality analysis
- In-situ monitoring for process control
- Remote analysis of gases and vapours
- Investigation of pollutants/degradation pathways
- Clinical chemistry tests

This device also offers a platform to carry out database development and artificial intelligence based spectral training in Mid-IR regime.

Conclusion

As a global enterprise, leading photonics innovation since 2002, WOE has built up customization engineering capability for chalcogenide fiber optics, fiber to free-space optics integration, portable spectrometer integration and precision motion control.

