INFRARED UNLEASHED

nlir
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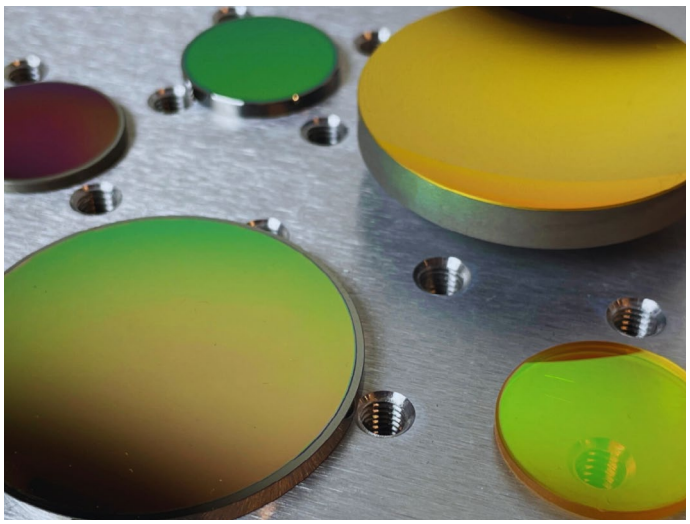
NLIR
PRODUCT CATALOGUE

MID-INFRARED SPECTROSCOPY WITH EASE

Our products offer innovative optical sensing solutions that enable new measurement, monitoring, and optical investigation possibilities for many different industries and research areas.



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WHAT IS NLIR?

NLIR (NonLinear InfraRed) offers mid-infrared spectrometers, light sources, wavelength converters, interfaces, accessories and complete measurement systems for a wide range of industrial and research applications. All systems are designed with a focus on speed and our spectrometers acquire spectra in milliseconds while still being highly sensitive and robust.

Our products are based on upconversion technology, a combination of unique patented inventions. The core of the upconversion technology is a nonlinear process that converts mid-infrared light to near-visible enabling the use of highly effective silicon-based detectors.

Content

MIDWAVE Spectrometer

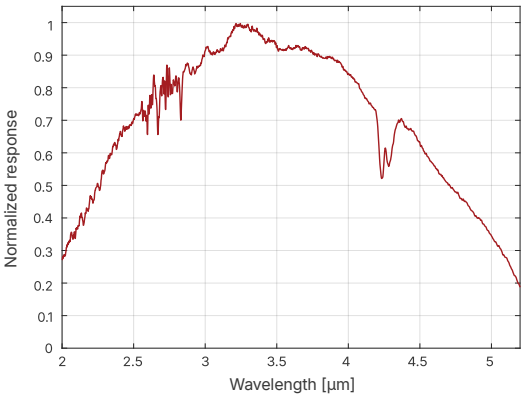
NLIR's MIDWAVE Spectrometer is a fast, portable and versatile tool for measuring mid-infrared light in the 2.0 – 5.0 µm range. Designed for applications requiring high-speed and accurate spectral measurements, it captures full spectra in milliseconds, making it ideal for both in and out of the lab.

At the core of the spectrometer is NLIR's patented upconversion technology, which converts mid-infrared light to near-visible light for detection. This approach leverages the superior speed and sensitivity of silicon-based detectors, enabling exceptional performance in the mid-infrared regime. More information about the technology can be found on our website: https://nlir.com/technology.

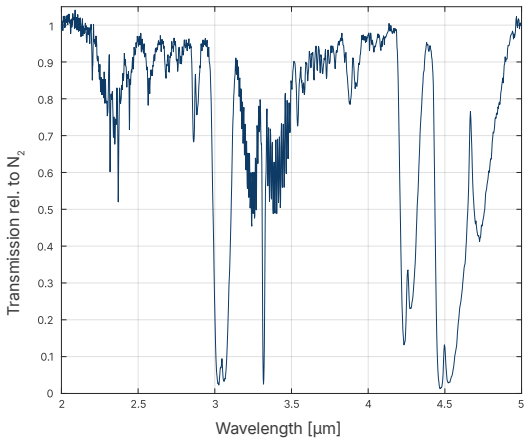
MIDWAVE Spectrometer	
Optical Bandwidth	2.0 – 5.0 µm
Resolution	< 6 cm^{-1}
Exposure Time	0.0108 – 500 ms
Max. Readout Rate	400 Hz
Bit Depth	16
Sensitivity	130k counts/(ms µW)
Dark Noise Std.[1]	11 counts
Minimum Detectable Power in 100 ms	5 pW/nm
Stability[2]	± 1 % over 24 hours
Optical Input[3]	SMA 905-Fiber Connector
Rec. IR Fiber Core Size	100, 200, 300 µm
Polarization Direction	Vertical
Trigger	5 V TTL
Connection	USB-B
Power Consumption	60 – 90 W
Supply Voltage	19 V
Operating Temperature	18 – 30 °C
Measurements (L × W × H)	306 × 200 × 100 mm
Weight	5 kg

[1] At minimum exposure time
[2] ± 1 °C ambient variation
[3] Free-space input available

The MIDWAVE Spectrometer is easy to set up and operate, featuring an intuitive GUI for plug-and-play measurements. For advanced users, API interfaces for MATLAB, Python, Rust and C (via DLLs) are included, enabling seamless integration into custom workflows and automated processes.



Normalized response of the MIDWAVE Spectrometer.



Gas transmission measured with the MIDWAVE Spectrometer.

LIGHT SOURCE CHARACTERIZATION

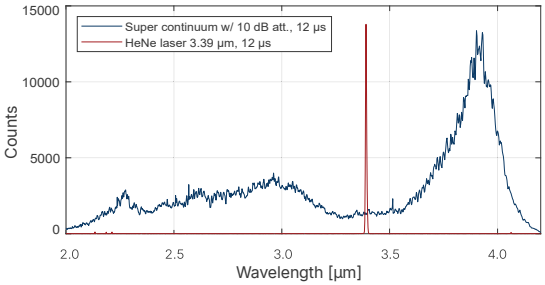
The MIDWAVE Spectrometer is capable of measuring the emission of various light sources.

The plot at the top illustrates data from single captures of a mid-infrared supercontinuum laser and a HeNe 3.39 µm laser. In both cases, the exposure time was set to 12 µs, and no averaging or additional data processing was applied, aside from background subtraction.

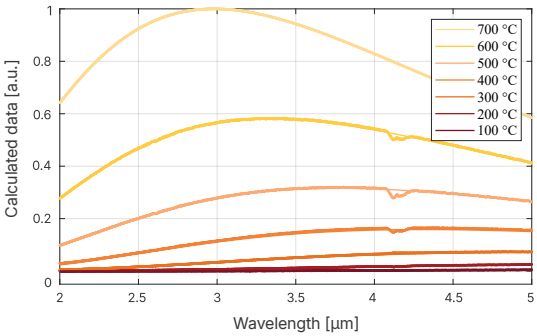
The noise observed in the supercontinuum laser curve is primarily attributed to the light source itself. The HeNe laser curve demonstrates the spectrometer's < 6 cm^{-1} resolution. Light from both laser sources was coupled into a fiber connected to the spectrometer using NLIR's COLLIMATOR Accessory.

The bottom plot shows spectra captured from a blackbody light source at different temperatures at 30 ms exposure time.

With the NLIzeR software it is possible to do an instrument specific relative calibration of the response using a black body source with a known temperature.



Measurement of two different mid-infrared laser sources.



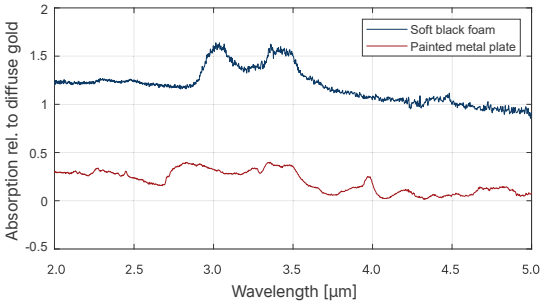
Measurement of a blackbody thermal light source at different temperatures.

NON-DESTRUCTIVE REFLECTION MEASUREMENTS

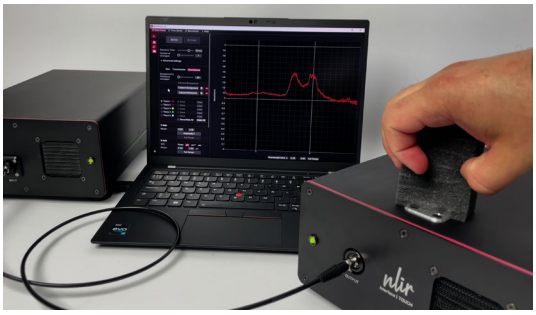
The MIDWAVE Spectrometer is highly sensitive, providing reliable results even from dark or low-reflecting samples. In the example shown, the NLIR TOUCH Interface is used together with the MIDWAVE Spectrometer to measure the reflectance of a black foam (Sample 1) and a red-painted metal plate (Sample 2).

With an exposure time of 50 ms, the curves display single-capture data relative to the reflection of a diffuse gold surface, without any additional data processing. Despite the very low reflection of the black foam, the spectrometer delivers excellent data.

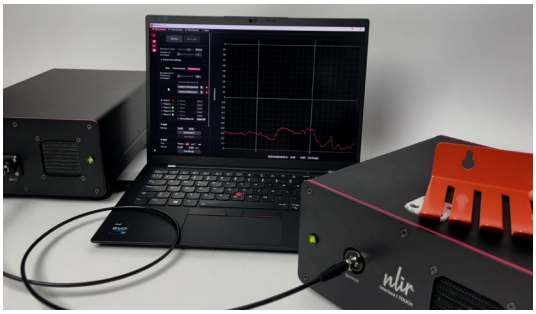
This demonstrates that the MIDWAVE Spectrometer is well-suited for high-speed reflection measurements across a wide range of sample types.



Reflection measurement of foam and painted metal using the TOUCH Interface.



Sample 1. Reflection measurements of a black foam.



Sample 2. Reflection measurements of a painted metal plate.

BUNDLE Spectrometer

Developers in both industry and research use mid-infrared (MIR) spectrometers for non-invasive characterization of gases, liquids and solids as well as characterization of light sources.

By combining NLIR's upconversion solution – the SPEKTRUM Wavelength Converter – with high-end, commercially available VIS/NIR spectrometers in a BUNDLE Spectrometer configuration, powerful mid-infrared analysis becomes available.

The Wavelength Converter shifts the MIR light to the VIS/NIR range, allowing silicon-based spectrometers to detect it. The two devices are simply connected via an optical fiber – no additional components or setup required.

Each BUNDLE is delivered to plug-and-play, including a simple guide for translating the VIS/NIR values to the corresponding MIR wavelength.

Flex BUNDLE Spectrometer.

Edge BUNDLE Spectrometer.

BUNDLE SPECTROMETER	Flex	Edge
Optical Bandwidth	2.0 – 5.0 µm	
Resolution	3 cm^{-1}	2.5 cm^{-1}
Exposure Time	0.009 ms – 40 s	0.0013 – 0.654 ms
Max. Readout Rate	1.4 kHz	130 kHz
Bit Depth	16	12
Sensitivity	8k counts/(ms µW)	1.6k counts/(ms µW)
Dark Noise Std.	60 counts	1 count
Minimum Detectable Power in 100 ms	75 pW/nm	25 pW/nm
Coupled With VIS/NIR Spectrometer	Tailored AvaSpec VARIUS	Tailored Wasatch Cobra 800
Optical Input[1]	SMA-905 Fiber Connector	
Optical Interconnect Fiber	FC/PC 50 µm Na 0.22	
Rec. IR Fiber Core Size	100, 200, 300 µm	
Polarization Detection	Vertical	
Power Consumption	60 – 90 W	
Supply Voltage	19 V	
Maximum Operating Temperature	30 °C	
NLIR's Wavelength Converter Measurements (L × W × H)	306 × 200 × 100 mm	
NLIR's Wavelength Converter Weight	5 kg	

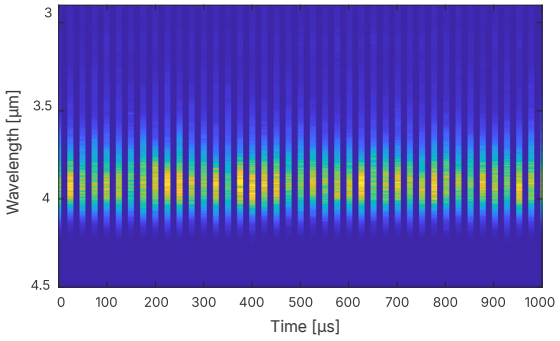
[1] Free-space input available

READ MIR SPECTRA WITH VIS/NIR SPECTROMETERS

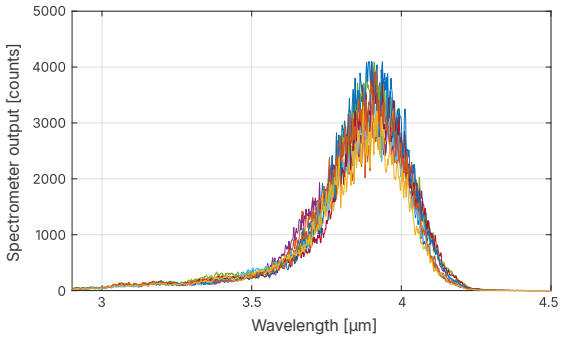
NLIR recommends two BUNDLE Spectrometer configurations: Flex with Avantes AvaSpec Varius and Edge with Wasatch Cobra 800 VIS/NIR spectrometers that brings new features otherwise unavailable with traditional MIR systems.

The result? High signal response, excellent resolution, and ultra-fast spectral acquisition. Existing software used with the VIS/NIR spectrometers remains fully compatible with the BUNDLE – NLIR provides a straightforward wavelength translation to complete the integration. Compare the two BUNDLE Spectrometer options in the data table on page 8 and choose the best one for your measurement needs.

The plots below show spectra from a 40 kHz repetition rate supercontinuum laser source.



Series of 40 kHz repetition rate pulses measured at 80 kHz acquisition rate.



10 consecutive pulses measured at 80 kHz acquisition rate.

SPEKTRUM Wavelength Converter

NLIR's wavelength converters translate mid-infrared light into the visible and near-infrared, providing a practical, versatile MIR tool for any photonics laboratory.

NLIR's SPEKTRUM Wavelength Converter converts light in the range of 1.9 – 5.3 µm directly to 682 – 886 nm, enabling detection using a wide range of silicon-based detectors.

Depending on the application and measurement requirements, various VIS/NIR detectors can be utilized to analyze the spectral content of the wavelength-converted mid-infrared light.

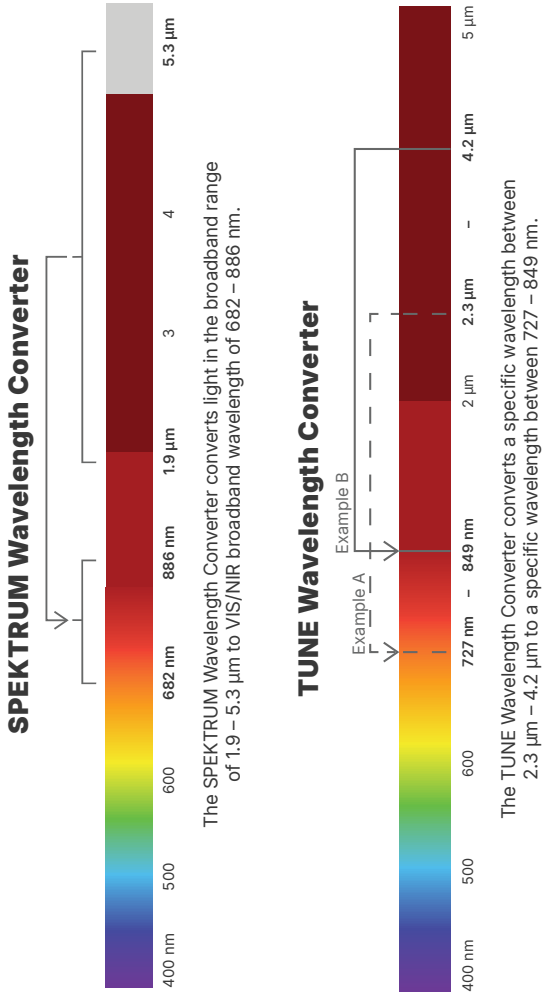
For increased convenience, the device is fiber-coupled at both input and output ports.

Customers are already measuring using everything from single-photon-coaters to 12.5 GHz detectors. Contact our experts today for a talk about the possibilities.

SPEKTRUM Wavelength Converter	
Optical Bandwidth Input	1.9 – 5.3 µm
Optical Bandwidth Output	682 – 886 nm
Conversion Resolution	2.5 cm^{-1}
Conversion Efficiency	2 × 10^{-4}
Output noise spectral density (682-886 nm)	120 fW/nm
Optical Input[1]	SMA-905 Fiber Connector
Stability[2]	± 1 % over 24 hours
Optical Output	FC/PC Fiber Connector
Rec. IR Fiber Core Size	100, 200, 300 µm
Polarization Sensitivity	Vertical
Power Consumption	60 – 90 W
Supply Voltage	19 V
Operating Temperature	18 – 30 °C
Measurements (L × W × H)	306 × 200 × 100 mm
Weight	5 kg
Mounting	4 × 1″ Posts

[1] Free-space input available
[2] ± 1 °C ambient variation

CONVERT MIR LIGHT TO VIS/NIR



TUNE Wavelength Converter

The NLIR wavelength converters translates specific ranges of mid-infrared light into visible/near-infrared light.

NLIR's TUNE Wavelength Converter efficiently converts a narrow spectral band within the 2.3 – 4.2 µm range directly to 727 – 849 nm with high conversion efficiency. The center wavelength can be tuned precisely, allowing selection of the exact wavelength for conversion and a narrow bandwidth.

With a conversion efficiency of up to 10%, the device ensures minimal thermal noise interference, as ambient infrared radiation is inherently blocked by ultra-narrow upconversion wavelength dependency. This technology enables the use of state-of-the-art silicon-based detectors to push mid-infrared light measurements into new regimes.

Control of the center conversion wavelength is conveniently done using the simple software included.

Depending on the application and measurement requirements, VIS/NIR detectors such as spectrometers, APDs, PMTs, or SPADs can be used to analyse the spectral or temporal content of the converted mid-infrared light.

For increased convenience, the device is fiber-coupled at both the input and output ports.

	TUNE Wavelength Converter	
Optical Bandwidth Input	2.3 – 2.8 µm	2.7 – 4.2 µm
Optical Bandwidth Output	727 – 771 nm	763 – 849 nm
Conversion Bandwidth	20 – 25 nm	25 – 300 nm
Conversion Efficiency[1]	3 %	
Output Noise[2]	20 pW	
Optical Input	SMA-905 Fiber Connector	
Optical Output	FC/PC Fiber Connector	
Rec. IR Fiber Core Size	100, 200, 300 µm	
Polarization Sensitivity	Vertical	
Power Consumption	60 – 90 W	
Supply Voltage	19 V	
Operating Temperature	18 – 30 °C	
Measurements (L × W × H)	306 × 200 × 100 mm	
Weight	5 kg	
Mounting	4 × 1″ Posts	
Tuning Speed	< 1 s	
Control Interface	USB-B	

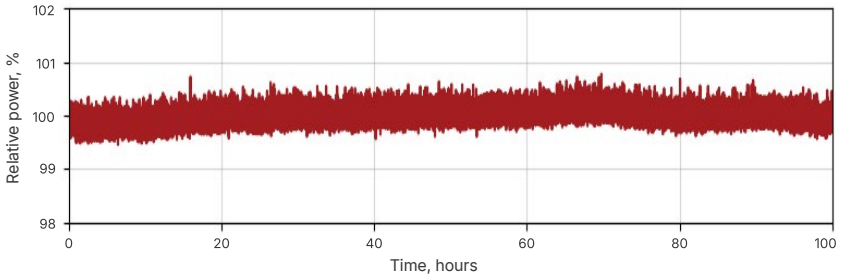
[1] Fiber-fiber conversion efficiency measured with a 100 µm core size 0.2 NA InF_3 input fiber or a 50 µm core size 0.22 NA input fiber. With optional free-space input, the conversion efficiency can be 10 % with optimally aligned input
[2] Depending on wavelength

FIBER Light Source

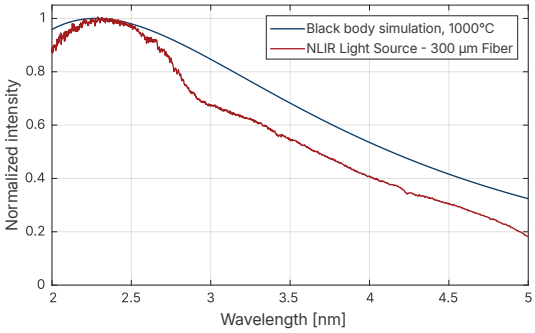
High-temperature mid-infrared (MIR) light sources offer a cheap and stable supply of CW power over a wide bandwidth.

NLIR's FIBER Light Source makes it easy to deliver broadband MIR light to a sample, e.g. using the wide range of MIR fiber coupled measurement interfaces.

The light source is plug-and-play. It turns on in a few seconds and has temperature actively stabilized, for a stable output over the full lifetime.



The stability of NLIR's FIBER Light Source when used over a period of 100 hours.



Normalized intensity of the FIBER Light Source.

	FIBER Light Source
Optical Bandwidth	1.2 – 8.0 µm
Source	1050 °C Silicon Carbide
Output Power[1]	5 mW
Optical Output	SMA-905 Fiber Connector
Lifetime[2]	> 1800 hours
Power Consumption	22 – 25 W
Supply Voltage[3]	19 V
Measurements (L × W × H)	130 × 160 × 90 mm
Weight	1.5 kg

[1] In 500 µm core size 0.3 NA chalcogenide fiber
[2] Typical point of time where output starts to decrease, source will show end-of-life status
[3] Delivered with the included 19 V supply or an interconnect cable to the MIDWAVE Spectrometer

AURALIS Light Source

NLIR's AURALIS Light Source delivers mid-infrared light in abundance, making it a good match even for dark materials such as black plastics or foams. AURALIS Light Source is designed for reflection measurements and can be coupled together with e.g. NLIR's SAMPLER Accessory, working as the light collection head. From here a fiber is connected to NLIR's SAMPLER Accessory which transfers the light from the sample to the 2.0 – 5.0 µm spectrometer for data acquisition.

NLIR's AURALIS Light Source directs light from the silicon carbide emitter onto an approximately 1 cm diameter spot at a 150 mm working distance. This broad illumination area, combined with light impacting the sample over a wide range of angles, ensures that even rough and uneven samples reflect light towards the collection optics.

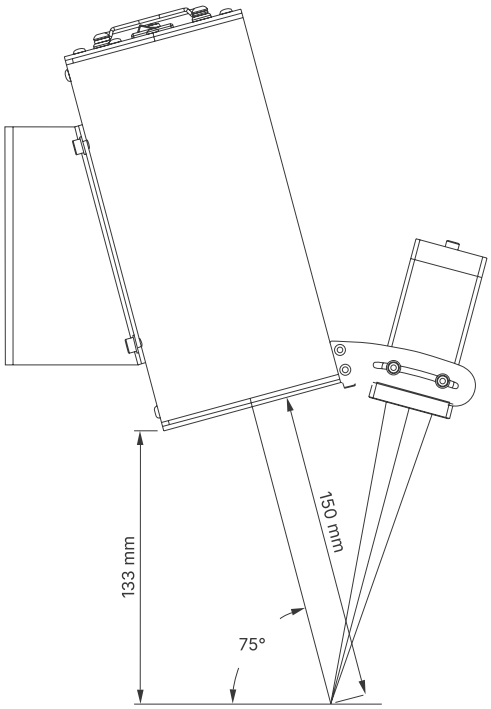
The light source is plug-and-play, activating in just a few seconds Additionally, its active heat management system ensures a constant output over the full lifetime of the source.

The schematic to the right illustrates the optimal setup where AURALIS Light Source is positioned to face a table or conveyor belt in a specular configuration at the ideal working distance of 150 mm. The unit is designed to be compatible with both a standard 100 mm VESA wall mount or a simple NLIR mounting bracket for real-time measurements in any environment.

AURALIS Light Source can be coupled together with SAMPLER Accessory to be installed at a conveyor belt for efficient production measurements.

	AURALIS Light Source
Optical Bandwidth	1.0 - 10.0 µm
Source	1050 °C Silicon Carbide
Features	Active Power Stabilization
Lifetime[1]	1800 hours
Optical Output	Free-Space
Intensity in Focus Spot	0.5 W/cm^2
Working Distance	150 mm
Power Consumption	22 - 25 W
Supply Voltage[2]	19 V
Measurements (L × W × H)	180 × 180 × 90 mm
Weight	1.6 kg
Protective Calcium Flouride Window	

[1] Typical point of time where output start to decrease, source will show end-of-life status
[2] Delivered with the included 19 V supply or an interconnect cable to the MIDWAVE Spectrometer



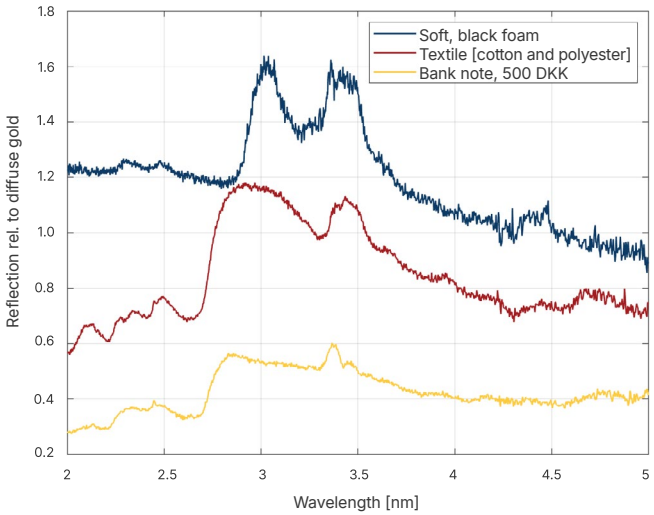
Technical drawing showing working distance and mounting of the AURALIS Light Source and the SAMPLER Accessory.

TOUCH Interface

NLIR's TOUCH Interface is a device that greatly simplifies the access to reflection measurements.

It has a built-in wide-band light source and reflects light on the sample in a 30° angle. The reflected light is conveniently coupled to a fiber. The TOUCH Interface is designed to work with differently shaped sample surfaces while at the same time minimize background signal. Due to its internal design, TOUCH Interface captures data of (almost) any sample regardless of its shape or surface.

EFFORTLESS REFLECTION MEASUREMENTS



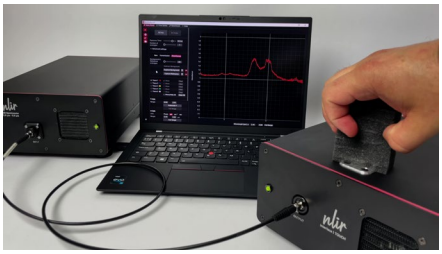
The graph to the left shows how simple it is to conduct reflection measurements of various samples with NLIR's TOUCH Interface.

Here, it demonstrates the absorption of three different samples: soft black foam, cotton and polyester textile and a banknote.

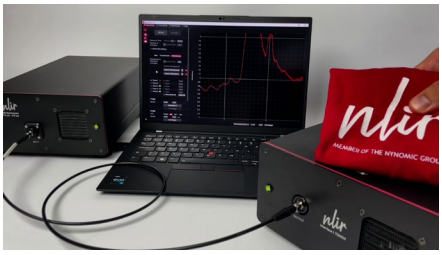
The exposure time used was 50 ms and no averaging or other data processing was applied. A diffuse gold reference is build into the protective lid for the sample port.

	TOUCH Interface
Optical Bandwidth	1.2 – 8.0 µm
Collection Spot Size	< 2 mm
Light Source	1050 °C Silicon Carbide
Optical Interface	Free-Space
Lifetime[1]	> 1800 hours
Optical Output	SMA-905 Fiber Connector
Power Consumption	22- 25 W
Supply Voltage	19 V
Measurements (L × W × H)	200 × 200 × 100 mm
Weight	2.5 kg

[1] Typical point of time where output starts to decrease, source will show end-of-life status



Reflection measurements of black foam using NLIR's TOUCH Interface.



Reflection measurements of cotton fabric using NLIR's TOUCH Interface.

REFLECTION Interface

NLIR's REFLECTION Interface is an optical system designed to reflect and direct infrared (1.0 – 10.0 µm) light efficiently. It is used in various applications where reflection-based optical pathways are needed.

It consists of two independent products – AURALIS Light Source and SAMPLER Accessory.

Designed to be fiber-coupled with MIDWAVE Spectrometer, this interface allows you to perform reflection measurements at a 15° angle, from 15 cm distance.

The combination of the large illumination area and a small sample area allows for easy alignment and setup of the system. The interface may be delivered with a visible-light light source for alignment upon request.

Mounting NLIR's REFLECTION Interface on a stand in your production line allows you to perform reflection measurements at scale in real time.

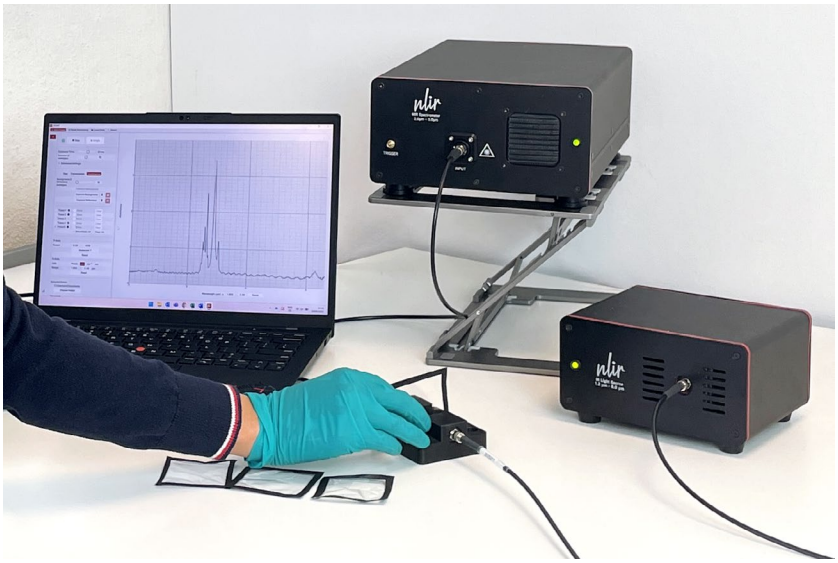
The specifications table for REFLECTION Interface can be found on page 13 (AURALIS Light Source) and page 18 (SAMPLER Accessory).

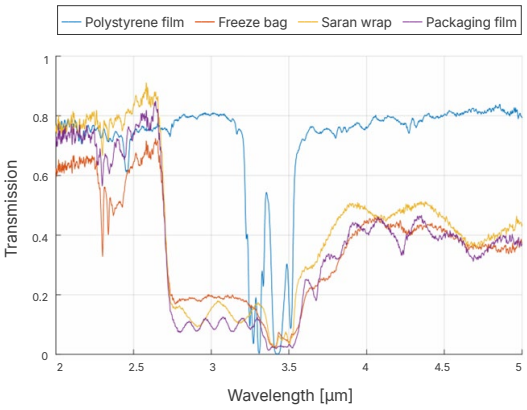
TRANSMISSION Interface

The TRANSMISSION Interface is designed for fast and straightforward transmission measurements of transparent or semi-transparent optical samples, including foils, thin films, optical coatings, non-water-based liquids, and gases.

It is optimized for use with the FIBER Light Source and MIDWAVE Spectrometer, delivering rapid and precise analysis in just a few milliseconds.

For applications requiring greater flexibility, the same high-performance transmission measurements can be achieved through the mechanical alignment of two COLLIMATOR Accessories.





Transmission measurements of different plastic films using the TRANSMISSION Interface. Exposure time was set to 30ms, and 10 averages were taken for each spectra.

TRANSMISSION Interface

Optical Bandwith	2.0 – 5.0 µm
Collimation Lens Material	CaF_2
Transmission[1]	> 40 %
Optical Connector	SMA-905 Fiber Connector
Measurements (L × W × H)	65 × 77 × 29 mm
Weight	220 g

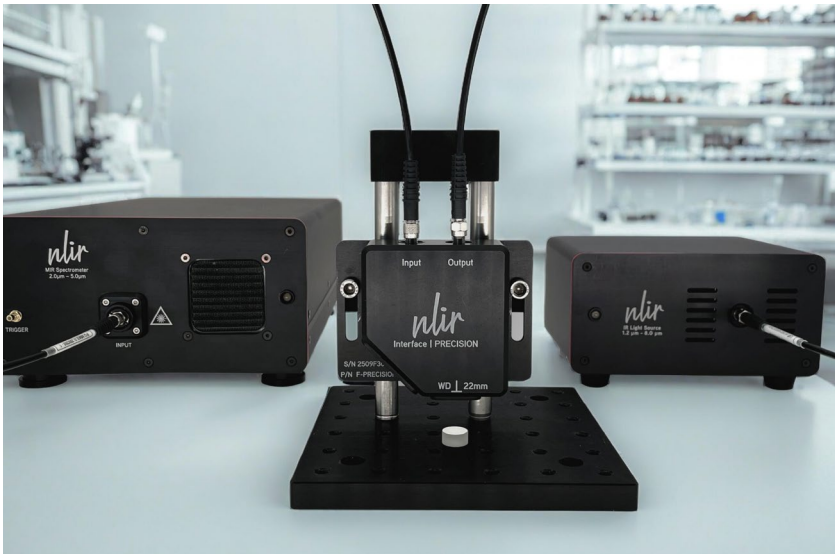
[1] Using a 400 and 200 µm fiber

PRECISION Interface

The PRECISION Interface is designed for highly accurate reflection measurements on small, well-defined areas of specularly reflecting surfaces. It enables measurements on areas smaller than 500 µm, with a working distance of 22 mm. The beam-splitter-based design allows for a 0° specular measurement.

Developed to work together with the FIBER Light Source and MIDWAVE Spectrometer, the PRECISION Interface allows for rapid reflection measurements, completing analyses in less than 100 ms. Using an IR optical fiber, the light is brought from the NLIR FIBER Light Source to the sample and returned to the NLIR MIDWAVE Spectrometer. This results in a fast and sensitive REFLECTION Measurement System.

For measurements on diffusely reflecting surfaces, the TOUCH Interface or REFLECTION Interface are more suitable alternatives.



	PRECISION Interface
Optical Bandwith	2.0 – 5.0 µm
Working Distance	22 mm
Transmission[1]	> 5 %
Focus Spot Size[2]	< 500 µm
Optical Connectors	SMA-905 Fiber Connectors
Measurements (L × W × H)	33 × 100 × 82 mm
Weight	385 g

[1] By reflection on a silver coated mirror
[2] Depends on fiber core size

SAMPLER Accessory

NLIR's SAMPLER Accessory is an effective tool designed to capture light from a specific point and couple it into a fiber. Constructed with two CaF_2 lenses and optimized for the 2.0 – 5.0 µm wavelength range.

The working distance of 146 mm ensures a balance between proximity – to maximize light capture – and sufficient distance to accommodate a flexible handling of the samples. This working distance can be adjusted upon request.

The SAMPLER Accessory is ideally suited for samples exhibiting both diffuse and specular reflectance and works with all light sources.

	SAMPLER Accessory
Optical Bandwidth	2.0 – 5.0 µm
Collection Spot Size[1]	1 – 2 mm
Working Distance[2]	146 mm
Optical Output	SMA-905 Fiber Connector
Maximum NA Supported	0.3
Mount Threads	M3 and M4
Measurements (L × W × H)	80 mm × 36 mm × 36 mm
Weight	210 g

[1] Depends on fiber core size
[2] Custom distancing available upon request

WORKING PRINCIPLE OF SAMPLER AND COLLIMATOR ACCESSORIES

Both NLIR's SAMPLER Accessory and COLLIMATOR Accessory are designed for efficient light collection and fiber coupling in the 2.0 – 5.0 µm range.

As shown on the illustrations on page 19, NLIR's SAMPLER Accessory is optimized for collecting light from a point source, while NLIR's COLLIMATOR Accessory is designed to couple collimated light into a fiber.

NLIR's SAMPLER Accessory uses a two-lens system (CaF_2) to first collimate the divergent light before focusing it into a fiber. This makes it ideal for capturing light from localized sources or diffuse targets where direct fiber coupling is not possible.

NLIR's COLLIMATOR Accessory uses a single CaF_2 lens to focus incoming light into a fiber or, equivalently, collimate light emitted from a fiber.

COLLIMATOR Accessory

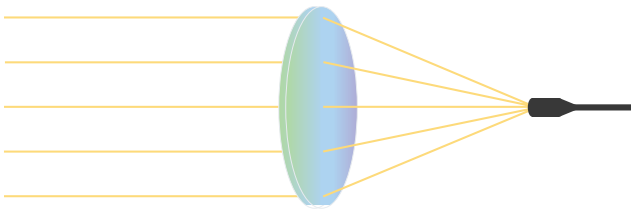
The COLLIMATOR is a simple, cost-effective, and efficient tool for coupling collimated light into a fiber.

It features a 20 mm CaF_2 lens, optimized for operation in the 2.0 – 5.0 µm wavelength range.

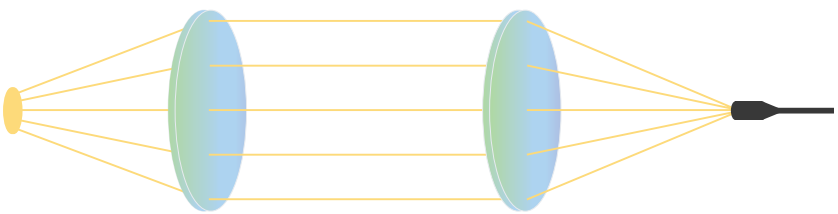
Additionally, the COLLIMATOR can be used in reverse to collimate light emitted from a fiber, making it a versatile optical component for various mid-infrared applications.

COLLIMATOR Accessory	
Optical Bandwidth	2.0 – 5.0 µm
Collimation Lens Material	CaF_2
Collimated Beam Size[1]	up to 11 mm
Optical Connector	SMA-905 Fiber Connector
Maximum NA Supported	0.3
Measurements (L × W × H)	30 mm × 25 mm × 25 mm
Weight	46 g

[1] Depends on fiber NA



Working principle of the COLLIMATOR Accessory.



Working principle of the SAMPLER Accessory.

TRANSMISSION Measurement System

Setting up an optical interface for a measurement can be time consuming. To simplify this process, NLIR offers two TRANSMISSION Measurement Systems to ease your measurement case. Each system includes NLIR's MIDWAVE Spectrometer, Light Source, Software, fibers and an interface or accessory of your choice – allowing you to plug in the devices and start measuring immediately.

There's no one-size-fits-all solution for spectroscopic transmission measurements, as different samples require different interfaces. Over the years, NLIR has conducted extensive testing across various industries and our most effective and widely used TRANSMISSION Measurement systems are featured here below.

Each TRANSMISSION Measurement System consists of:

- MIDWAVE Spectrometer
- FIBER Light Source
- Interface or Accessory of your choice
- 2 x MIRFIBER mid-infrared fibers

CHOOSE YOUR TRANSMISSION MEASUREMENT INTERFACE

TRANSMISSION Interface

Enables smooth mid-infrared transmission measurements in real time

COLLIMATOR Accessory

Collimates NIR/MIR light to a fiber effortlessly

HOW TO CHOOSE THE RIGHT TRANSMISSION MEASUREMENT SYSTEM FOR YOUR NEEDS?

Transmission measurements are well suited for samples that are sufficiently transparent in the mid-infrared range (2.0 – 5.0 µm) or thin enough to allow light to pass through. This can include foils, thin polymer films, optical coatings, gases, or even liquids in flow cells. As a rule of thumb, films up to a few tens of micrometers in thickness are typically measurable, depending on material absorption. The advantage of transmission is that it provides detailed information on internal structure – such as chemical composition across multilayer films or coatings – giving insights that are not always accessible with reflection-based techniques.

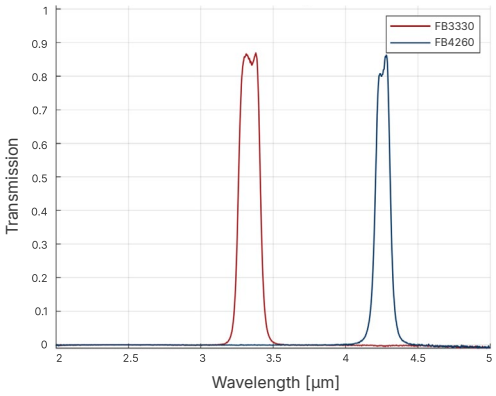
NLIR offers two ways of performing transmission measurements: with TRANSMISSION Interface, which is a pre-aligned tool for straightforward laboratory measurements of transparent and semi-transparent samples, and with COLLIMATOR Accessory – a flexible solution that can be combined and aligned for more demanding or custom setups, offering high-performance measurements where precision alignment is required.

Measurement Examples

OPTICAL COATING CHARACTERIZATION WITH NLIR'S MIDWAVE SPECTROMETER

NLIR's TRANSMISSION Interface combined with a FIBER Light Source were used to carry out these transmission measurements of optical coatings: a FB3330-150 IR Bandpass filter with center wavelength at 3.33 µm and FB4260-105 IR Bandpass filter with center wavelength at 4.25 µm resulting in the spectra depicted in the graph to the right.

NLIR's MIDWAVE Spectrometer was set to 20 ms exposure time and 10 averages were taken for each sample.

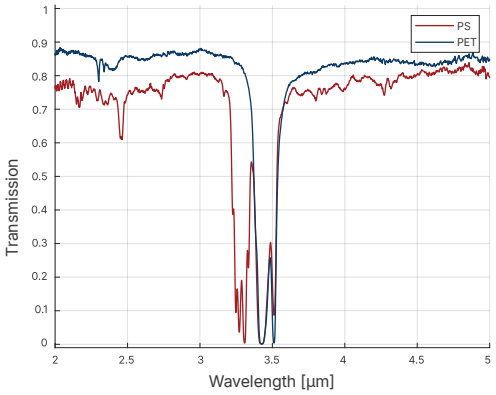


PLASTIC TRANSMISSION

NLIR's TRANSMISSION Interface combined with a FIBER Light Source were used for these transmission measurements of a polystyrene (PS) film and a polyethylene (PET) film.

NLIR's MIDWAVE Spectrometer was set to 20 ms exposure time and 10 averages were taken for each sample.

In a real measurement scenario for plastic identification algorithms would routinely tolerate much shorter exposure times and faster acquisition.

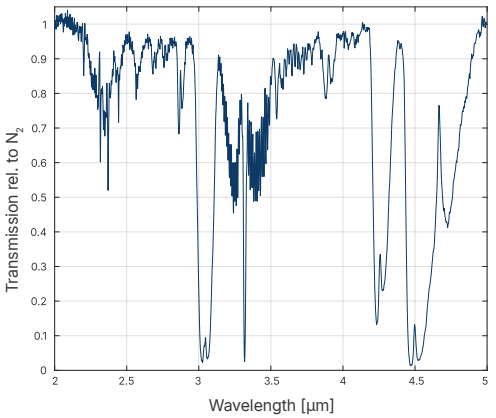


MEASUREMENT OF MULTIPLE GASES

The figure shows the transmission spectrum of a gas cell with a mix of 6 different gases (CO_2, N_2O, CO, CH_4, C_2H_2, and N_2) measured using NLIR's MIDWAVE Spectrometer, FIBER Light Source, two COLLIMATORS, and two MIRFIBERs.

A single shot of 20 ms exposure time captures the data shown, and no further data processing was applied. This measurement shows that it is possible to monitor many different gases at the same time with NLIR's equipment and obtain live information about the gas composition.

From data like this, concentration values can be derived using chemometric of machine learning techniques.



REFLECTION Measurement System

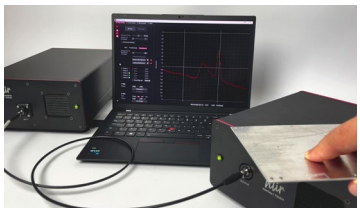
Setting up an optical interface for a measurement can be time consuming. To simplify this process, NLIR offers a range of REFLECTION Measurement Systems to ease your measurement case. Each system includes NLIR's MIDWAVE Spectrometer, a Light Source, Software, fibers and an interface of your choice – allowing you to plug in the devices and start measuring immediately.

There's no one-size-fits-all solution for spectroscopic reflection measurements, as different samples require different interfaces. Over the years, NLIR has conducted extensive testing across various industries and our most effective and widely used REFLECTION Measurement systems are featured here below.

Each REFLECTION Measurement System consists of:

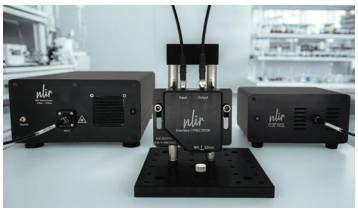
- MIDWAVE Spectrometer
- FIBER or AURALIS Light Source (except for TOUCH Interface)
- Interface of your choice
- MIRFIBER mid-infrared fiber(s) based on the system requirements

CHOOSE YOUR REFLECTION MEASUREMENT INTERFACE



TOUCH Interface

Facilitates easy reflection measurements on individual samples, regardless of their surface or shape



PRECISION Interface

Enables reflection measurements on a small, well-defined area

REFLECTION Interface

Allows you to perform non-destructive mid-infrared reflection measurements efficiently

HOW TO CHOOSE THE BEST REFLECTION MEASUREMENT SYSTEM FOR YOUR NEEDS?

Many samples measured in reflection need a powerful light source and a means to get the reflected light to the spectrometer. NLIR has designed several REFLECTION Measurement Systems for efficient measurements of various samples including but not limited to measurement of black plastics, coated metal plates or reflective optics.

Unlike the typical NIR setup, NLIR recommends to measure in specular reflection when working in the MIR wavelength range. This is always the case in the REFLECTION Measurement Systems.

When needing to characterize fast-moving large objects at a conveyor belt, the REFLECTION Interface is the best fit. In contrast, PRECISION Interface allows exact measurements of areas smaller than 500 µm, with a working distance of 22 mm, while TOUCH Interface enables non-destructive reflection measurements of almost any sample, regardless of the surface or sample structure.

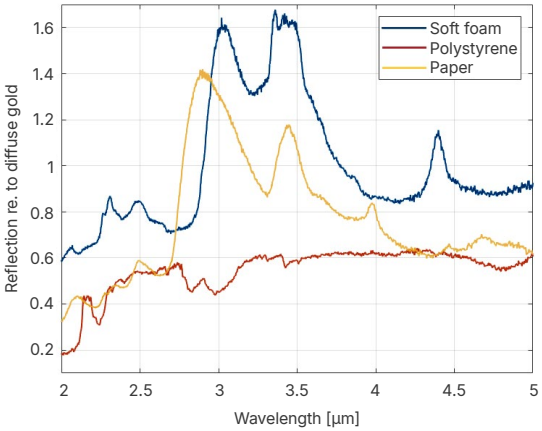
Measurement Examples

REFLECTION FROM DIFFUSE SURFACES

Using REFLECTION Interface together with MIDWAVE Spectrometer, several samples with rough surfaces were analyzed.

First, a reference measurement was obtained by reflecting light off the diffuse gold target. Subsequently, this target was replaced with soft foam, hard polystyrene, and paper.

The raw data, relative to the reference, is displayed in the figure to the right. These measurements were conducted exceptionally quickly, with an exposure time of just 50 ms.

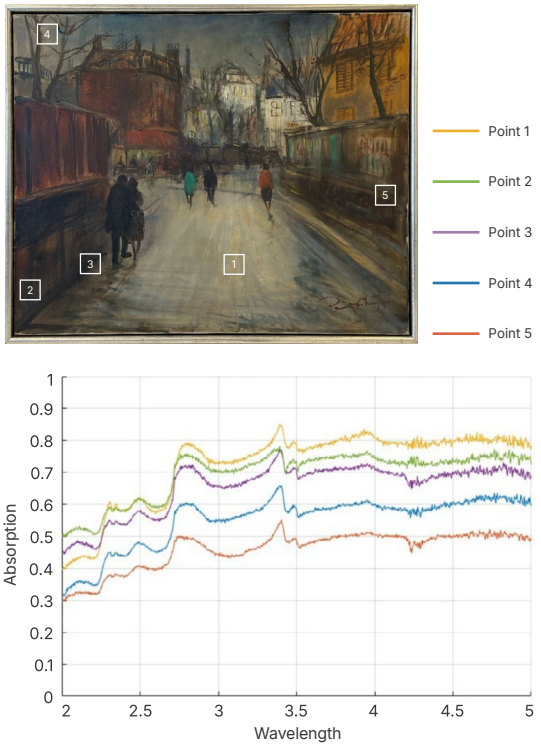


MID-INFRARED ABSORPTION ANALYSIS OF A PAINTING

Mid-infrared reflection spectroscopy was performed on an early-mid 20th century painting by Danish artist Poul Kastrup. Spectra were collected at five points over the painting using NLIR's REFLECTION Interface and MIDWAVE Spectrometer.

The graph displays the mid-infrared absorption spectra of five different points measured on a painting, covering wavelengths from 2.0 – 5.0 µm. Each curve represents a distinct sampling point, with variations in absorption intensities and peak features indicating differences in material composition across the surface.

The spectra indicate that Point 5, with lower absorption, likely has an inert dry mineral, Point 2, 3 and 4 show more structured absorption due to binders or hydrated pigments and Point 1 has highest and broadest absorption suggesting a combination of organic binders and possibly hydrated material.



Absorption Spectra of 5 points in a painting. Exposure time was set to 50 ms, and 10 averages were taken for each spectra.

Industrial

CHARACTERIZATION OF OPTICAL COATINGS

Fast and accurate spectroscopy is essential for characterizing optical coatings – both during production and in post-production quality checks. Traditional infrared methods like FTIR, monochromators, or filter wheels often fall short on either speed or spectral resolution. NLIR's mid-infrared spectrometers make it easy to perform rapid transmission and reflection measurements, supporting both real-time production monitoring and high-throughput quality control.

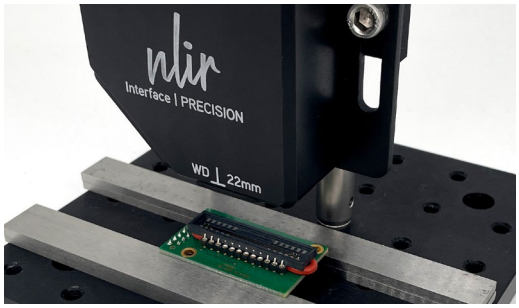
This opens the door to improving quality and shortening production time for infrared coatings using monitoring techniques typically limited to the visible and near-infrared range.

BLACK PLASTIC SORTING

Plastic recycling is gaining traction among public stakeholders and companies aiming for more circular processes. While many sorting technologies exist, black plastics still pose a major challenge.

Standard near-infrared (NIR) spectrometers operate in a range where black plastic can't be detected at all. NLIR's MIDWAVE Spectrometer combined with the REFLECTION Interface can reliably distinguish black plastics – as well as colored ones. The system is built for industrial use: it's the fastest mid-infrared spectrometer on the market, with no moving parts and no need for crygenic cooling. It is fiber-coupled, highly sensitive, and delivers a live feed of high resolution for a wide range of applications.

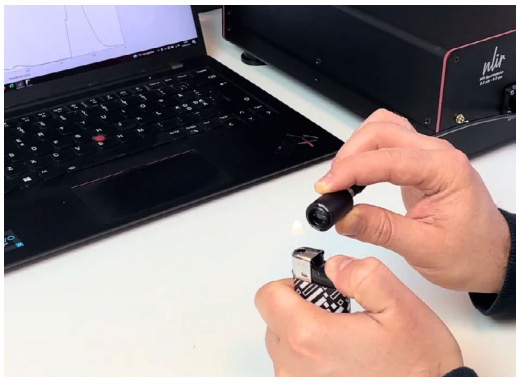
INTEGRATED OPTICS CHARACTERIZATION



As integrated photonics continue to advance, precise optical characterization is key to optimizing performance and ensuring reliability.

NLIR's mid-infrared spectrometers, combined with the PRECISION Interface, offer a simple, non-contact way to probe integrated optical components in 0° reflection angle – providing detailed insight into the optical properties of their surfaces.

COMBUSTION AND THERMAL EMISSION ANALYSIS



In most remote sensing applications, speed and sensitivity are critical. NLIR's mid-infrared spectrometers are the fastest available, offering a wide range of speed and sensitivity options. They enable rapid measurements of targets at any distance – just point the fiber head at a flame or other hot source to capture its emission.

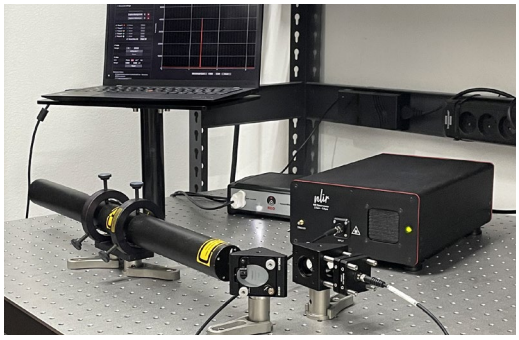
With microsecond-level exposure times, it is possible to track combustion and detect chemical compositions in real time with time-resolved spectroscopy.

Research

LASER BEAM DIAGNOSTICS

With the rapid progress in coherent infrared light sources in recent years, there is an increasing need for diagnostics that can keep up.

NLIR's fast and sensitive spectrometers enable live monitoring of beam alignment and ultra-fast pulse-to-pulse spectral acquisition at up to 130 kHz. Combined with NLIR's unique wavelength conversion technology – allowing the use of GHz-bandwidth detectors – these tools offer valuable insight into the development and operation of new mid-infrared light sources.



FAST-EVENT SPECTROSCOPIC ANALYSIS

Critical chemical changes happen in milliseconds – or faster. Traditional spectrometers like FTIR are too slow or fragile to capture these events. Our mid-infrared spectrometer operates in the 2.0 – 5.0 µm range with ms exposures and acquisition rates up to hundreds of kHz, enabling precise, time-resolved analysis of fast transformations such as curing, combustion, coating, or drying.

With no moving parts and robust industrial compatibility, it delivers lab-quality insight directly on the production line. Fast-event spectroscopic analysis helps detect deviations instantly, reduce waste, and optimize process performance – unlocking control over the rapid processes that defines modern manufacturing.

HERITAGE SCIENCE INSPECTION

Mid-infrared spectroscopy offers unique advantages for non-destructive analysis of cultural heritage objects. In the 2.0 – 5.0 µm range, it enables clear identification of functional groups in organic and inorganic materials – such as binders, varnishes, pigments and degradation products.

Our spectrometer combines high sensitivity with portability and robustness, making it ideal for measurements in museums, conservation labs or archaeological sites. With fast acquisition and no sample preparation, researchers can uncover material composition, monitor aging and support preservation – without compromising the integrity of valuable artifacts.

MATERIAL INSPECTION

Many materials contain critical chemical details invisible to conventional visible or near-infrared inspection. NLIR's spectrometer operates in the 2.0 – 5.0 µm mid-infrared range, identifying key molecular signatures like moisture, solvents, and functional coatings.

With high-speed spectral acquisition and a compact, rugged design, NLIR's equipment enables real-time, in-line material inspection for precise, non-contact analysis during production. This gives manufacturers greater control over material quality without slowing the process.

Customer Reviews

A primary instrument for our team's fast, AI-based research activity

We have been using NLIR's MIDWAVE Spectrometer for about two years now, successfully performing inline plastic characterization. The MIDWAVE Spectrometer has become a primary instrument for our team's fast, AI-based plastic waste stream characterization research activity.

Stas Zinchik, Ph.D.
MICHIGAN TECHNOLOGICAL UNIVERSITY

Versatile characterization enabled by fiber-coupled spectrometer

We use the NLIR's MIDWAVE Spectrometer for our calibration set-up. We appreciate the versatility of fibre coupling, the fast response of the detector and the ability to work at room temperature. All these aspects help us in the fundamental step of independent characterization of sources and optical elements.

Eliana La Francesca, Ph.D.
INAF-IAPS

Superb spectral signatures of thermal sources

We are thrilled to be able to carry out in-situ detection of fine species thanks to NLIR spectrometer's high sensitivity. The high SNR gives superb contrast to discern the spectral signatures from thermal background signal.

Grace Shu Hui Ham
MEASUREMENT, CONTROL AND DATA SCIENCES CLUSTER AT ARCELORMITTAL

A key device for sensitive, broadband trace gas detection

We are very satisfied with the outstanding performance of the NLIR's upconvertion spectrometer, offering both superior sensitivity and spectral range. These advantages allowed us to develop a versatile broadband (> 600 cm^{-1}) trace gas sensor for single species as well as fast and stable multi-species detection. It has been a pleasure working with their innovative and skilled technical team.

Associate Professor Dr. Frans JM Harren & Dr. Qing Pan
RADBOUND UNIVERSITY

Contact Us

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