S2050 Mid-Infrared Spectrometer

Data sheet

- 2.0 – 5.0 µm bandwidth
- Up to 130 kHz full-spectrum readout rate
- Down to 5 pW/nm sensitivity
- Down to 2.5 cm^{-1} resolution on 2048 px

The NLIR S2050 MIR Spectrometer is based on a novel measurement scheme that upconverts the MIR light to near-visible light. Silicon-based near-visible light detectors are far superior to MIR light detectors in terms of detectivity, speed and noise. The NLIR upconversion technology therefore brings these attractive features, and the advantages that follow, to the MIR regime.

The spectrometer is made in three editions: S2050-400 is the most sensitive with max. 400 Hz full spectrum readout rate; S2050-1k is faster and has better resolution but lower sensitivity; S2050-130k has the best resolution and the highest readout rate. All versions come with a GUI interface for easy plug-and-play measurements in various applications; additionally, API interfaces for MATLAB, Python and C (DLLs) are available.

	S2050-400 The most sensitive edition with full spectrum readout rate	S2050-1k* Faster and has better resolution but lower sensitivity	S2050-130k* The best resolution and the highest readout rate
Optical Bandwith	2.0 – 5.0 µm		
Resolution	6 cm^{-1}	3 cm^{-1}	2.5 cm^{-1}
Exposure Time [1]	0.0108 - 500 ms	0.009 ms – 40 s	0.0013 – 0.654 ms
Max. Readout Rate	400 Hz	1.4 kHz	130 kHz
Bid Depth	16		12
Sensitivity	130k counts/(ms µW)	8k counts/(ms µW)	1.6k counts/(ms µW)
Dark Noise Std. [2]	11 counts	60 counts	1 counts
Minimum detectable power in 100 ms	5 pW/nm	75 pW/nm	25 pW/nm
Optical Input [3]	SMA 905-fiber connector		
Polarization Direction	Vertical		
Maximum Operating Temperature	30 °C		
Physical Dimensions (H x L x W)	100 x 306 x 200 mm		
Weight [4]	5 kg		
Software	All versions come with a GUI interface for easy plug-and-play measurements in various applications. Additionally, API interfaces for MATLAB, Python and C (DLLs) are available.		

*Spectrometer is a bundle of two devices connected by optical fiber.
[1] Longer effective exposure times can be achieved for the S2050-130k model by stacking acquired spectra.
[2] At minimum exposure time.
[3] Fiber port is removeable for free-space use.
[4] For bundle devices: add weight of second device (approx. 2kg)

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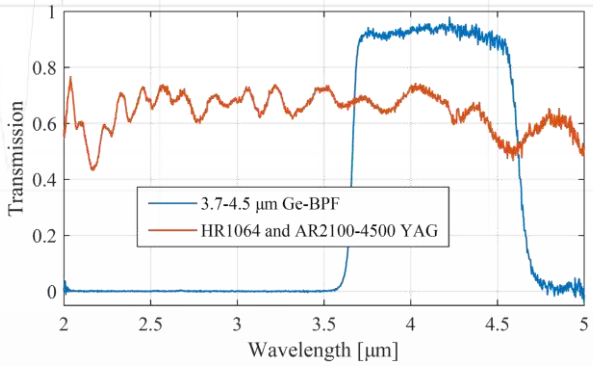
Application examples



Optical coating measurement

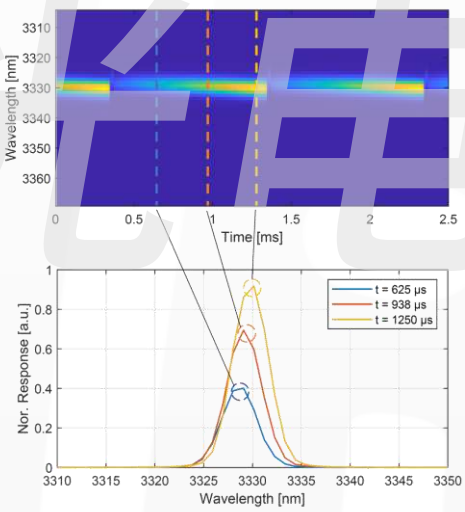
A 30 W globar was used as light source for these transmission measurement of coated optical windows: a Ge bandpass filter (BPF) for 3.7 – 4.5 µm and a YAG mirror coated with high-reflection at 1064 nm and high-transmission at 2.1 – 4.5 µm. The S2050-400 spectrometer was set to 20 ms exposure time and capturing just single shots. No averaging or smoothing has been applied to the data subsequently.

Such measurements are used for coating quality control or even production monitoring.

80 kHz MIR spectroscopy

The drive current of a mid-infrared laser at 3329 nm is modulated in amplitude at 1 kHz and the ultra-fast 80 kHz edition of the NLIR 2.0 – 5.0 µm spectrometer measures the laser spectrum with a temporal resolution of 12.5 µs. When the drive current is modulated, the amplitude and center frequency of the laser changes, and these characteristics are clearly visible in the data shown in the figure.

Measurement done by Marc-Simon Bahr at HAW Hamburg, Department of Information and Electrical Engineering.



kHz-rate optical coherence tomography

Optical coherence tomography is a well-known in-depth imaging technique in the near-infrared that, however, has numerous advantages in the mid-infrared region. The NLIR upconversion technology is used to realize kHz line-rate spectroscopy that enables live mid-infrared OCT monitoring.

From Niels M. Israelsen *et al.*, "High-resolution mid-infrared optical coherence tomography with kHz line rate," Opt. Lett. 46, p. 4558 (2021).