



future's
in the making

FiPOS ATR

fiber probes





Table of Contents

General design of FiPOS ATR fiber optic probes	6
Types of FiPOS ATR fiber optic probes	7
FiPOS fiber probe couplers	11
FiPOS ATR fiber optic probes applications	13
FiPOS ATR fiber optic probes overview	16

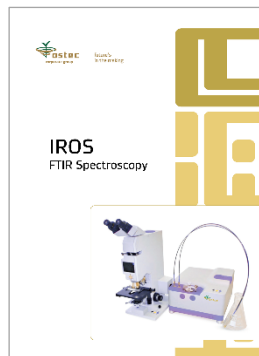
Our mission is to be a company that finds, protects and develops cutting-edge ideas to create new products for technology progress. That is why the symbol of our company is a growing sprout.

Ostec select the best innovative technologies and instruments, modify by corporate engineering and provide complete solutions on international market by Ostec Company Group.

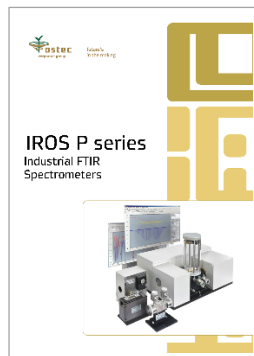
We offer to our clients: the most suitable equipment to meet customer's requirements, deep knowledge of customer's applications, qualified and reliable maintenance support.



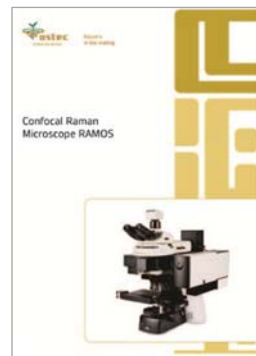
Our other products:



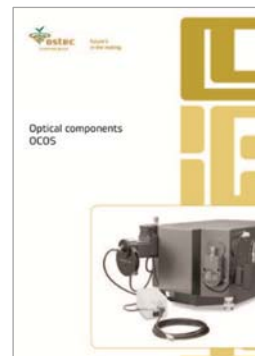
IROS
FTIR Spectroscopy



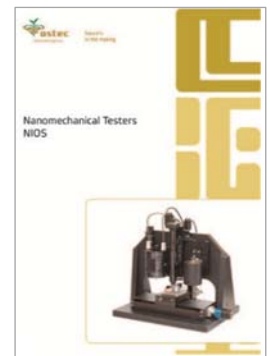
IROS P series
Industrial FTIR
Spectrometers



RAMOS
Confocal Raman
Microscopes



OCOS
optical components



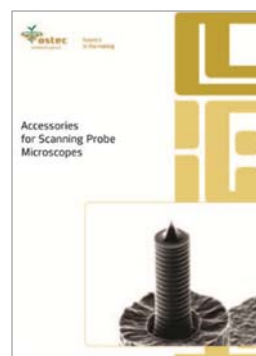
NIOS
Nanomechanical
Testers



AVOS
vibration control
solutions



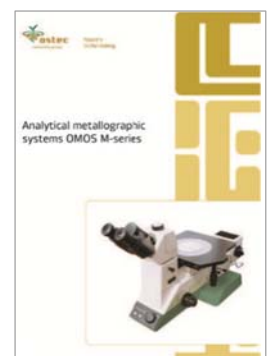
SEOS 02
optical emission
spectrometer



Accessories for
Scanning Probe
Microscopy



LIOS 500N
laser elemental
analyzer



OMOS M series
Analytical
Metallographic
Systems

Ostec partner in the development and production of ATR Fiber Probes is art photonics GmbH.

art photonics GmbH, founded in Berlin in September 1998, is one of the worldwide leaders in development and production of specialty fiber products for a broad spectrum from 300 nm to 16 μm . Unique technologies of Polycrystalline Mid InfraRed (PIR) fibers and metal coated silica fibers are used for assembly of various spectroscopy probes for medical diagnostics and industrial process control, in volume production of fiber for medical and industrial lasers, for different fiber bundles, etc.

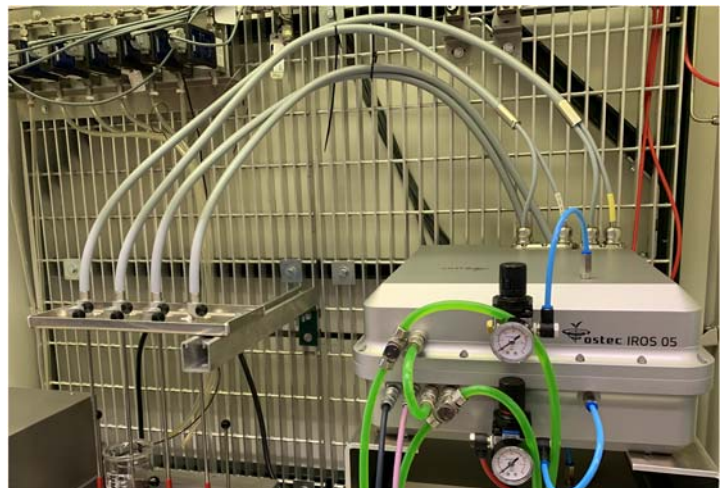


"We are pleased to work with Ostec to accelerate the sales and distribution of our products worldwide. This should allow for more scientists and engineers to have access to our leading fiber-optic probes for spectroscopic analysis."

Viacheslav Artyushenko,
Founder and CTO of art photonics

Application fields

- Reaction monitoring in real time
- Process Analytical Technologies (PAT)
- Crystallization process screening
- Remote polymerization control
- In-situ IR spectroscopy for PAT in chemical, petrochemical, atomic, biopharmaceutical and food industry



FiPOS product line

FiPOS product line from Ostec & art photonics GmbH is a cluster of innovative fiber optic probes and fiber probe couplers designed for in-line analytical analysis in wide spectral range from UV to Mid-IR (550 cm^{-1} to $55\,550\text{ cm}^{-1}$).

FiPOS family of immersion fiber probes includes ATR, transmission, transfection, fluorescent and diffuse reflection probes all compatible with any FT-MIR, FT-NIR or dispersion spectrometer, process-photometer, IR-LED or QCL spectral sensor to use in-line for PAT applications.

FiPOS Fiber Probe Couplers (FPC) couple any FTIR spectrometer with various fiber optic probes and upgrade it to eliminate sampling and to run reaction monitoring in-line. Our fiber probe couplers provide high coupling efficiency for ATR – absorption, transmission or reflection process-spectroscopy in a wide spectral range from UV to Mid-IR to use fiber-coupled FTIR not only with LN-cooled MCT detectors but with TE-cooled MCT and uncooled IR detectors as well.

FiPOS fiber optic ATR probes advantages

- High throughput in any part of Near & Mid InfraRed spectrum (0.5–2 μm , 1.5–6 μm , 3–16 μm)
- ATR tip shaped for immersion in liquid flow without dead zone
- Flexible and robust for industrial applications in harsh environment
- Compatible with all spectrometers and automated process-interfaces
- Unique developments in the field of high temperature fiber optic ATR probes (up to +250°C)
- Unique high-quality IR optical fibers
- Reduced losses between fibers and ATR crystal tip
- Highest transmittance coefficient of fiber optic ATR probes on the market
- Customized solutions

FiPOS probes design is cleanable for many processes where probe optics can be contaminated by media. Industrial probes are compatible with process-interfaces SensoGate-FOS and Ceramat-FOS with approved fittings to secure their semi or full automated use in complete process control systems. They can be retracted, cleaned and calibrated during chemical process to enable remote process-control in any liquid, gas or solid mixtures under harsh environmental conditions.

Combined with FTIR spectrophotometers, our fiber probes facilitate qualitative and quantitative product analysis and enable the determination of specific chemical and physical properties.

We offer two categories of **FiPOS** product portfolio: standard and customized.

The standard products consist of pre-configured probes and probe couplers, which can be implemented in the laboratory, pilot plants or in production.

The customized products allow users to custom configure fiber probes and couplers based on their unique process requirements.

Choosing right ATR fiber probe



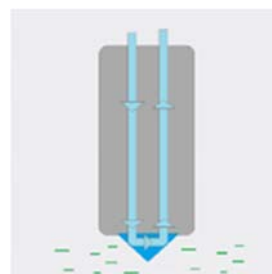
The most important issue in the FTIR analysis is right choice of type of the ATR fiber probe. The best probe type depends on the nature of the sample and environment conditions.

Regardless of the fiber probe, the concept is still the same – light from the FTIR analyzer is guided by the optical fiber probe onto the sample. From there the light with the sample spectra is captured by a fiber optic detection line and returned to the analyzer where the data is analyzed.

Beam tracing is very simple – the radiation goes from the input fiber to the ATR crystal, is reflected (once or several times) from the ATR tip surface and focuses back to the output fiber coupled to the spectrometer detector.

Partial penetration of IR-light in media of ATR-tip contains its absorption spectra.

The ATR crystal is reliably fixed inside metal or polymer parts of the tip, sealed with polymer ring and can not fall away.



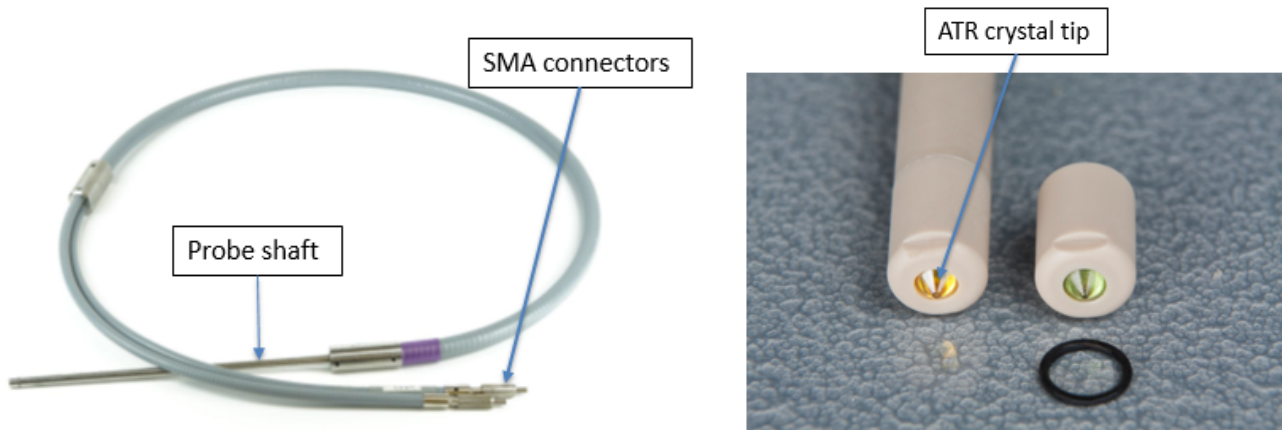
General design of FiPOS ATR fiber optic probes

ATR probe consists of: ATR crystal tip at the end of immersible part (so-called shaft) and Mid-IR optical fiber bifurcated to 2 legs with SMA connectors.

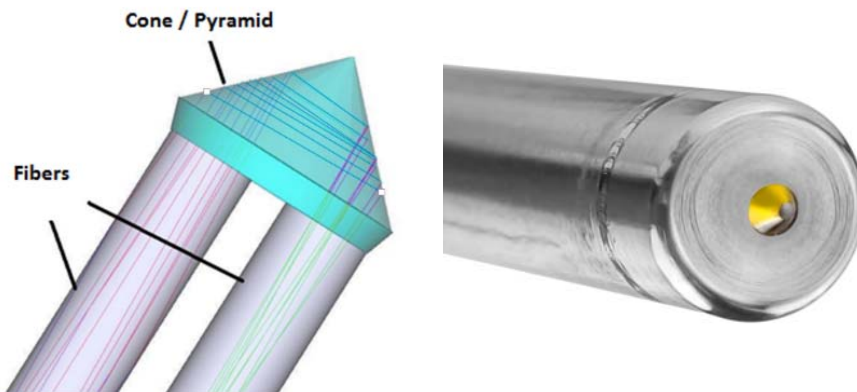
ATR crystal tip and Mid-IR optical fiber are the most important parts of the probe.

Probes with metal shaft and robust stainless steel protective conduit are suitable for reaction monitoring in the plant and in a lab reactor.

Probes with polymer shaft and replaceable ATR tips are suitable for lab applications.



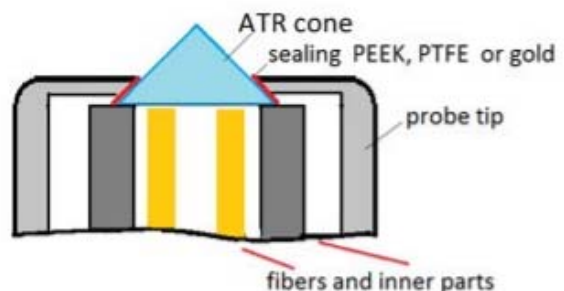
Standard design



- Two-bounce reflection ATR crystals
- Input and output fiber
- ATR crystals of conic and pyramid shape
- Special design to withstand high outer pressure
- Special design of ATR crystal to provide better sensitivity according to refractive index

Special design for lab application

- Replaceable ATR tip
- Lower price
- Possibility to manufacture dielectrical shaft



Types of FiPOS ATR fiber optic probes

Ostec and art photonics offer wide range of fiber ATR probes for different research and industrial applications.



Standard probes



High temperature probes



Sterilizable probes



Probes for lab applications



Touch probes



Loop probes

Standard fiber optic ATR probes

Near & Mid-IR fiber ATR probes produced for any type of FT-NIR, FT-IR and other IR spectrometers, photometers and IR-LED or QCL spectral sensors.

ATR immersion fiber optic probes with patented design are suitable for reaction monitoring in lab, pilot plant and for full automated process control.



Main features

- High throughput in any part of Near & Mid InfraRed spectrum
- ATR tip shaped for immersion in liquid flow without dead zone
- Flexible and robust for industrial applications in harsh environment
- Compatible with all spectrometers and automated process-interfaces

Applications

- Reaction monitoring in real time
- Process Analytical Technologies (PAT)
- Remote polymerization control
- Remote process-control in-situ for molecular media analysis at harsh conditions in chemical, petrochemical, atomic, biopharmaceutical and food industry



High temperature fiber optic ATR probes

Fiber optic ATR probes for harsh environment can be used for process-spectroscopy in Near & Mid IR range to monitor reactions in-line in a broad temperature range from -150°C to +250°C. They can resist to high pressures up to 200 Bar and used with FTIR or any other IR spectrometers and spectral sensors in automated process control with process-interfaces.

The air flow cools polycrystalline fibers inside the probe shaft. A thermocouple controls the shaft temperature.



Main features

- High throughput in selected parts of Near & Mid IR spectra
- ATR tip shaped for immersion in liquid flow without dead zone
- Robust for industrial applications in harsh environment up to +250°C
- Resistant to high pressure
- Compatible with all spectrometers and automated process-interfaces

Applications

- Remote reaction monitoring in-line in temperature range -150°C/+250°C
- PAT applications in lab, pilot plant or industry with process-interfaces for automated process control
- Polymerization process control
- In-situ IR spectroscopy for PAT in chemical, petrochemical, atomic, biopharmaceutical and food industry



Sterilizable fiber optic ATR probes

Sterilizable ATR fiber probes are produced with any type of ATR element and for any type of FTIR spectrometers.

The unique shaft-in-shaft design allows the ATR sensor to be used in bioprocesses where sterilization is required, without forgetting the famous benefits of Mid-IR FTIR spectroscopy.



Main features

- Fiber assembly is easy detachable
- No need to retract the whole probe out of the fermenter, just pull the fiber assembly out of the operational shaft and store it separately
- Sealing the operational shaft is possible for the sterilization, cleaning, deactivation or any other treatment

Applications

- Reaction monitoring in real time
- Process Analytical Technologies (PAT)
- Remote polymerization control
- Crystallization process screening
- In-situ IR spectroscopy for PAT in chemical, petrochemical, atomic, biopharmaceutical and food industry



Fiber optic ATR probes for lab applications

ATR probes for laboratory applications with PEEK shaft are cost-effective and perfect to use in small lab reactors and open vessels. They do not contain metal parts in the tip and can be used for the monitoring of electrochemical reactions, potentiometric cells, measurements in high-frequency fields.

PTFE tip is available on request.

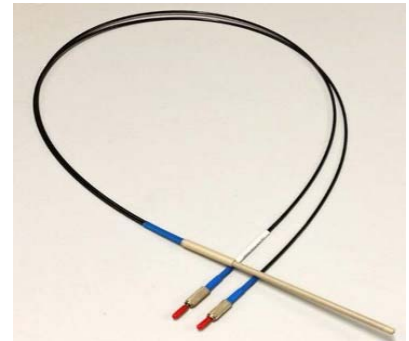


Main features

- Evanescent absorption spectra without dead zone problems
- Optimal ATR crystal selection to match customer application
- Cost effective solution for in-line reaction monitoring

Applications

- Reaction monitoring in real-time
- Remote polymerization control
- Crystallization process screening
- In-situ IR spectroscopy for soft surfaces, pastes and liquids



Fiber optic ATR touch probes



Touch probes are built with a flat ATR tip and are intended for the measurement of pellets, polymers, powders, etc.

The cleaning of such probe tip is much easier in comparison with conical ATR crystal.



Fiber optic ATR loop probes

ATR loop PIR fiber probes are perfect for remote analysis of composition of liquids, pastes and soft surfaces with no need for sample preparation. An unusual ATR tip is a polycrystalline fiber loop. It is attached to fibers and is replaceable or disposable. Loop fiber probe is the simplest one to enable low-cost ATR spectroscopy.

Kits of 5 or 10 fiber loop tips can be purchased separately to be used with the fiber probe bought once. Loop tips can be made with several fiber turns to enhance sensitivity of such tip.



Main features

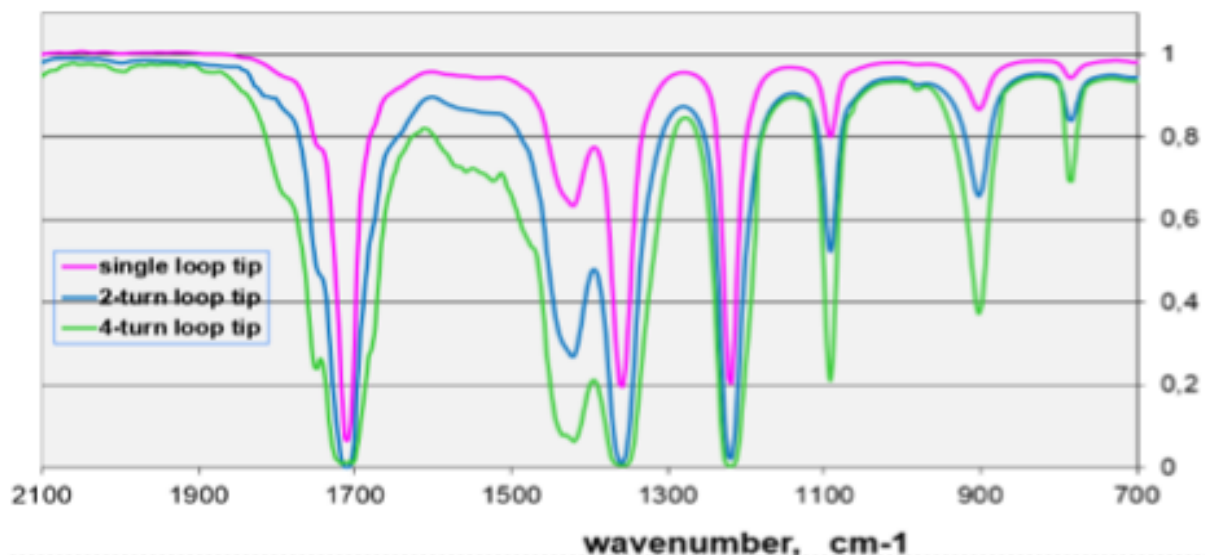
- High throughput at Mid-IR range
- On-line absorbance spectroscopy of liquids, pastes and soft solid surfaces
- Compatible with all FTIR, QCL and IR filter spectrometers
- Cost-effective alternative to more expensive ATR IR fiber probes
- Replaceable ATR loop PIR fiber tips

Applications

- Remote evanescent absorption (ATR) spectroscopy in-situ
- Multiple ATR spectroscopy by immersion of fiber loop in liquid
- In-vivo molecular spectroscopy for medical diagnostics by simple touch of ATR loop to skin or tissue



transmission spectra in Acetone
for single, 2-turn and 4-turn loop tips



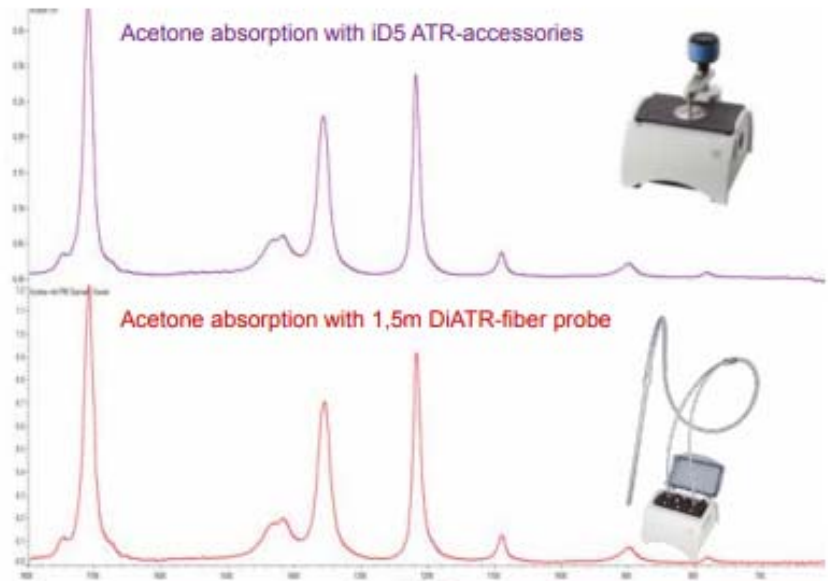
FiPOS fiber probe couplers

FiPOS fiber probe couplers enable easy coupling of fiber probes with any FTIR spectrometer.

Coupling of **FiPOS** probes with FT spectrometers eliminates the need to prepare samples and place them into the sample chamber, and makes remote analysis possible for molecular reaction monitoring in-line.

Fiber coupler FPC-2M

Fiber coupler FPC-2M enables efficient coupling of fiber probes with iS5 – the smallest FTIR spectrometer from Thermo. FPC-2M design is based on two off-axis parabolic mirrors inside the standard accessories iD1 which can be adjusted for maximum signal from SMA-terminated probe.

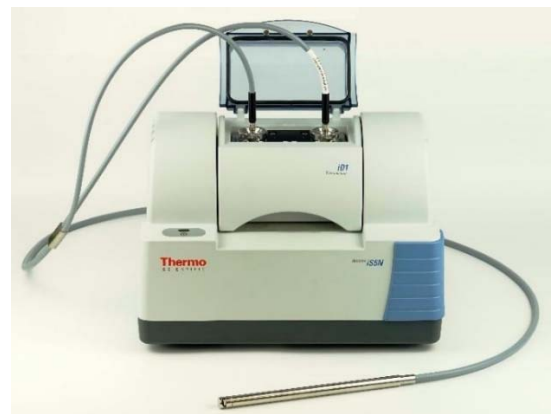


Fiber probe coupler for Nicolet iS5

- In/Out ports made compatible with SMA-terminated fiber probe
- Able to be purged
- Ready to install (iD form factor)
- *Only for use in Mid-IR region*

Fiber probe coupler for Nicolet iS5N

- In/Out ports made compatible with SMA-terminated fiber probe
- Able to be purged
- Ready to install (iD form factor)
- *Only for use in Near-IR region*

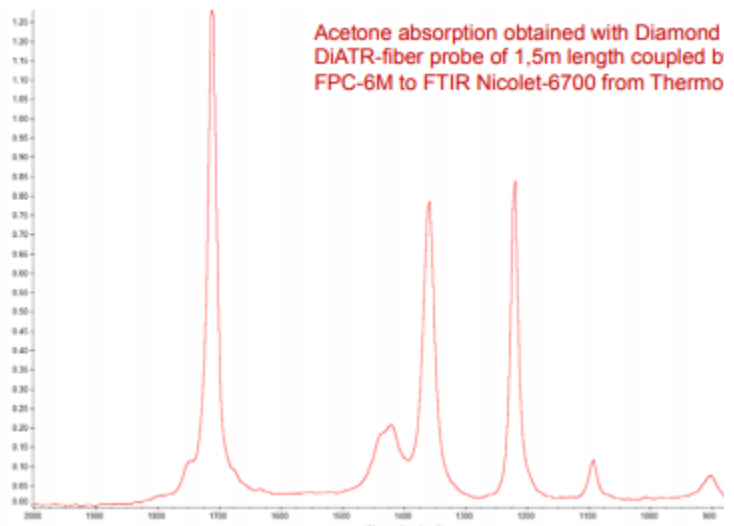


Fiber coupler FPC-6M



Fiber probe coupler FPC-6M provides the highest efficiency coupling of any fiber probe with bench FTIR spectrometer when it's installed in its sample chamber. Thus FPC-6M enables in-line reaction monitoring in lab, while it can be also modified for process control with industrial FTIR and robust probes with SMA or other customized connectors

- Compatible with Nicolet 5700, 6700, iS10, iS50, and Avatar 360
- In/Out ports made compatible with SMA-terminated fiber probe
- Able to be purged
- Mounted on standard baseplate
- For use in Mid-IR and Near-IR regions



Fiber Cross-system coupler

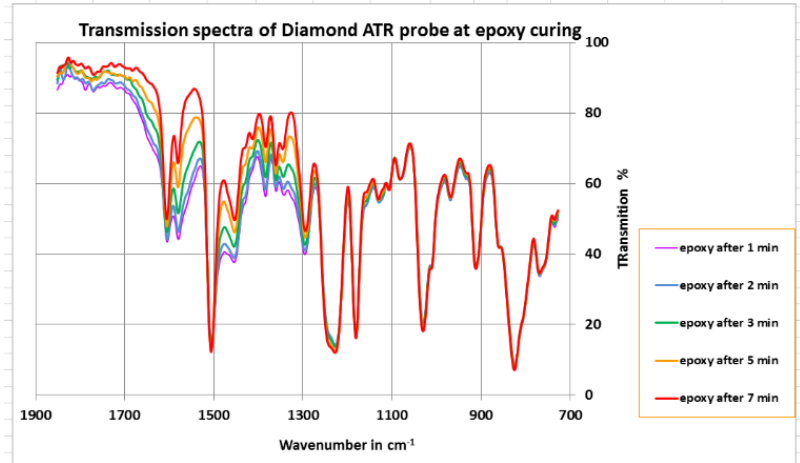
- Compatible with any FTIR spectrometer
- Mounted on customized baseplate
- In/Out ports made compatible with SMA-terminated fiber probe
- Able to be purged
- For use in Mid-IR and Near-IR regions



FiPOS ATR fiber optic probes applications

On-line reactions monitoring

- Chemical synthesis
- Extraction, dissolution, crystallization
- Degradation and contamination of oils
- Cryo reactions
- Sludge measurements
- Determination of hydroxyl number of polyols
- Monitoring of anti-solvent crystallization
- Analysis of solvent mixtures



Conical design of ATR crystal makes it easy to retract the tip out of the cured epoxy. The transmission in the range 1 600 – 1 900 cm^{-1} is enough to see absorption bands of C=O groups even using FTIR spectrometer iS5 from Thermo with DTGS detector.

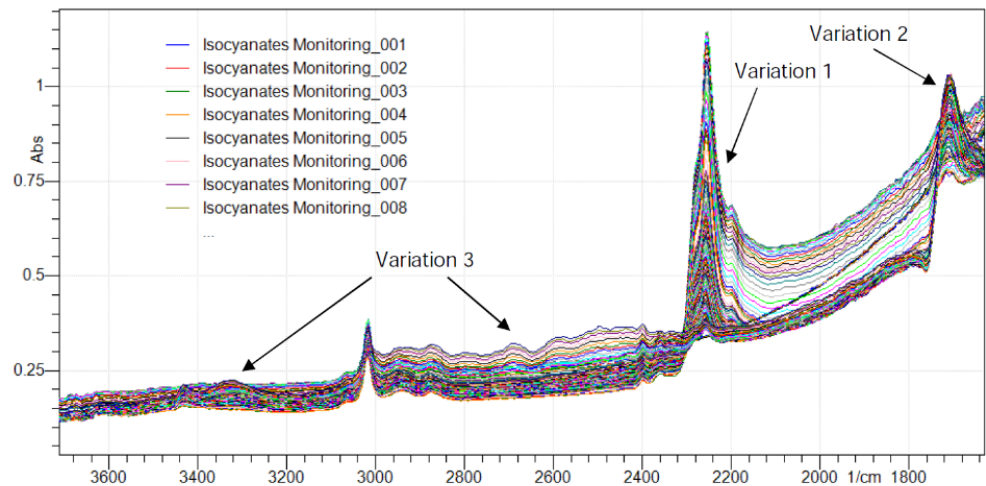
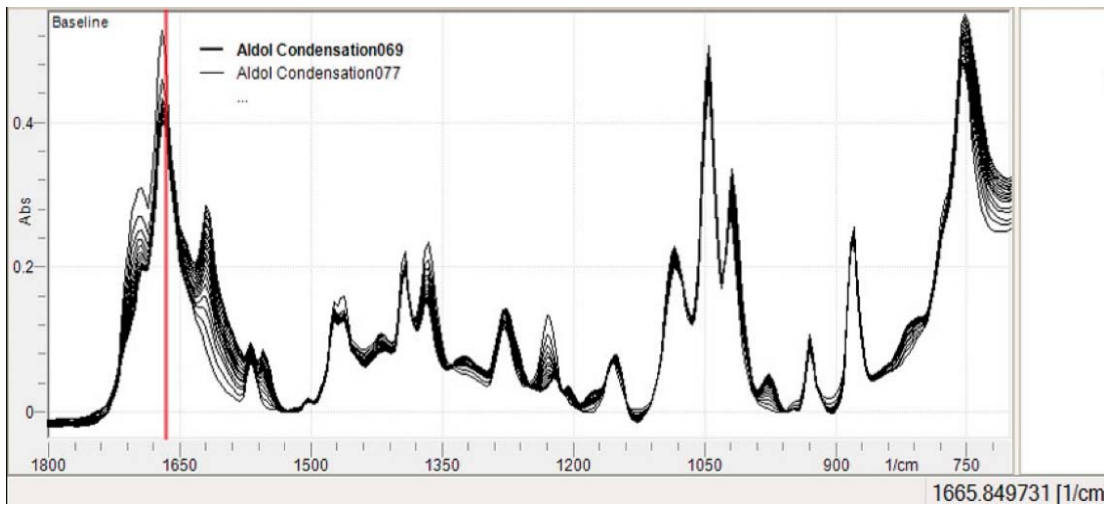
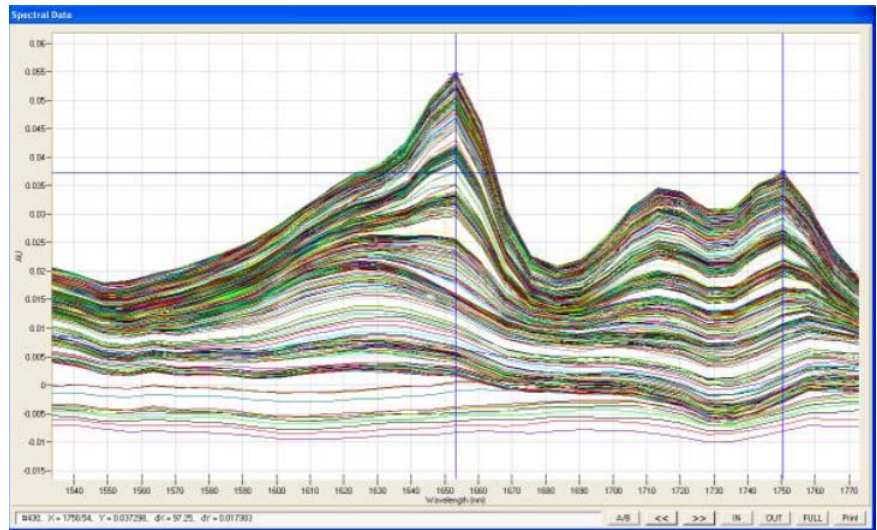
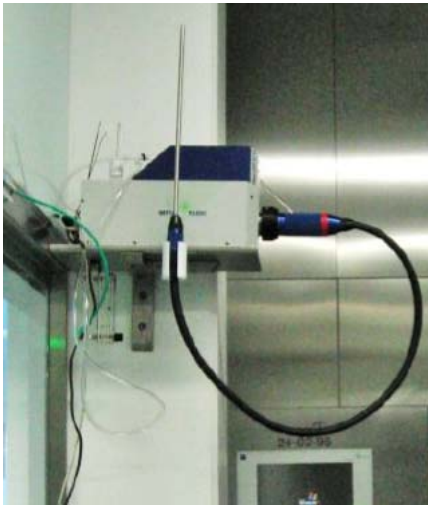


Figure 2. Reaction run FT-IR spectra acquired during the reaction and major variations observed

Control of API-production with PIR-fiber FTIR-spectroscopy in pharma industry

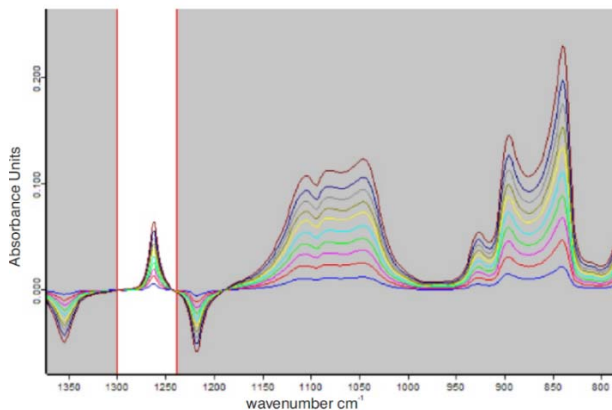
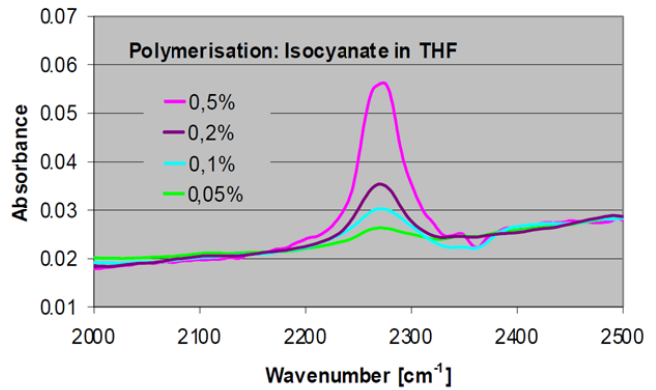
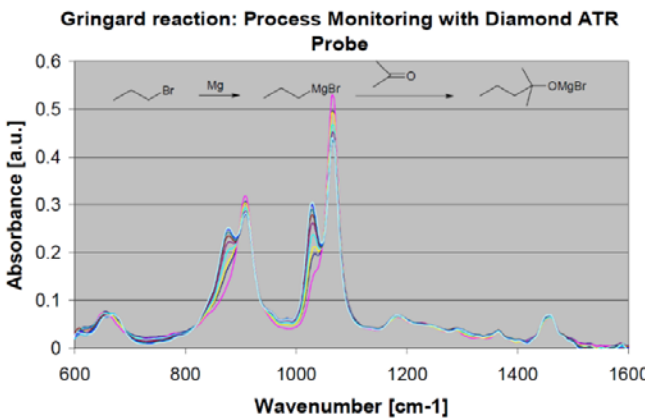


Spectra of API in hot polymer measured by Diamond cone ATR probe coupled to iC10 FTIR (MTAC)

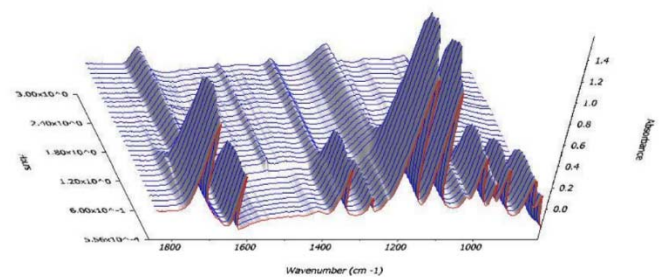
Summary from the customer:

...The system is working as expected and has approximately 3 times the sensitivity of the OEM probe. The presence of spectral data (with acetone across the spectral range) confirms the probe performance...

Polymerization, extraction, synthesis monitoring



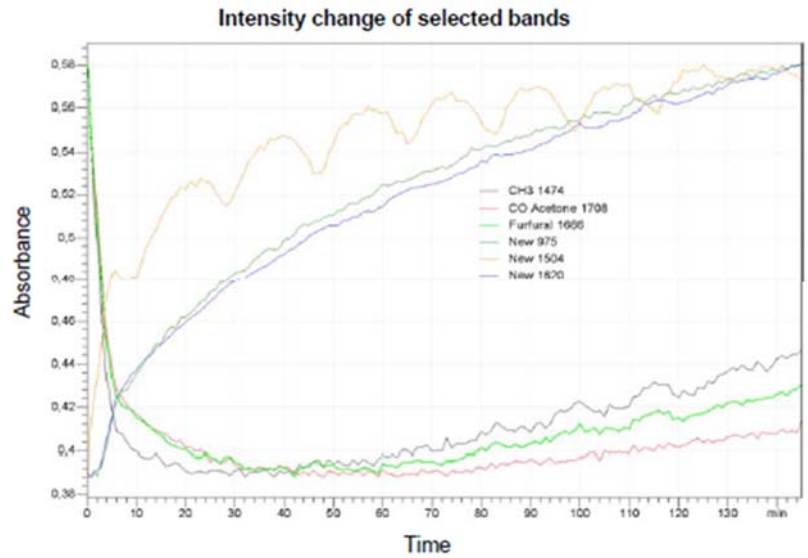
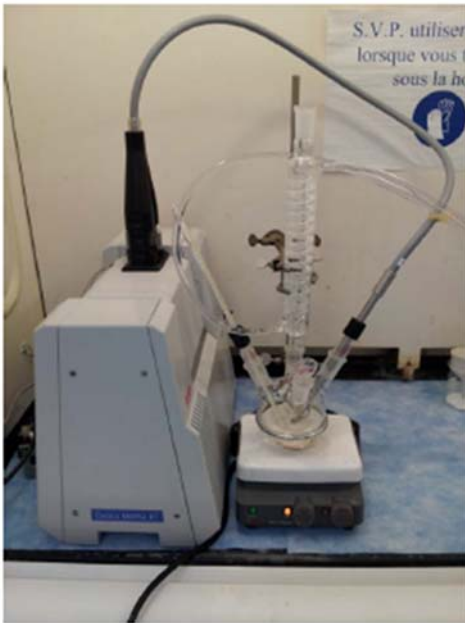
Online monitoring of extraction process (silicon oil by acetone)



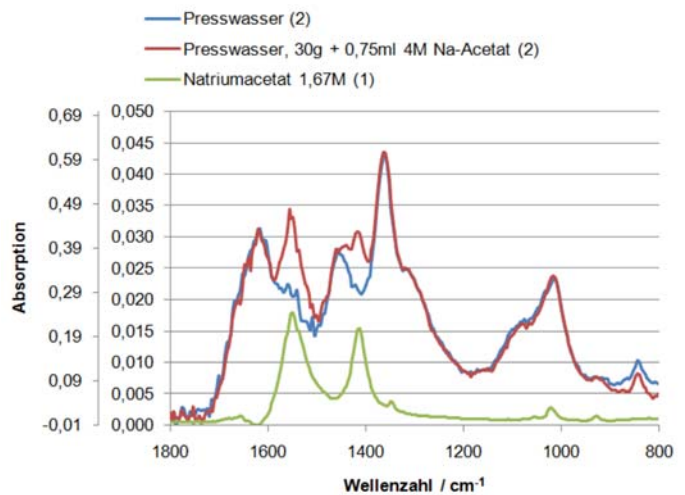
Monitoring of the PVA polymerization reaction showed an abrupt rather than gradual change in concentration

Laboratory reaction monitoring

Real-time monitoring of the condensation reaction of furfural on acetone to produce 4-(2-furyl)-3-buten-2-one using a MB-Rx reaction monitor with DTGS detector, fiber optic launcher, polycrystalline fibers, ZnSe ATR probe



Control of anaerobic digestion on-line



ATR fiber probe immersed in biomass with process-interface and coupled with FTIR spectrometer can control fermentation on-line to increase yield in biogas production and to prevent process failures.

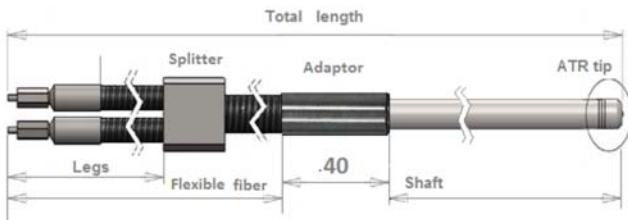


FiPOS ATR fiber optic probes overview

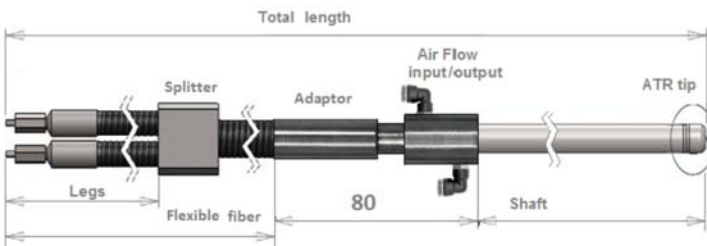
Main technical parameters of typical probes are listed below.
Other configurations and customized probes can be produced on request.

General parameters

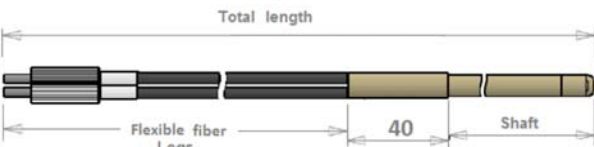
	Standard probes	High temperature probes	Sterilizable probes	Probes for lab applications	Loop probes
Total length	1.5 m (opt. from 1 m to 5 m)				1 m (opt. PIR up to 5 m, CIR up to 10 m)
Shaft length	300 mm (opt. 100–700 mm)			150 mm (opt. 100–500 mm)	120 mm
Shaft diameter	12 mm, 6.3 mm (opt. 3 mm)	12 mm	12 mm, 6.3 mm (opt. 3 mm)	6.3 mm	10 mm
Shaft material	Hastelloy C22			PEEK (polyetheretherketone)	PEEK
Length of legs	500 mm (opt. 200–500 mm)				
Protective tube material	Liquid Tight SS-Conduit, KOPEX-Tube			PEEK	
Minimal bending radius	130 mm				
Input/Output connectors	Long SMA (opt. any other type)				



Standard ATR probes



Sterilizable ATR probes



High-temperature ATR probes





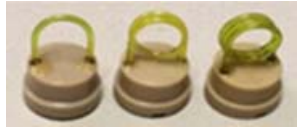


Laboratory ATR probes



Detachable loop ATR probes

ATR crystals selection

Material of the tip	Angle at the top	Refractive index	Number of reflections	Spectral range	Chemical resistance	Mechanical strength/ Durability
 Diamond	90°	2.4	2	600–1 900 cm ⁻¹	Highest. Can be used in any liquid	Ultimate
 ZnSe	90°	2.4	2	600–3 100 cm ⁻¹	pH range: 5–9 Complexing agents (ammonia and EDTA) will also erode surface	Low
 Si & Ge	120°	Si-3.4 Ge-4	2	600–3 100 cm ⁻¹	Si: pH range 0– 10 Ge: pH range 1–12	Moderate Moderate
 ZrO₂	60°	1.9	3	1 550–9 000 cm ⁻¹	pH range: 0– 14 Do not use with strong acids and alkalis	High
 Detachable loops	Not defined	2.1	Multiple	600–2 500 cm ⁻¹ or 1 550–6 500 cm ⁻¹ depending on fiber in probe	pH range: 5–9 Complexing agents and SO ₂ ions will also erode surface	Low

Specification

Type	Standard		PEEK Lab	High temperature	Sterilizable	
Shaft Ø	6.3 mm	12 mm	6.3 mm	12 mm	6.3 mm	12 mm
ATR crystal						
Diamond, 600–1900 cm⁻¹	200 Bar -150°C +140°C	200 Bar -150°C +140°C		200 Bar -150°C +250°C	200 Bar -150°C +140°C	200 Bar -150°C +140°C
Si, 600–3 100 cm⁻¹	100 Bar -150°C +140°C	100 Bar -150°C +140°C	7 Bar -100°C +140°C	100 Bar -150°C +250°C	100 Bar -150°C +140°C	100 Bar -150°C +140°C
Ge, 600–3 100 cm⁻¹	10 Bar -150°C +80°C	10 Bar -150°C +80°C	7 Bar -100°C +80°C		10 Bar -150°C +80°C	10 Bar -150°C +80°C
ZnSe, 600–3 100 cm⁻¹		10 Bar -150°C +140°C	7 Bar -100°C +140°C	10 Bar -150°C +250°C		
ZrO₂ with CIR 500/550 fiber, 1 550–9 000 cm⁻¹	100 Bar -150°C +90°C	100 Bar -150°C +90°C	7 Bar -100°C +90°C	100 Bar -150°C +200°C	100 Bar -150°C +90°C	100 Bar -150°C +90°C
Detachable loop	PIR fiber 900/1000, 10 cm shaft PEEK, 110 cm total, PEEK tubing with SMA 905 connectors, 600–2 500 cm⁻¹, -50°C +90°C, Disposable ATR loop tip					
	CIR fiber 500/550, 10 cm shaft PEEK, 110 cm total, PEEK tubing with SMA 905 connectors, 1 550–6 500 cm⁻¹, -50°C +90°C, Disposable ATR loop tip					

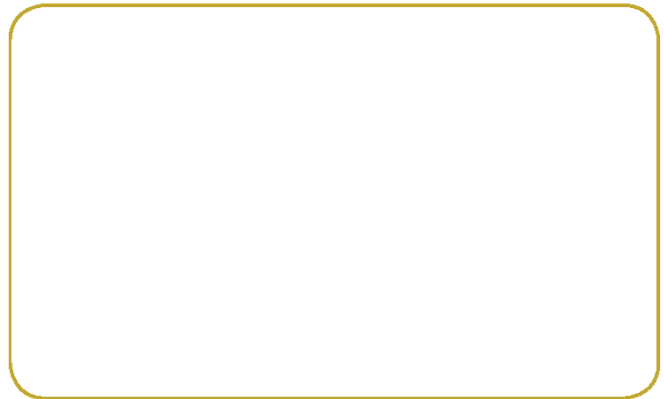




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