

Spectroscopy Fiber Optic Probes for In-line Analytical Analysis

FlexiSpec® product line – is a cluster of innovative Fiber Optic Probes and Fiber Probe Couplers designed for in-line analytical analysis in broad spectral range – from UV to Mid-IR.

FlexiSpec® family of Immersion Fiber Probes includes ATR, Transmission, Transflection, Fluorescence 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.

FlexiSpec® 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 provides high coupling efficiency for ATR-Absorption, Transmission or Reflection process-spectroscopy in a broad spectral range, from UV to Mid-Infrared – to use fiber coupled FTIR spectrometer not only with LN-cooled MCT-detectors, but with uncooled detectors as well.

FlexiSpec® 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 or UV/Vis spectrophotometers, our fiber probes facilitate qualitative and quantitative product analysis and enable the determination of specific chemical and physical properties.

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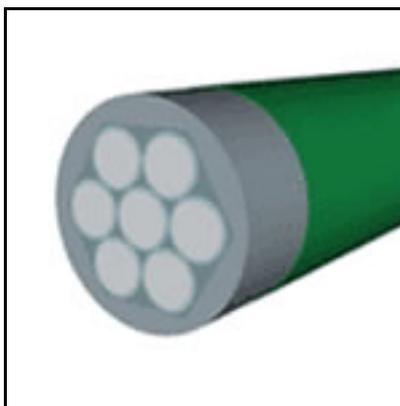
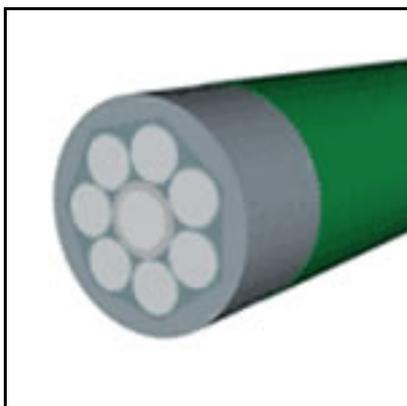
We offer two categories of FlexiSpec® product portfolio: standard and customized. The standard products consist of preconfigured probes and probe couplers, which can be implemented in the laboratory, pilot plants or in production. The customized products allow users to custom configure fiber probes and couplers based on their unique process requirements. Please browse our website to find additional information regarding spectroscopy fiber products.

Fiber Probes for Process Spectroscopy

Fiber probes for process spectroscopy are based on coherent bundle design which provides the best coupling efficiency with spectrometers, light emitters (LED, lasers, lamps, etc.) and media of spectral analysis to investigate its reflectance, fluorescence or absorption spectra.

Features:

- Multi-channel Process - Photometry & Spectroscopy with up to 37 channels capacity
- High Optical throughput at pre-selected set of characteristic wavelengths
- Compatibility with a variety of light sources, filter and mini-spectrometers
- Special design for customer application
- Assembly with polymer or metal coated fibers
- High Temperature probes for up to 600°C applications
- Fiber diameter from 100 µm up to 600 µm in coherent bundles with up to 469 fibers



Specification

Fibers	6+1 or 7+1 Fibers 50,100,200,300 µm core Middle based fiber - with Metal coating	Fiber type UV-VIS Fiber type VIS-NIR
Probe Tip	PEEK Tube Ø 1.0mm with Titanium Ferrule Stainless Needle Ø 1.5mm L=60mm with Hand piece Ø 8 mm L=80mm	Available custom design
Spectral Range	200-960nm or 280-2100nm	220-4000 nm special design

Protective Tubing	Flexible Hard Plastic Polymer PEEK Ø 1.0mm Flexible Ni or Cr plated Metal Tube Ø 4.9mm	Available PVC or PVC + Polycarbonate Tube Ø 3.0-5.0 mm
Temperature Range	-40°C +120°C up to 600°C - on request	High or Low temperature Probes available on request
Optical Connectors	SMA-905 +ST or FC -FC	custom design connectors available on request
Transmission Channel	For typical receiving rectangle optical input line construction of fibers or circular	
Flexibility	Main part with minimal bend Radius -20mm (Short Time); -45mm (Long Time)	Minimal radius up to 5mm available on request
Accessories	<ul style="list-style-type: none"> * Liquid Absorbance Measuring long pass Optical Head with Adjustable in distance Spherical Mirror * Optical AR Coated Lens System for Parallel Beam * Reflection Probe End for Powders and thick Samples 	

Fiber Optic ATR-Probes

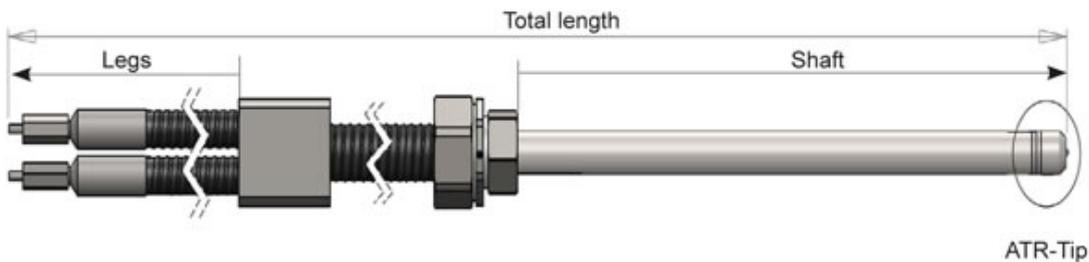
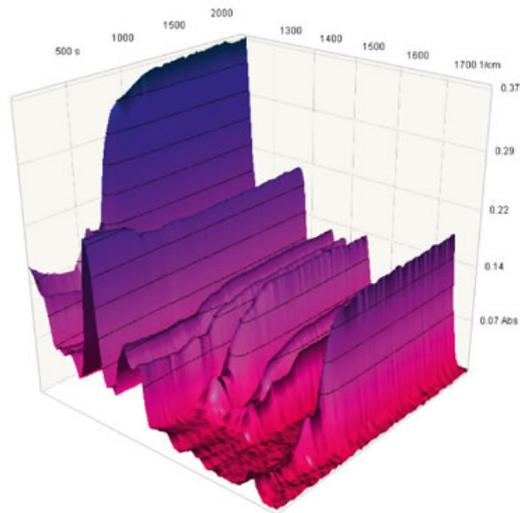
- High throughput in any part of Near & Mid InfraRed-spectrum
- ATR-tip shaped for immersion in liquid flow without dead zone
- Flexible and robust for industrial applications in harsh environment
- Compatible with all spectrometers and automated process-interfaces

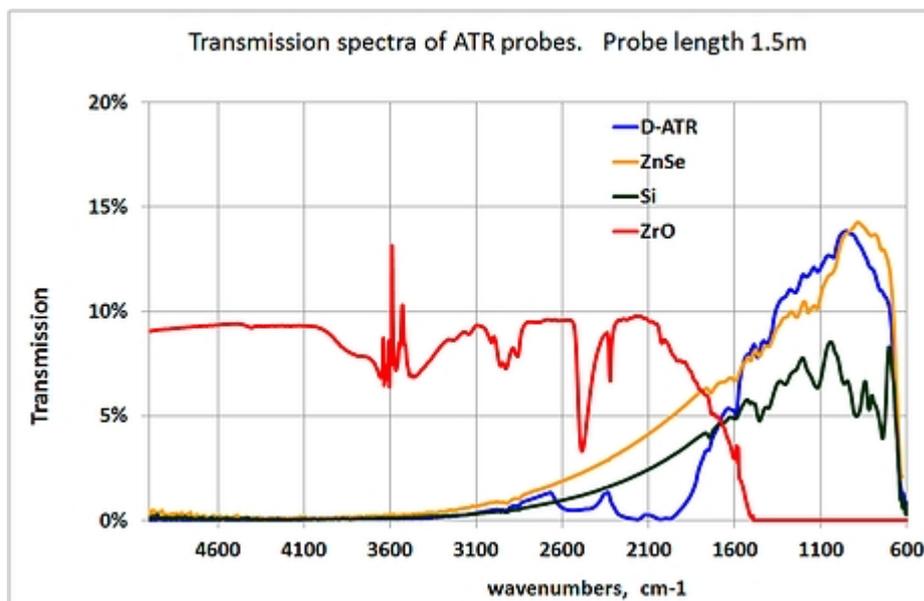
FlexiSpec® product line is the latest generation of Attenuated Total Reflection. Near & Mid IR-fiber ATR-Probes produced for any type of FT-NIR, FT-IR and other IR-spectrometers, photometers and IR-LED or QCL spectral sensors.

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

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 & Food Industry





Specification of Fiber Optic Immersion ATR- Probes FlexiSpec®

Probe type	Diamond ATR	ZnSe ATR	Silicon ATR	Cubic Zirconium ATR
Transmission	5.2-17μm (600-1900cm ⁻¹)	3.2-17μm (600-3100cm ⁻¹) +	5.2-17μm (600- 3100cm ⁻¹)	1.5-6.5μm (1550- 650cm ⁻¹)
Fiber type	PIR-900/1000 Silver Halide	PIR-900/1000 Silver Halide	PIR-900/1000 Silver Halide	CIR 500/550 Chalcogenide glass (As-S)
Temperature range	-100°C / + 140°C	-100°C / + 140°C	-100°C / +140°C	-100°C /+ 90°C
Pressure (max)	200Bar (300 Bar) on request	10 Bar	100 Bar	100 Bar

Total Length	1.5 m (opt.:1m to 5m)*
Shaft Length	300 mm (opt.: 100-700 mm)*
Shaft Diameter	12 mm, 6.3 mm (opt.:3mm)
Shaft Material	Hastelloy C22
Length of Legs	500 mm (opt. 200 - 500 mm)
Protective Tube Material	Liquid Tight SS-Conduit, KOPEX-Tube
Minimal Bending Radius	130 mm
Input / Output Connectors	Long SMA (opt.: any other type)
Compatible Process-Interfaces	Ceramat-FOS or SensoGate-FOS**

*Customized dimensions are available on request

**Available for 12 mm shafts only

Fiber Optic ATR-Probes for Lab Applications

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

Our new designed IR fiber ATR probes with PEEK shaft are cost effective and perfect for use in small lab reactors and open vessels.

All ATR probes from FlexiSpec® product line are compatible to any type of FT-IR and other IR-spectrometers, photometers and sensors.

Applications:

Reaction Monitoring in real time
 Remote Polymerization Control
 Crystallization Process Screening
 In-situ IR-Spectroscopy for soft surfaces, pastes and liquids

Specification of Fiber Optic ATR-Probes for lab applications *FlexiSpec®*

Type of ATR element	ZnSe	Ge	Si	ZrO
Transmission range	3.2 – 17µm (3100-600 cm ⁻¹)	3.2 – 17µm (3100-600 cm ⁻¹)	3.2 – 17µm (3100-600 cm ⁻¹)	1.1– 6.5µm (9000-650 cm ⁻¹)
Fiber type	PIR-900/1000	PIR-900/1000	PIR-900/1000	CIR-500/550
Temperature range	-100°C/+140°C	-100°C/+140°C	-100°C/+140°C	-100°C/+90°C
Pressure (max)	7 Bar	7 Bar	7 Bar	7 Bar

Parameters of Fiber Optic ATR-Probes for lab applications *FlexiSpec®*

Total Length	1,5 m (opt: 1 to 5m)
Shaft Length	150mm (opt.:100 to 500mm)
Shaft Diameter	6.3mm
Shaft Material	PEEK (polyetheretherketone)
Length of Legs	500mm (opt.: 200 to 500mm)
Protective Tube Material	PEEK
Minimum Bending Radius	130mm
Input / Output Connectors	Long SMA (opt.: any other type)

Fiber Optic ATR-Probes for Harsh Environment

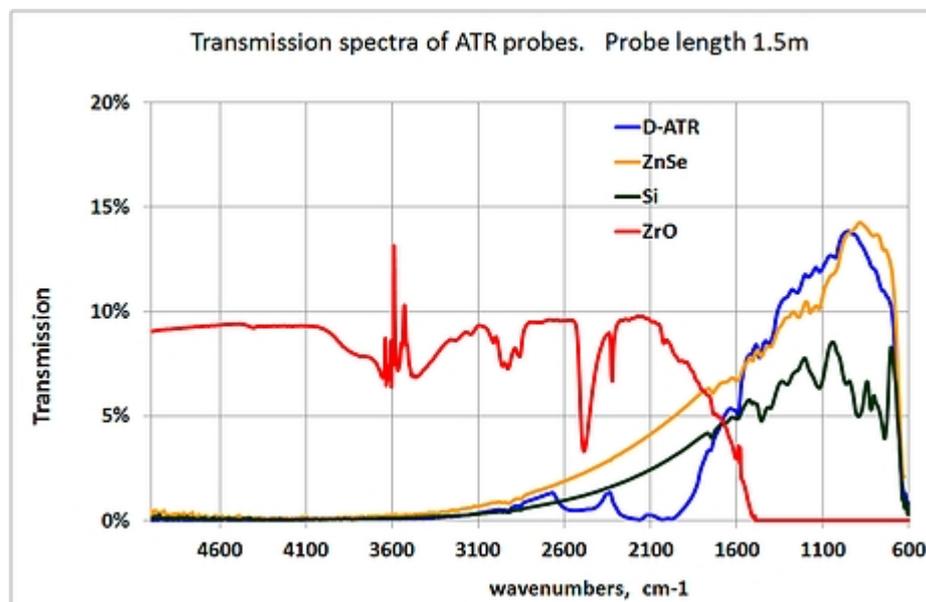
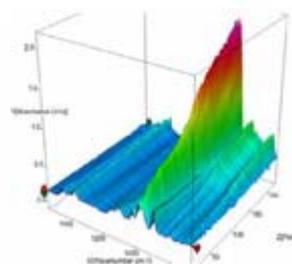
- High throughput in selected parts of Near & Mid InfraRed-spectra
- ATR-tip shaped for immersion in liquid flow without dead zone
- Robust for industrial applications in harsh environment up to 250°C
- Resistant to high pressure
- Compatible with all spectrometers and automated process-interfaces

FlexiSpec® probes include new type of Attenuated Total Reflection (ATR-) probes designed for harsh application conditions.

HT-ATR immersion IR-fiber probes can be used for process-spectroscopy in Near & Mid IR range to monitor reactions in-line in a broad temperature range from -100° to +250°C. They can resist to high pressures up to 200Bar and used with FTIR or any other IR-spectrometers and spectral sensors in automated process control with process-interfaces.

Applications:

- Remote Reaction Monitoring in-line in temperature range -100/+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 & Food Industry



Specification of IR-Fiber HT-ATR-Probes for High Temperatures FlexiSpec®

Probe type	Diamond ATR	Silicon ATR	Cubic Zirconium ATR
Transmission	5.2-17µm (600-1900cm ⁻¹) + 3.2-4.5µm (2300-3100cm ⁻¹)	5.2-17µm (600-3100cm ⁻¹)	1.5-6.5µm (1550-6650cm ⁻¹)
Fiber type	PIR-900/1000 Silver Halide	PIR-900/1000 Silver Halide	CIR 500/550 Chalcogenide glass (As-S)

Temperature range	-100°C / + 250°C	-100°C / + 250°C	-100°C /+ 200°C
Pressure (max)	200Bar	100Bar	100Bar

Common Parameters of HT-ATR-Probes for High Temperatures FlexiSpec®

Total Length	1.5m (opt.: 1m to 5m)*
Shaft Length	300 mm (opt.: 300-700 mm)*
Shaft Diameter	12mm
Shaft Material	Hastelloy C22
Length of Legs	500mm (opt.: 200mm to 500mm)
Protective Tube Material	Liquid Tight SS-Conduit, KOPEX-Tube
Minimal Bending Radius	130mm
Input / Output Connectors	Long SMA (opt.: any other type)
Cooling Air Flow Parameters	Excess pressure 0.5Bar, Flow 2300l/h
Inner temperature control	Inside shaft to control ATR tip temperature

Sterilizable IR-ATR Fiber Probe for Bio- Process Monitoring

- 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

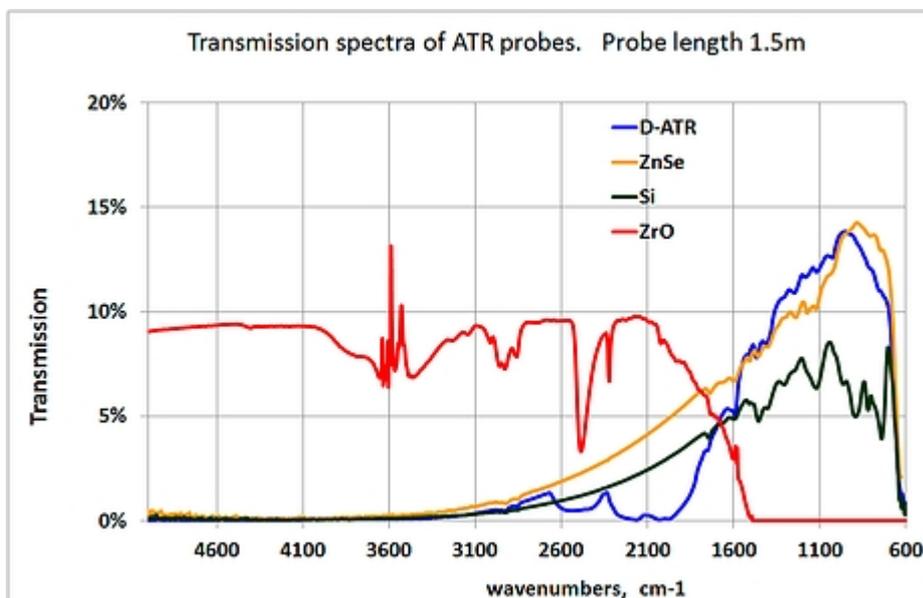
Sterilizable ATR Fiber Probe is a new product of our *FlexiSpec®* product line. This ATR Probes are produced with any type of ATR element and for any type of FTIR spectrometers.

Unique Shaft-in-Shaft design enables use of *FlexiSpec®* ATR Probe in Bio process where sterilization is required without having to forgo the renowned advantages of MID-IR FTIR spectroscopy.

With our new design you don't need to take out all the probe from the reactor during the reactor sterilization process. Just detach the fiber assembly whereas the sensitive tip can remain fixed in the reactor and be sterilized together with it.

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 & Food Industry



Specification of Fiber Optic Immersion ATR- Probes FlexiSpec®

Probe type	Diamond ATR	Silicon ATR	Cubic Zirconium ATR
Transmission	5.2-17 μ m (600-1900cm ⁻¹)	5.2-17 μ m (600-3100cm ⁻¹) +	1.5-6.5 μ m (1550- 650cm ⁻¹)
Fiber type	PIR-900/1000 Silver Halide	PIR-900/1000 Silver Halide	CIR 500/550 Chalcogenide glass (As-S)
Temperature range	-100°C / + 140°C	-100°C / + 250°C	-100°C / +200°C
Pressure (max)	200Bar (or 300 Bar)	100 Bar	100 Bar

Common Parameters of Fiber Optic ATR-Probes FlexiSpec®

Total Length	1.5 m (opt.:1m to 5m)*
Shaft Length	300 mm (opt.: 100-700 mm)*
Shaft Diameter	12 mm, 6.3 mm (opt.:3mm)
Shaft Material	Hastelloy C22
Length of Legs	500 mm (opt. 200 - 500 mm)
Protective Tube Material	Liquid Tight SS-Conduit, KOPEX-Tube
Minimal Bending Radius	130 mm
Input / Output Connectors	Long SMA (opt.: any other type)
Compatible Process-Interfaces	Ceramat-FOS or SensoGate-FOS**

*Customized dimensions are available on request

**Available for 12 mm shafts only

ATR-Loop InfraRed Fiber Optic Probes

- High throughput at Mid InfraRed range
- On-line absorbance spectroscopy of liquids, pastes & 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

ATR-Loop Infrared PIR-fiber probe was the first in FlexiSpec® product line designed for use with FTIR and other Mid IR spectrometers. ATR-Loop PIR-fiber probes are perfect for remote analysis of composition of liquids, pastes and soft surfaces with no need in sample preparation.

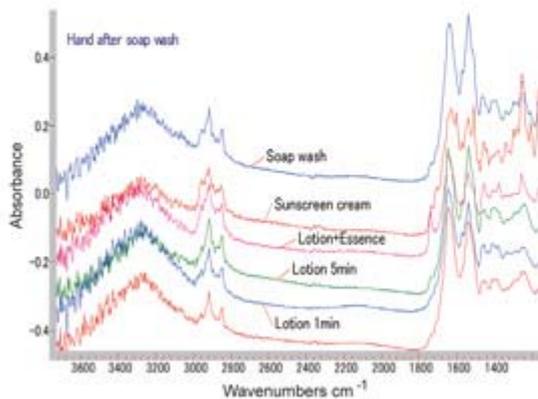
Loop fiber probe is the simplest one in FlexiSpec® product family to enable low cost ATR-spectroscopy.

Applications:

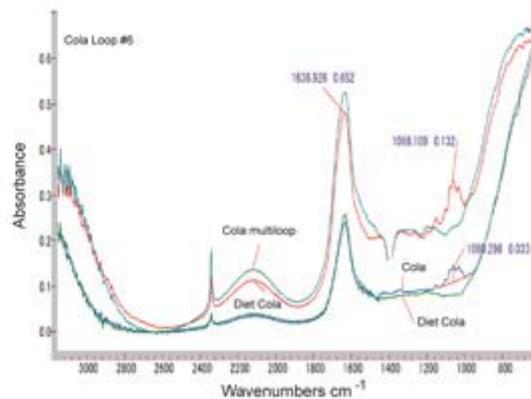
- Remote evanescent absorption (ATR-) spectroscopy in-citu
- Multiple ATR-spectroscopy by immersion of fiber loop in liquid
- In-vivo molecular spectroscopy for medical diagnostics by simple touch of ATR-Loop to skin or tissue



Skin Absorption Spectra with ATR-Probe



Cola Spectra with DLP-probe




Specification of Fiber Optic ATR-Loop Probes FlexiSpec®

Probe type	Chalcogenide-IR (CIR)	Polycrystalline-IR (PIR)
Transmission range	6500 – 1700cm ⁻¹	3600 – 600cm ⁻¹
Fiber type	Chalcogenide glass (As-S)	Silver Halide (AgCl:AgBr)
Temperature range	≤ 90°C	≤ 100°C

Common Parameters of Fiber Optic Multi-Loop Probes FlexiSpec®

Total Length	1m (opt.: PIR up to 5m, CIR up to 10m) *
Shaft Length	120mm *
Shaft Diameter	10mm
Shaft Material	PEEK
Protective Tube Material	PEEK
Input / Output Connectors	Long SMA-905 (opt.: any other type)
Detachable PIR fiber Loop	Loop; Multi-Loop (Double-, Triple-Loop, etc.)

*Customized dimensions are available on request

Fiber Optic Transmission and TransFlex Probe

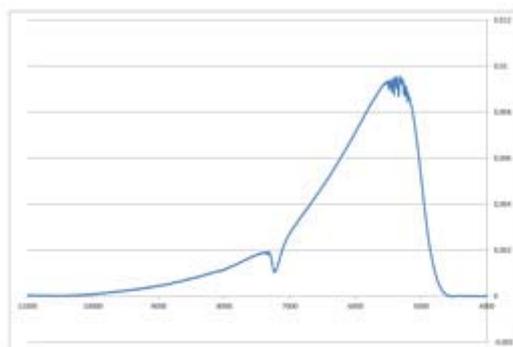
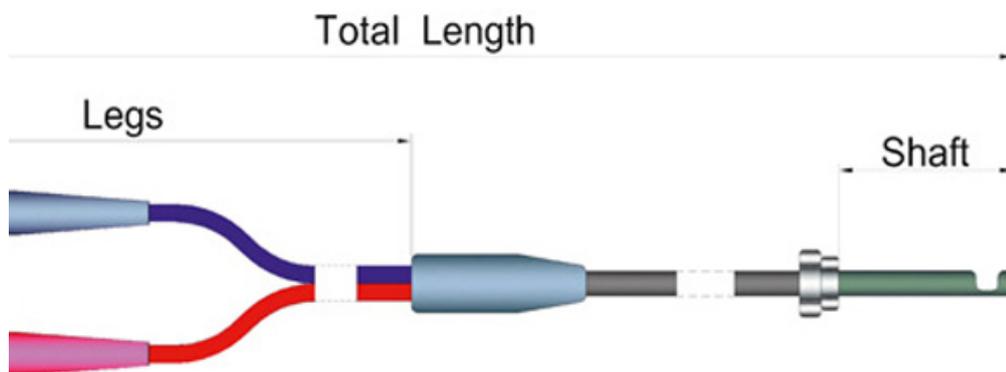
- On-line transmission spectroscopy in liquids at long distance
- High throughput in any part of UV –Vis to Mid Infrared spectra
- Flexible and robust for industrial applications in harsh environment
- Compatible with all spectrometers and automated process-interfaces

FlexiSpec® product line includes the latest generation of Transmission (single pass) & TransFlex (dual pass) fiber optic probes to be used with any spectrometer or photometer.

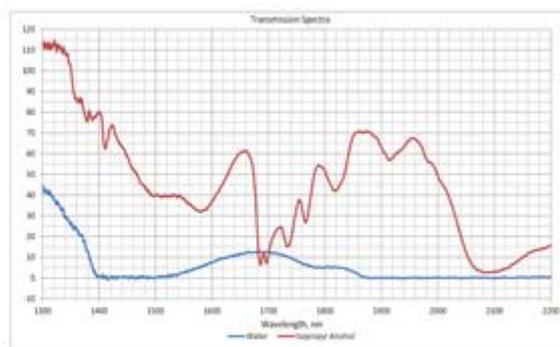
FlexiSpec® Single & Dual Pass fiber optic probes are compatible with process-interfaces to be cleanable and to enable reaction monitoring in lab, pilot plant and run full automated process control.

Applications:

- Reaction Monitoring in real time
- Process Analytical Technologies (PAT)
- Crystallization Development & Screening
- Analytical Characterization
- Biopharmaceutical Analysis
- Biofuel Development & Production



Transmission spectra of 100m long Trans-Probe



NIR-absorption of water and Isopropyl Alcohol



Specification of Fiber Optic Transmission and Transfection Probes FlexiSpec®

Probetype	Transmission		Transfection		
Transmission range	0,2 - 1,3 µm	0,4 - 2,2 µm	0,2 - 1,3µm	0,4 - 2,2 µm	1,6 - 5,5 µm
Fiber type	Silica UV-Vis	Silica Vis-NIR	Silica UV-Vis	Silica Vis-NIR	CIR
Gap dimension	2; 5; 10; 20 mm	2; 5; 10 mm	2; 5; 10; 20 mm	2; 5; 10 mm	0.05 – 2.0 mm
Temperature range	≤ 200°C	≤ 200°C	≤ 200°C	≤ 200°C	≤ 100°C
Minimum Bending Radius	120 mm (for 600 µm core)				130 mm

Common Parameters of Fiber Optic Transmission and Transfection Probes FlexiSpec®

Total Length	1,5 m (opt: 1 – 30m) *
Shaft Length	230mm (opt: 50 – 500mm) *
Shaft Diameter	12mm
Shaft Material	SS, Hastelloy C22
Protective Tube Material	Liquid Tight SS-Conduit, KOPEX-Tube
Input / Output Connectors	Long SMA; FC/PC; ST
Compatible Process-Interfaces	Ceramat-FOS or SensoGate-FOS

*Customized dimensions are available on request

Transmission Infrared Fiber Optic Probe for Gases

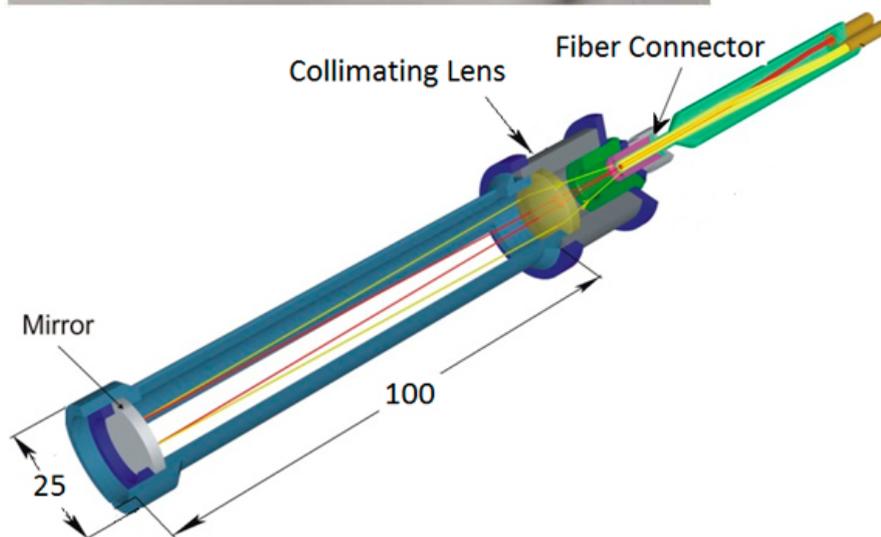
- On-line transmission spectroscopy in gases
- High throughput in any part of NIR-MIR spectra
- Flexible and robust for industrial applications
- Compatible with any spectrometer

FlexiSpec® product line includes the latest generation of Transmission infrared fiber optic probes for gases to be used with any spectrometer or photometer.

The design of Transmission Fiber Probe for gases is based on a bifurcated fiber bundle. Due to low Mid IR-attenuation in gases the collimated beam design of double pass (or multiple pass) gas cell is needed to increase optical path length to 10 – 40cm. This design is easily realized by the mean of the collimating objective and reflecting mirror cell.

Applications:

- Reaction investigation and monitoring in real time
- Analytical Characterization
- Exhaust gases monitoring
- Solvent vaporization monitoring
- Associated petroleum gas monitoring



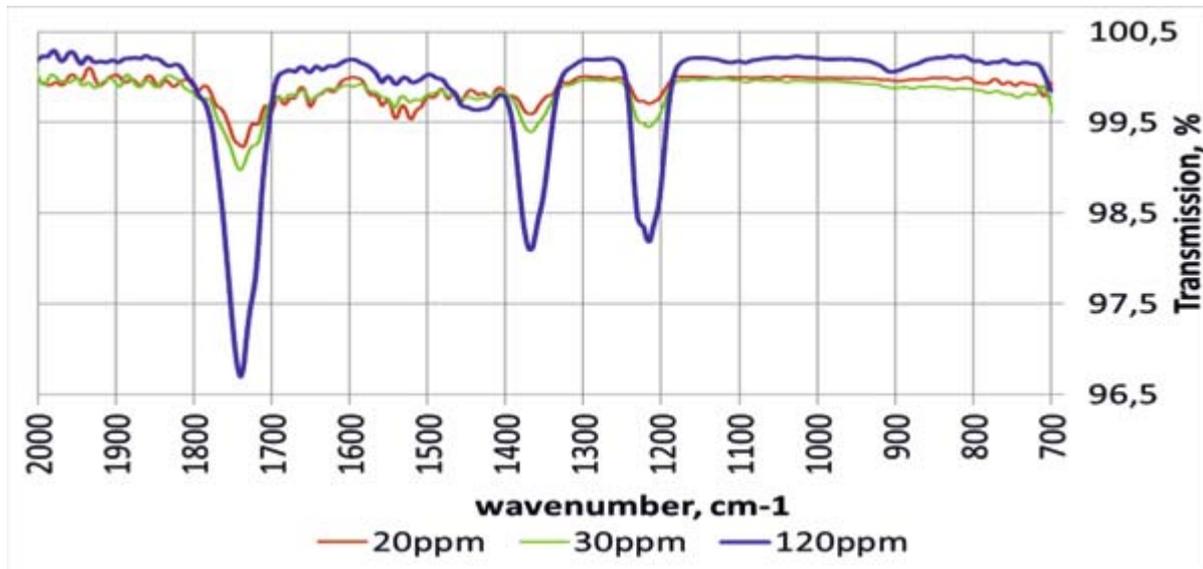
Specification of Gas Transmission Fiber Optic Probes *FlexiSpec®*

Probe type	Transmission in double-pass gas cell		
Transmission range	0,5 - 2,2 μ m	1,6 – 5,5 μ m	3 – 18 μ m
Fiber type	Silica	Chalcogenide IR	Polycrystalline IR
Temperature range	-50°C +200°C	-50°C +90°C	-50°C +140°C
Sensitivity	>1ppm depending on optical path, spectrometer performance, gases in test		

Common Parameters of Gas Transmission Fiber Optic Probes *FlexiSpec®*

Total Length	1,5 m (opt: 1 – 30m) *
Transmission Cell Length	100mm (opt: 5 – 200mm) *
Transmission cell Diameter	25mm
Shaft Material	Stainless Steel, Hastelloy C22
Protective Tube Material	Liquid Tight SS-Conduit, KOPEX-Tube
Input / Output Connectors	Long SMA *

*Customised dimensions are available on request.



Cleanable Fiber Probes with Process Interfaces

- Process analysis during reaction free from optics contamination
- Retractable fiber probes cleaned in process with in-line wash and in-line calibration capabilities
- Manual, semi or fully automated process control systems made with control unit UNICAL-FOS 9000
- Zero baseline at any time and precise spectroscopy analysis

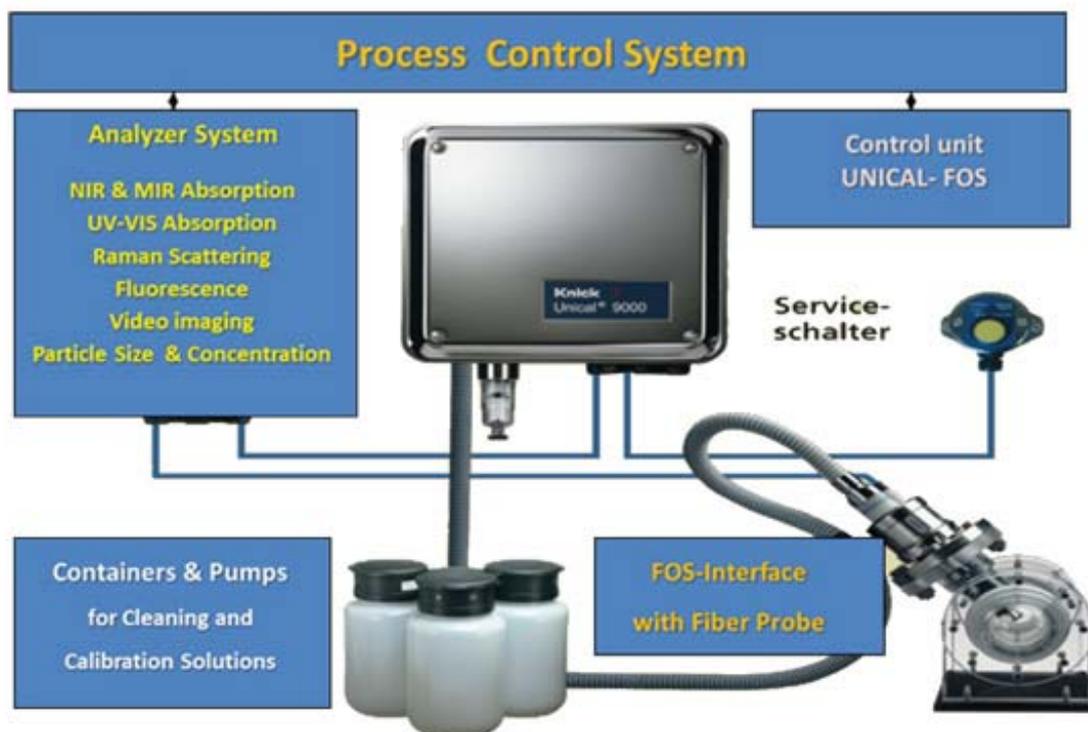
FlexiSpec® probes design enables their use for reaction monitoring with no artifacts caused by optics contamination as they can be retracted, cleaned

and calibrated during chemical process. Process-interfaces SensoGate-FOS and Ceramat-FOS made by KNICK with approved fitting & flanges for FlexiSpec® probes to secure their semi or full automated use in complete process systems.

Applications:

- Reaction Monitoring in real time
- Full Automated Process Control in PAT applications
- Complete cleaning of all parts according GMP, Hygiene, etc.
- Analytical Characterization
- Biopharmaceutical Analysis
- Biofuel Development & Production

Before requesting the product please fill the “Checklist for installation of Ceramat® FOS and SensoGate® FOS” to help us to proceed your request promptly.



Triple cleaning process for ATR-probe on olive oil

