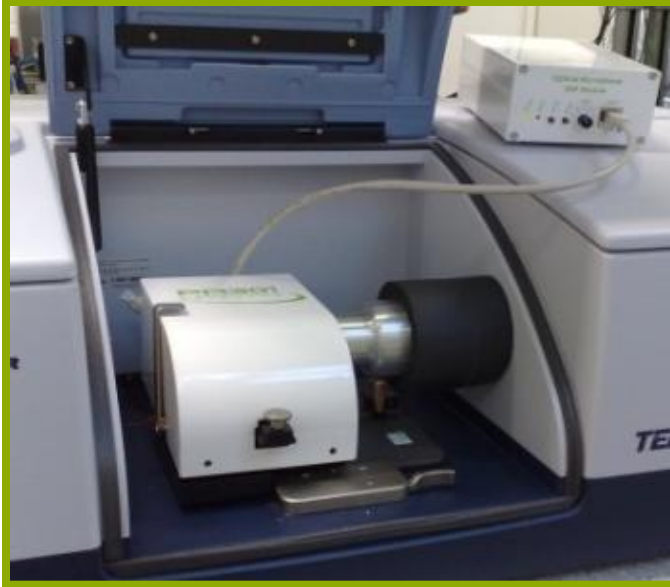


FTIR accessory: **PA301**



Ultra-high performance photoacoustic detector
for solid, semi-solid, and liquid samples

Product concept

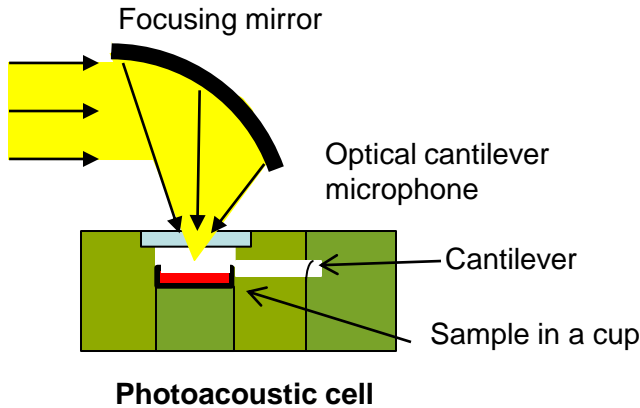


- PA301 is a photoacoustic FTIR accessory that can be used for the measurement of solid, liquid and semisolid samples
- PA301 is utilizing the patented cantilever based optical microphone technology that provides high sensitivity for the measurement
- PA301 detector improves laboratory productivity and safety by enabling extremely versatile and rapid analysis of solid, semi-solid, and liquid samples in any form without sample preparation.

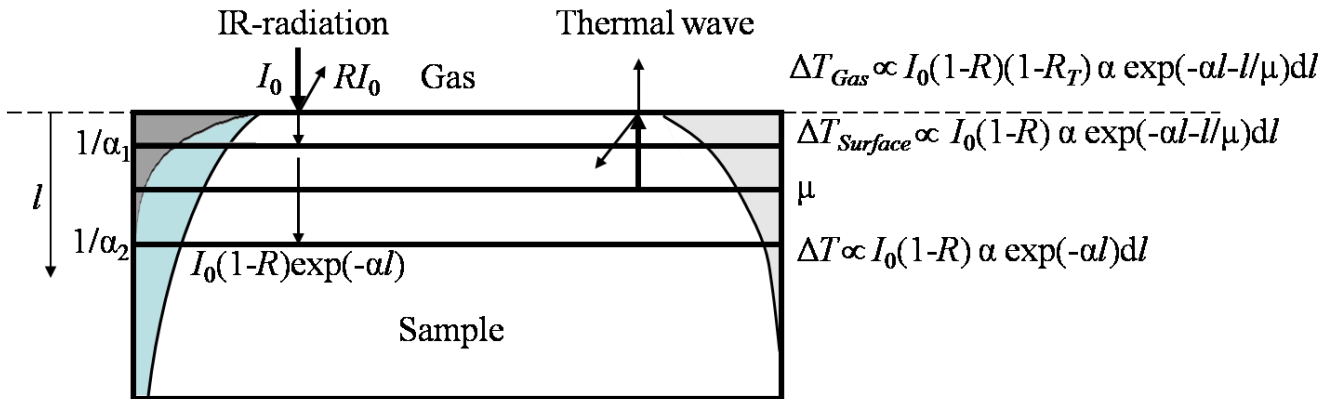


Operation principle

Photoacoustic detection

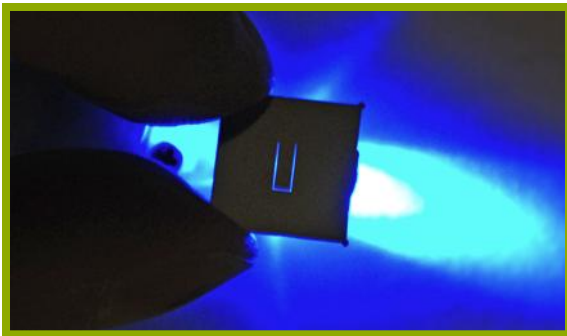
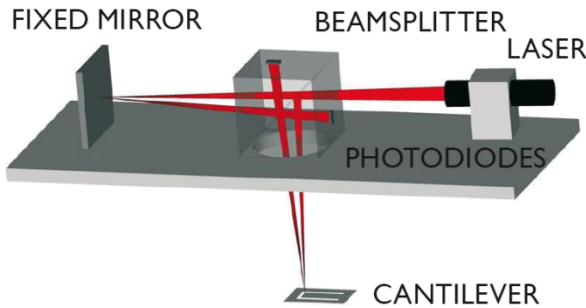


- Photoacoustic spectroscopy directly measures a sample's infrared absorption. The absorption of infrared radiation in the sample creates heat which is transferred into the surrounding gas and a photoacoustic signal is generated via thermal expansion.
- The expansion of gas is then detected with a cantilever pressure sensor.



Ultrasensitive Optical microphone

- The heart of the system is the patented optical microphone
- It is comprising of a MEMS cantilever coupled with a laser readout interferometer.
- It is capable of digitally measuring microscopic movements of the cantilever sensor, having a dynamic range greater than any analog circuitry can ever obtain.

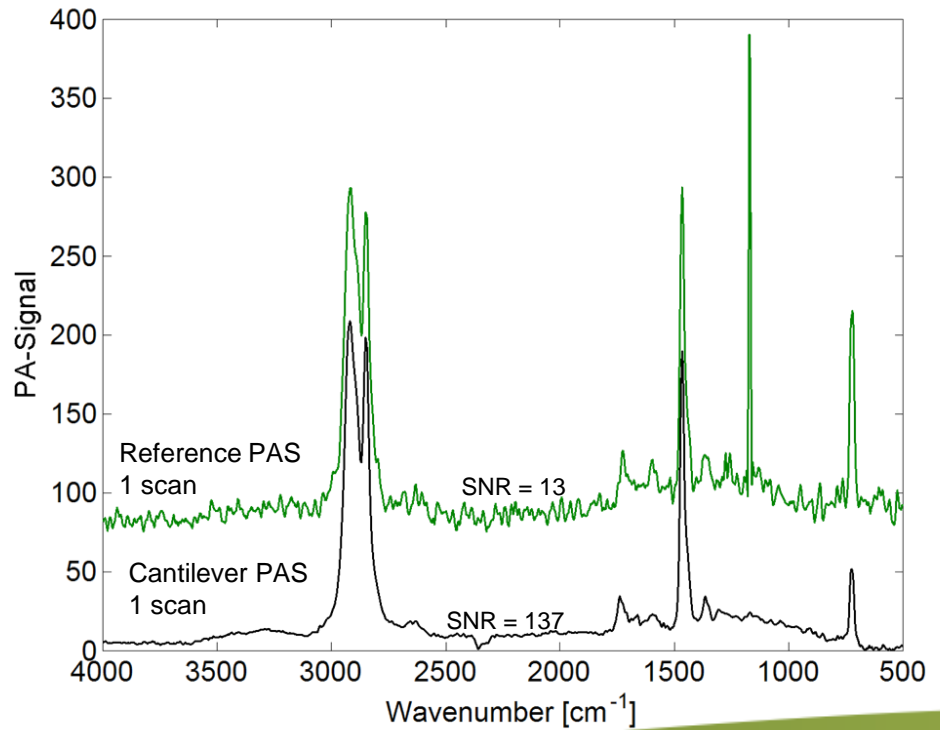
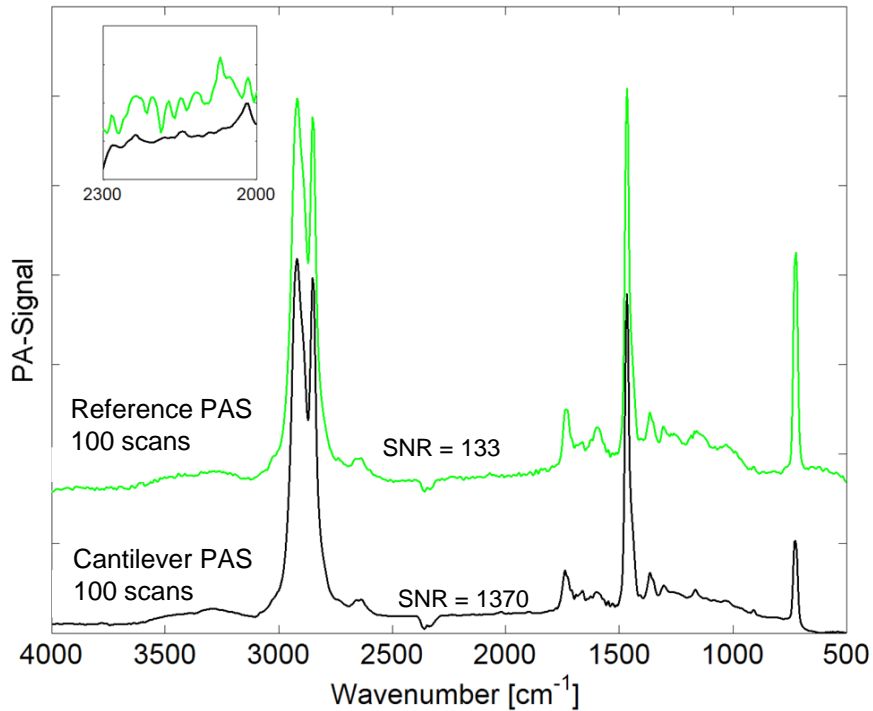


Δx [m]	Δp [Pa]	ΔT [K]	Δm [g]
2×10^{-12}	2×10^{-7}	2×10^{-9}	4×10^{-12}

With 1s measurement time.

PA301 Performance

- Due to the ultrasensitive cantilever microphone the SNR of PA301 is ten times higher than with other photoacoustic detectors using condenser microphone.
- This means that same SNR is received in 100 times shorter time scale.
- It also means that equal SNR without helium purge is still achieved 10 times faster.
- Cantilever microphone also does not lose its performance over the time.

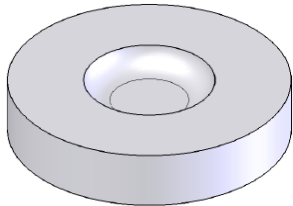
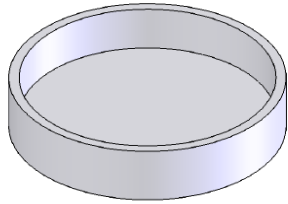


Versatility



- PA301 can measure any kind of samples with minor or no sample preparation.
- The spectra can be used for qualitative and quantitative analysis of samples.
- Commercial transmission spectrum libraries can be used for material identification.
- PA301 can be connected to nearly any existing FTIR device.

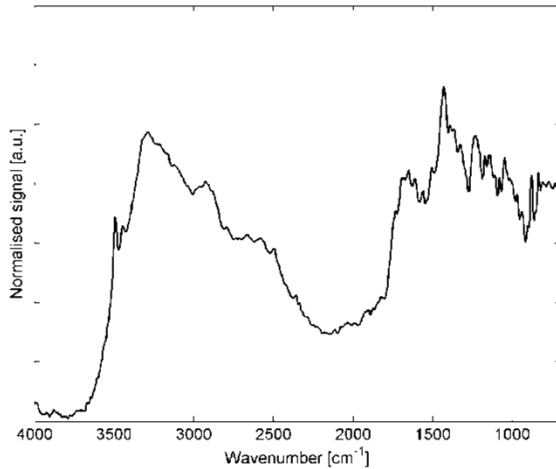
Easy sampling



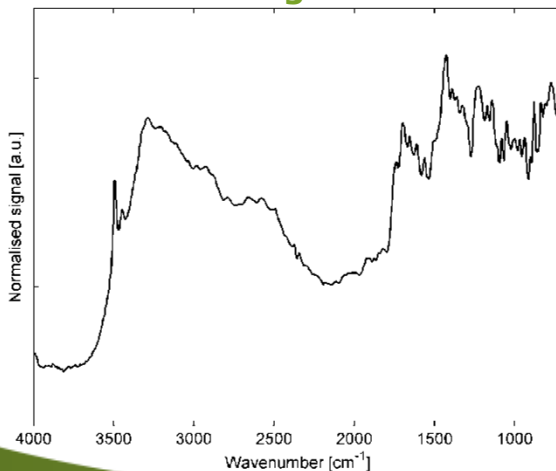
- Sampling is extremely easy.
- Just set the sample in the middle of the cup, insert the cup inside the cell and measure.
- No sample preparation is needed.
- Samples are not consumed, which saves valuable or delicate samples.
- Sample cups are replaceable and washing up can be avoided.
- Sample is not pressed, grinded, dissolved, mixed with KBr or even contacted.
- The only requirement is that sample fits into the sample holder whose maximum dimensions are 10 mm in diameter and 9 mm in height.
- Helium purging is also made easy, no external flow meters are needed.

Inensitive to sample morphology

Broken tablet



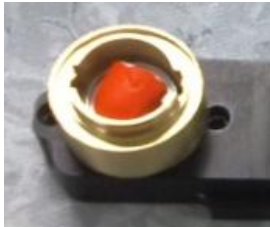
Fine ground



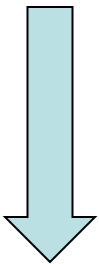
- Makes sampling easy.
- Makes quality control easy.
- Fibers, single particles, powders and large solid samples can be directly measured.

Capability for depth profiling

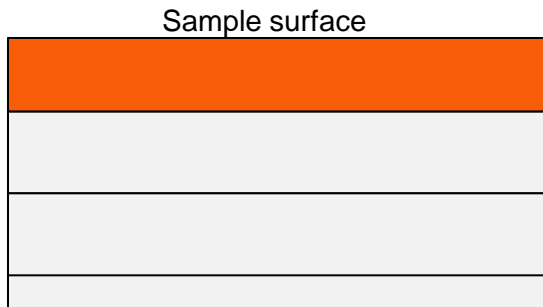
- Photoacoustics enables depth profiling of the samples.
- Maximum depth is selected by varying the FTIR interferometer mirror speed.
- Thermal diffusivity of the sample determines the absolute value of maximum depth.
- Step-scan interferometry allows constant sound frequency for all wavenumbers and it has basically no lower limit as usually in constant velocity scanning.
- Different depths can be separated by a signal phase.
- It is possible to vary depth from range of 1 μm to few hundreds of micrometers.



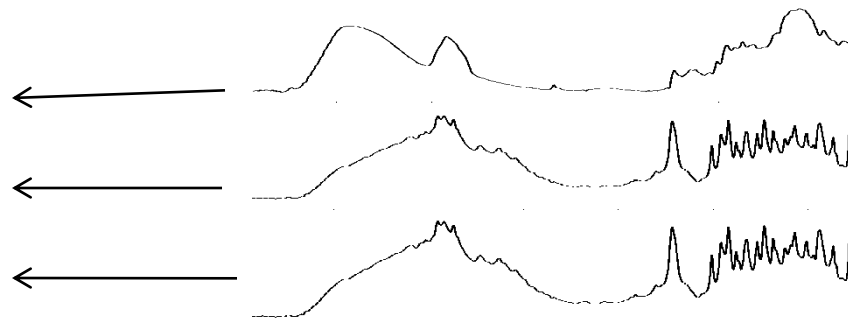
Depth from surface



Layered sample



Spectrum of the layer



Phase

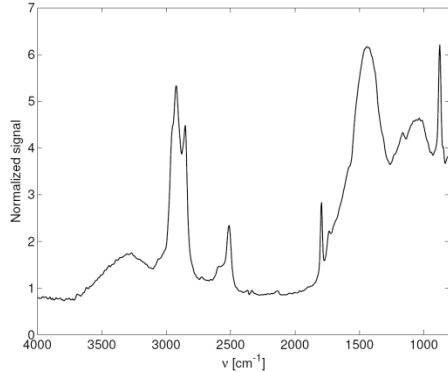
0°

90°

180°

Application: Black samples

Bitumen



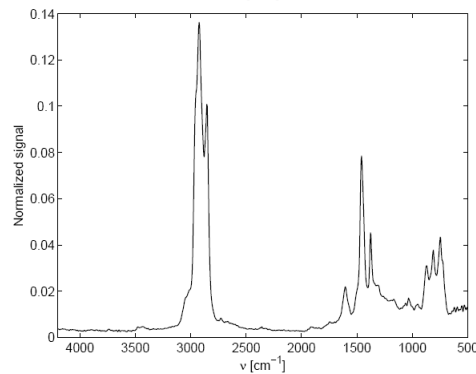
- Photoacoustic spectroscopy suits extremely well for the measurement of dark samples that have low transmittance or reflectivity on a wide spectral range.

- The reason for this is that the photoacoustics is a direct absorption measurement technique – the higher the absorbance the higher the signal is.

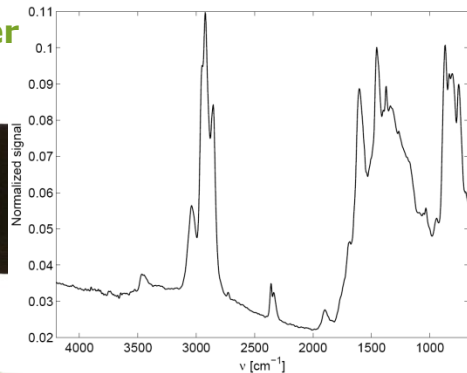
- With other techniques (transmission, ATR, DRIFT) proper spectra are difficult to obtain from dark samples due to the high absorption.

- With the PA301 accessory no sample preparation is needed and contaminated sample cups can be discarded after use.

Heavy fuel oil

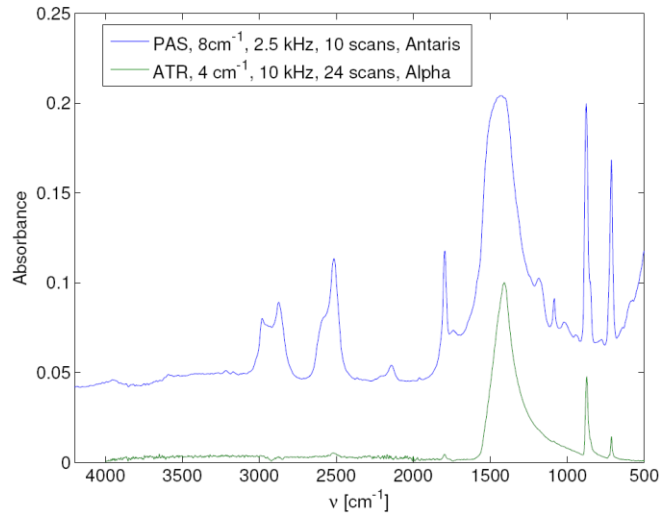


Deposit from heat exchanger

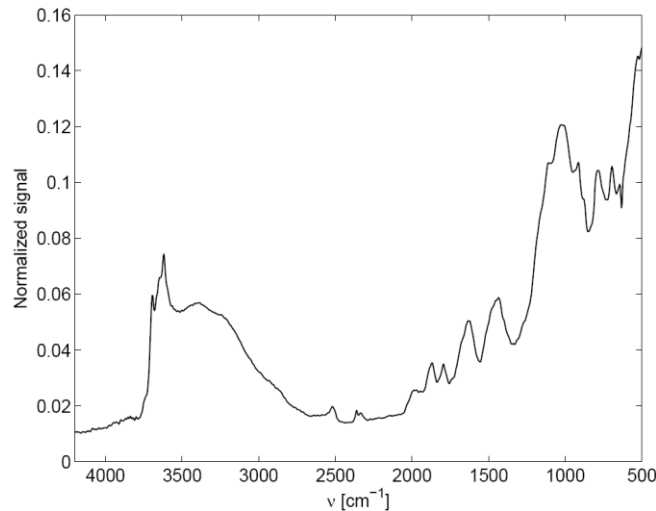


Application: Soil and mineral samples

Ca,Mg carbonate



Clay soil sample



- Photoacoustic spectroscopy (PAS) is an advantageous method for the measurement of soil and mineral samples since it is contactless measurement and insensitive to the sample morphology.
- In PAS no sample preparation is needed such as for example mixing with KBr in diffuse reflectance.
- Mineral samples typically have a very hard surface, and therefore, a proper optical contact is hard to obtain with ATR method even with a diamond ATR.

Other typical applications

- Dark samples (eg. bitumen, rubber, etc)
- Study of carbons, coals, hydrocarbons, hydrocarbon fuels
- Corrosion
- Clays and minerals
- Wood and paper
- Polymer layers
- Food products
- Biology and biochemistry
 - e.g. Proteins
 - Bacteria
 - Fungi
- Medical applications
 - Human tissue
 - Drug characterization and penetration
 - Teeth and hair and bacteria
- Nondestructive measurement of carbonyl compounds, textiles, and catalysts