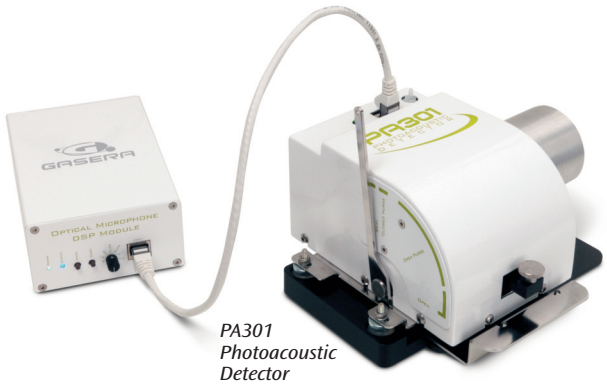
PA301 and PA101 – *Photoacoustic Accessory for Analysis of Difficult Samples and Depth Profiling*



PA301 Photoacoustic Detector

FEATURES OF THE PHOTOACOUSTIC ACCESSORY

- *Versatile and rapid analysis of solid, semi-solid, liquid, and gas samples*
- *Ideal sampling technique for highly absorbing samples*
- *Requires no sample preparation, and is non-destructive*
- *Depth probing capabilities*
- *Patented optical microphone based on cantilever sensor technology*
- *May be used in the NIR/MIR/FIR spectral regions*

Photoacoustic spectroscopy (PAS) overcomes drawbacks that may occur with traditional spectroscopic sampling techniques due to the physical and chemical nature of the sample. PAS is ideal for the analysis of highly absorbing samples, layered polymers, fibers, and samples with varying surface roughness such as minerals and soils. The technique is non-destructive. Using PA technologies, Gasera accessories offer high sensitivity, good selectivity and fast response time for reliable analysis of gases, liquids, and solid materials. A dedicated gas analyzer and a multipurpose analyzer for solids, semi-solids, liquids, and fibers are available.

High sensitivity is achieved by using a patented cantilever pressure sensor that is over hundred times more sensitive compared to a membrane, which is used in conventional techniques. Gasera's patented cantilever-type pressure sensor is designed to significantly improve the sensitivity of photoacoustic spectroscopy. An extremely thin cantilever portion moves like a flexible door due to the pressure variations in the surrounding gas. The movement of the free end of the cantilever can be about two orders of magnitude greater than the movement of the middle point of the tightened membrane under the same pressure variation. This is because the cantilever only bends and does not stretch.

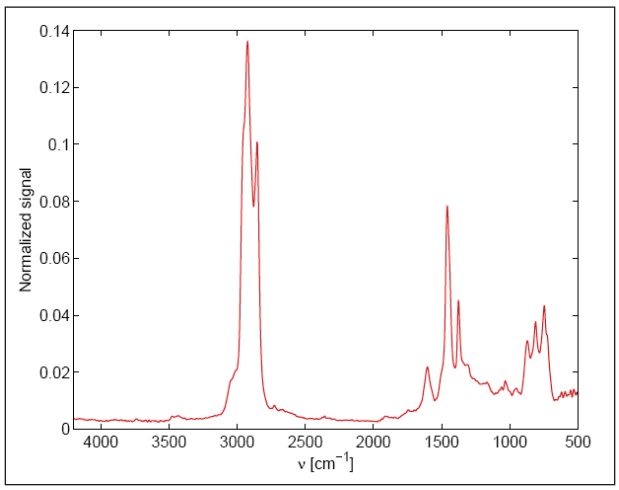
Data collection may be performed in rapid-scan mode optimized at 2.5 kHz or in step-scan mode with or without phase modulation. In rapid-scan or slow step-scan mode the thermal diffusion depth, defined as the length to decay 37% (1/e) of the original thermal wave amplitude, increases at longer wavelengths. For experiments performed in step-scan mode with phase modulation, the thermal diffusion depth may be linearized, eliminating the signal dependency on wavelength. Table 1 and 2 summarize thermal diffusion depths for rapid-scan and step-scan experiments for a typical polymer. For optimal performance, Helium purge gas is recommended.

Table 1: Thermal diffusion depth (L) in microns from PAS step scan without phase modulation and rapid scan sampling modes for a polymer with thermal diffusivity = 0.001 cm²/s.

Frequency (Hz)	L, 6000 cm^{-1}	L, 3000 cm^{-1}	L, 1000 cm^{-1}	L, 400 cm^{-1}
5	92	130	224	355
10	65	92	159	251
25	41	58	100	159
2,500	4	6	10	16

Table 2: Thermal diffusion depth (L) in microns from PAS sampling in step-scan mode with phase modulation for a polymer with thermal diffusivity = 0.001 cm²/s.

Phase Modulation Frequency (Hz)	L	Phase Modulation Frequency (Hz)	L
2	126	200	13
4	89	400	9
10	56	700	7
50	25	900	6



Heavy oil spectrum collected using the PAS301 (8 cm^{-1}, scan time 25 s)

PA101 is a low volume gas analyzer having an internal gas volume of 30 mL. The absorption is measured directly by applying photoacoustic techniques. This makes the measurement free of drift. It is the key factor for the unbeatable stability and reliability without frequent background measurement. Typical low volume applications are headspace analysis, synthesis and decomposition process analysis, and outgassing of materials measurements. Typical measurement concentration for PAS of the gas phase is in the sub-ppm region.

PA101 for gas analysis

Photoacoustic Accessory Specifications

PA301

Dimensions (W x D x H)	170 x 180 x 95 mm (excludes baseplate and fittings)
Weight	3.0 kg
Operational Conditions	
Temperature Range	15–35 °C
Humidity Range	below 90% RH
Pressure Range	Ambient
Sample Cups	10 mm ID x 9 mm H 5 mm ID x 1 mm H
Purge Gas	He (preferred)

PA101

Dimensions (W x D x H)	165 x 165 x 290 mm (excludes baseplate and fittings)
Weight	6.0 kg
Gas Cell Volume	30 mL
Gas Pressure	300–1500 mbar
Temperature	Ambient to 50 °C
Particulate Size	Less than 1 micron
Operational Conditions	
Temperature Range	0–45 °C
Humidity Range	Below 90% RH
Pressure Range	Ambient

Power Supply Unit for PA301 and PA101

Input Voltage	100–240 VAC; 50–60 Hz
Input Power Max	30 W

Ordering Information

Photoacoustic Accessory

Part Number	Description
180-11XX	PA301 *Includes photoacoustic cell, digital signal processing unit, sampling cups and holders, carbon black reference, baseplate, KBr window and cabling*
180-10XX	PA101 *Includes photoacoustic cell for gas sampling, digital processing unit, baseplate, BaF_2 window and cabling*
180-2010	Gas Flow Meter

Notes: PA301 and PA101 require the gas flow meter. Please see the FTIR instrument code sheet for XX.

Options

Part Number	Description
180-2011	PAS301 Carbon Black Reference
180-2012	Sample Cups, small
180-2013	Sample Cups, large
180-2014	KBr, 19 x 2 mm
180-2015	BaF_2, 19 x 2 mm
180-2016	Si, 19 x 2 mm
180-2017	Quartz, 19 x 2 mm
180-2018	ZnSe, 19 x 2 mm
180-2019	CsI, 19 x 2 mm
180-2020	KBr, 14 x 2 mm
180-2021	BaF_2, 14 x 2 mm
180-2022	Si, 14 x 2 mm
180-2023	Quartz, 14 x 2 mm
180-2024	ZnSe, 14 x 2 mm
180-2025	CsI, 14 x 2 mm

Notes: PA301 uses one 19 x 2 mm window. PA101 uses one 14 x 2 mm window.

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