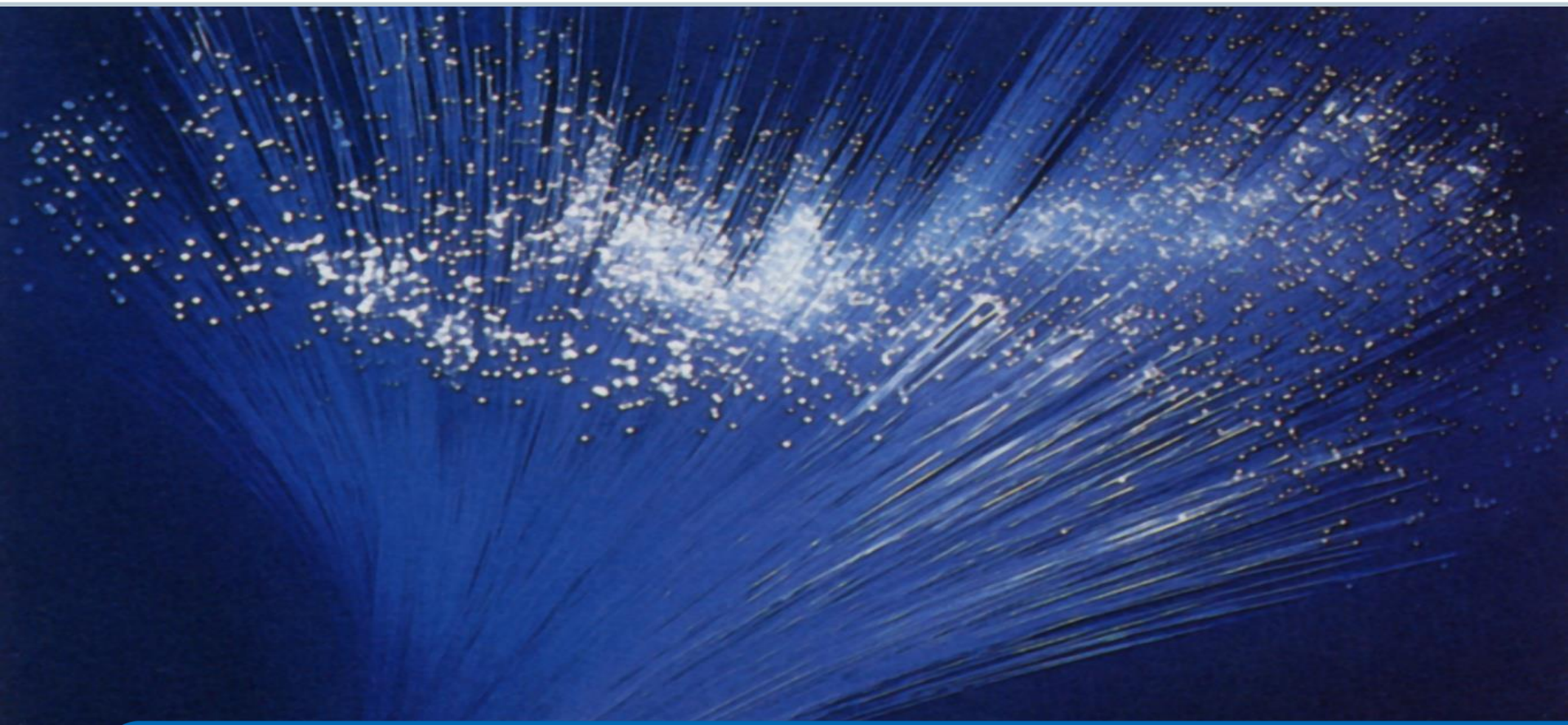
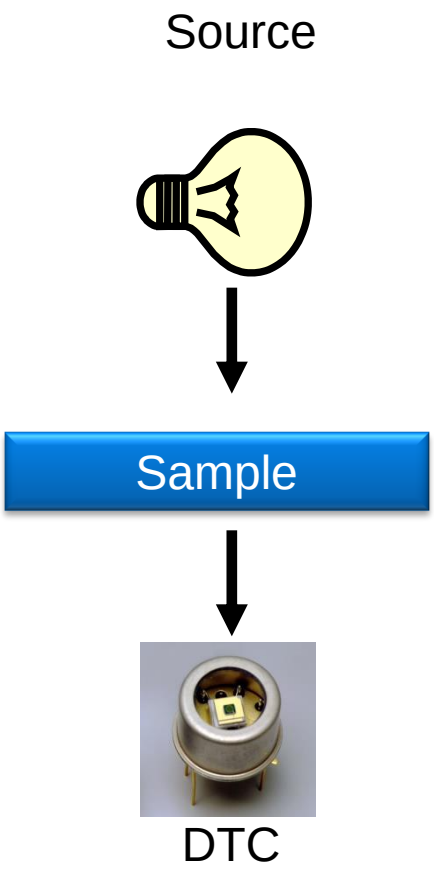
Probe technology for in-situ NIR applications

NIR&Wood – Sounds Good! #2
San Michele all'Adige, May 30, 2016

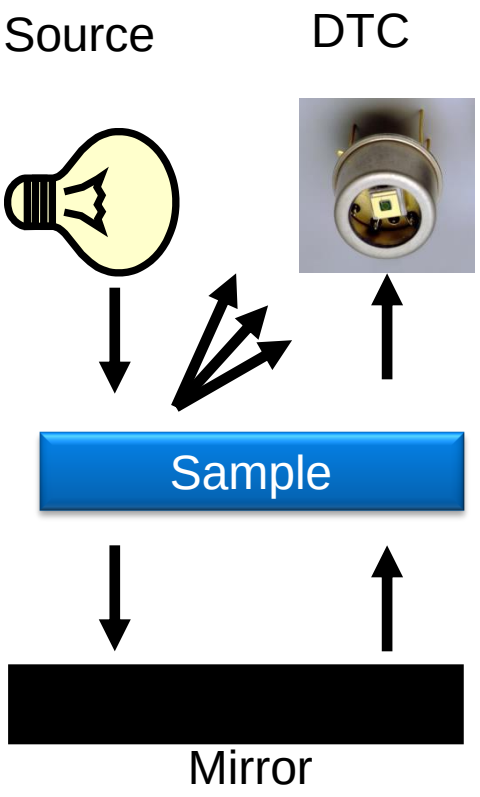


Sampling technology: definitions/1

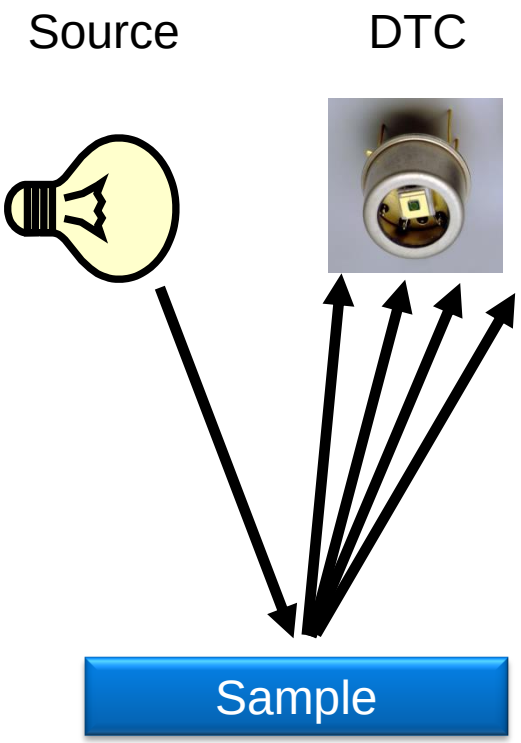
Trasmission



Transflectance

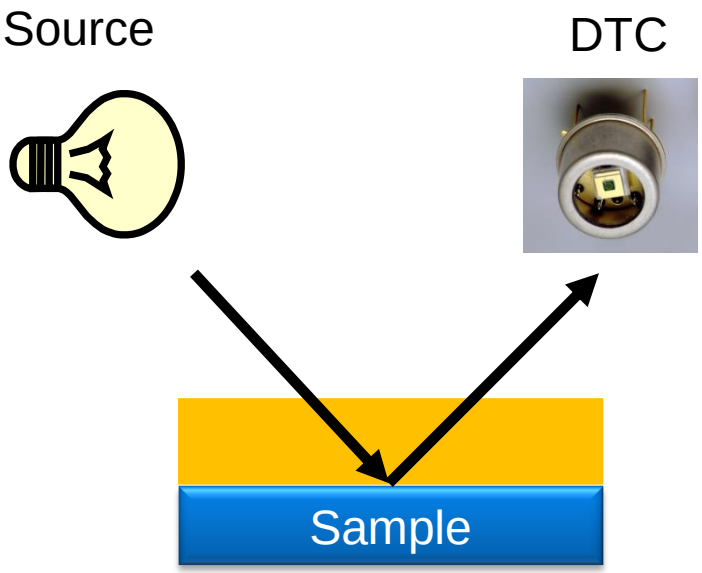


Diffuse reflectance

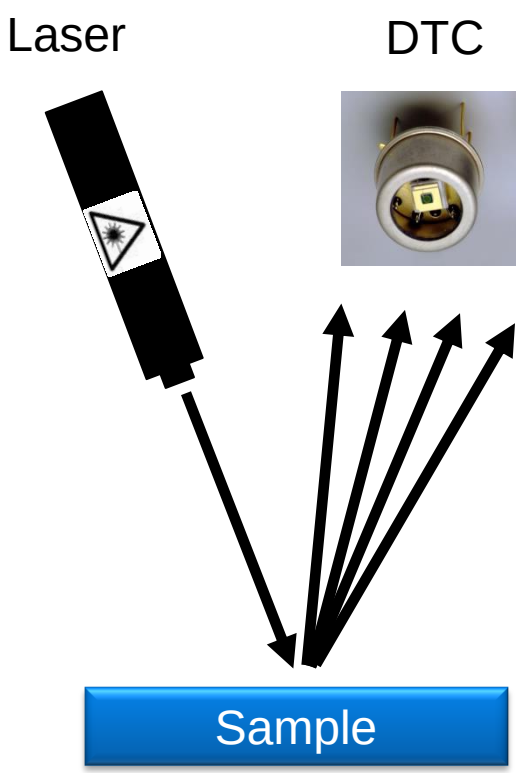


Sampling technology: definitions/1

ATR



Raman Scattering



FO Cables, connectors

- FO cables use standard male SMA 905 connectors
- Adaptors for connecting 2 fibres

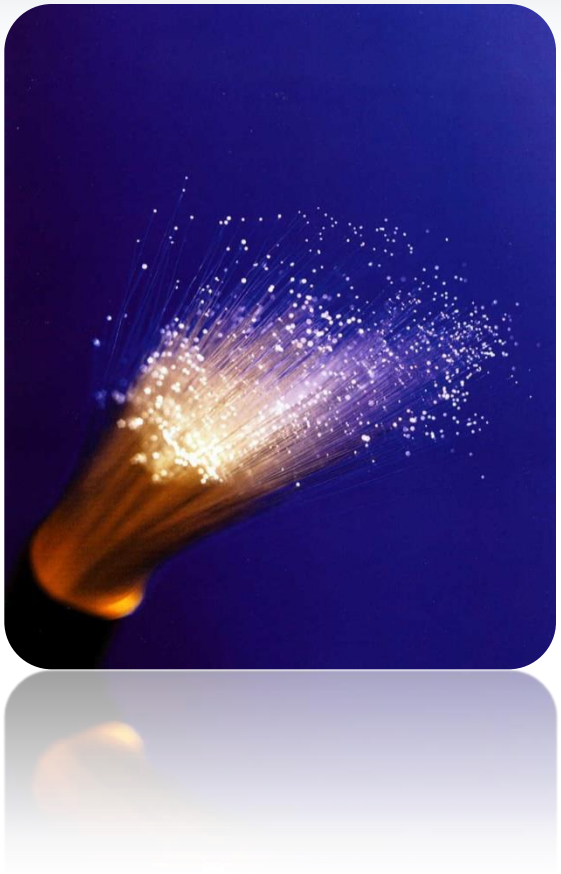
Overview

- Fiberoptic technology
- Reflectance Probes
- Sensor Heads
- Transmission Probes
- Flow Cells
- Transflectance Probes

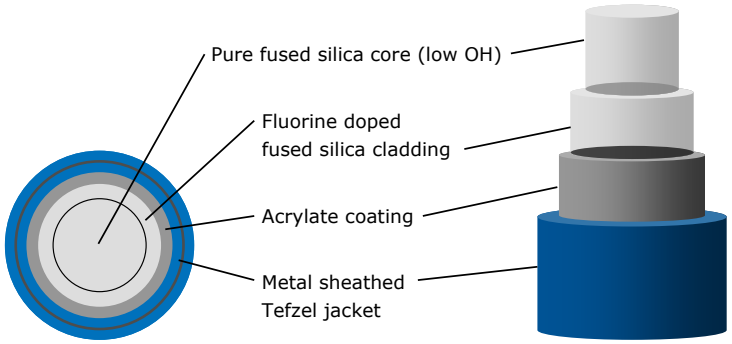
Overview

- **Fiberoptic technology**
- **Reflectance Probes**
- **Sensor Heads**
- Transmission Probes
- Flow Cells
- Transflectance Probes

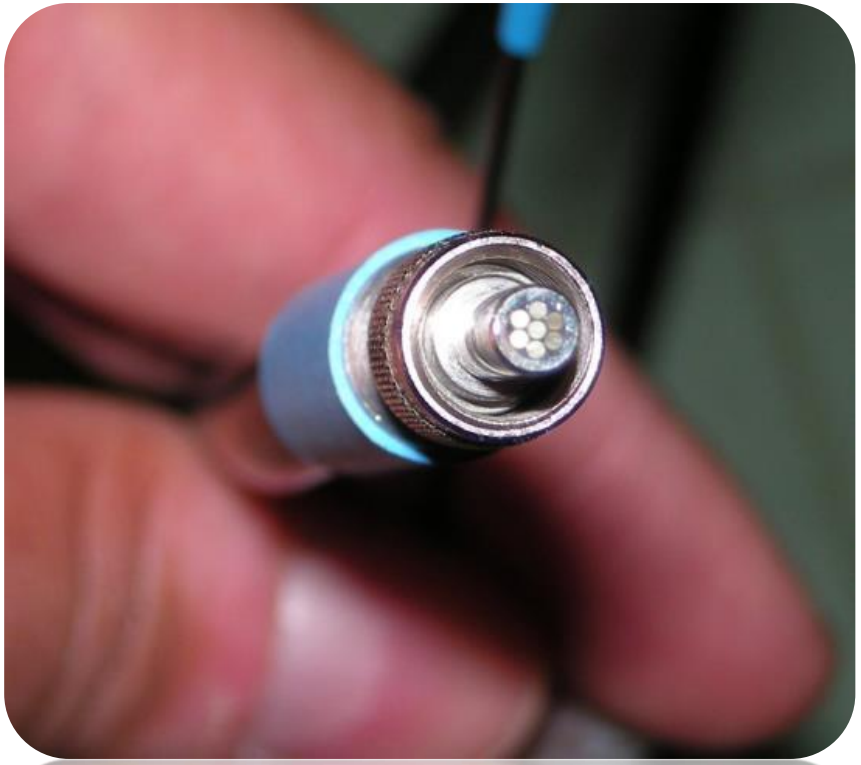
Light Fiber Optics (“FO Cables”)



- NIR ⇔ low OH content quartz fiber
- Core diameter Ø 600 µm or 1000 µm
- Cladding and coating defines the optical and mechanical properties
- 7+7 fibers for reflection probes
- 6+1 fibers for reflection or transflection
- 1+1 fibers for transmission



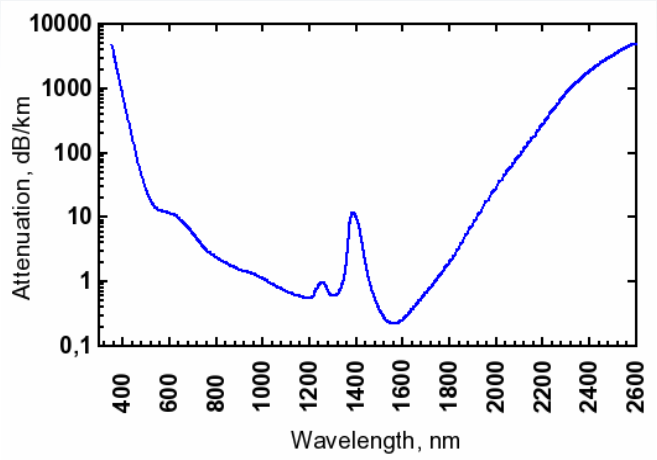
Monofiber Vs. Fiber bundle



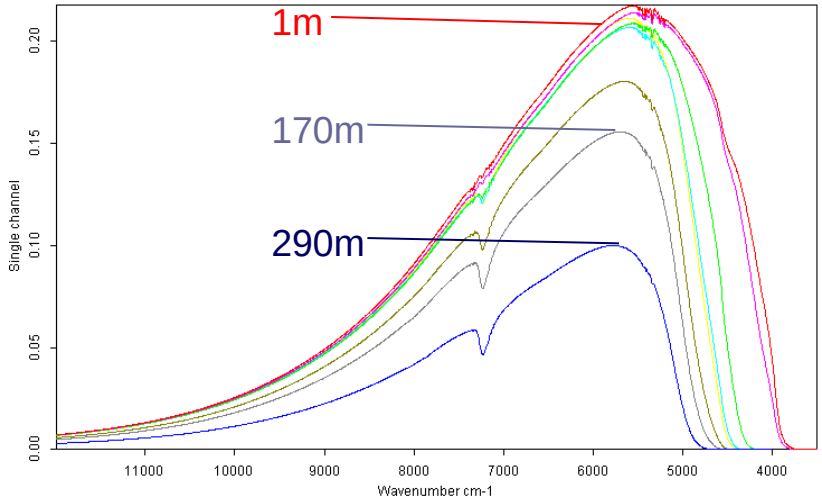
Sampling technology: spectral range

	MIR	NIR	Raman
Transmission	+	+++	n/a
Transflectance	-	++	n/a
Diffuse reflectance	+	+++	+++
ATR	+++	-	n/a

Achievable Distances

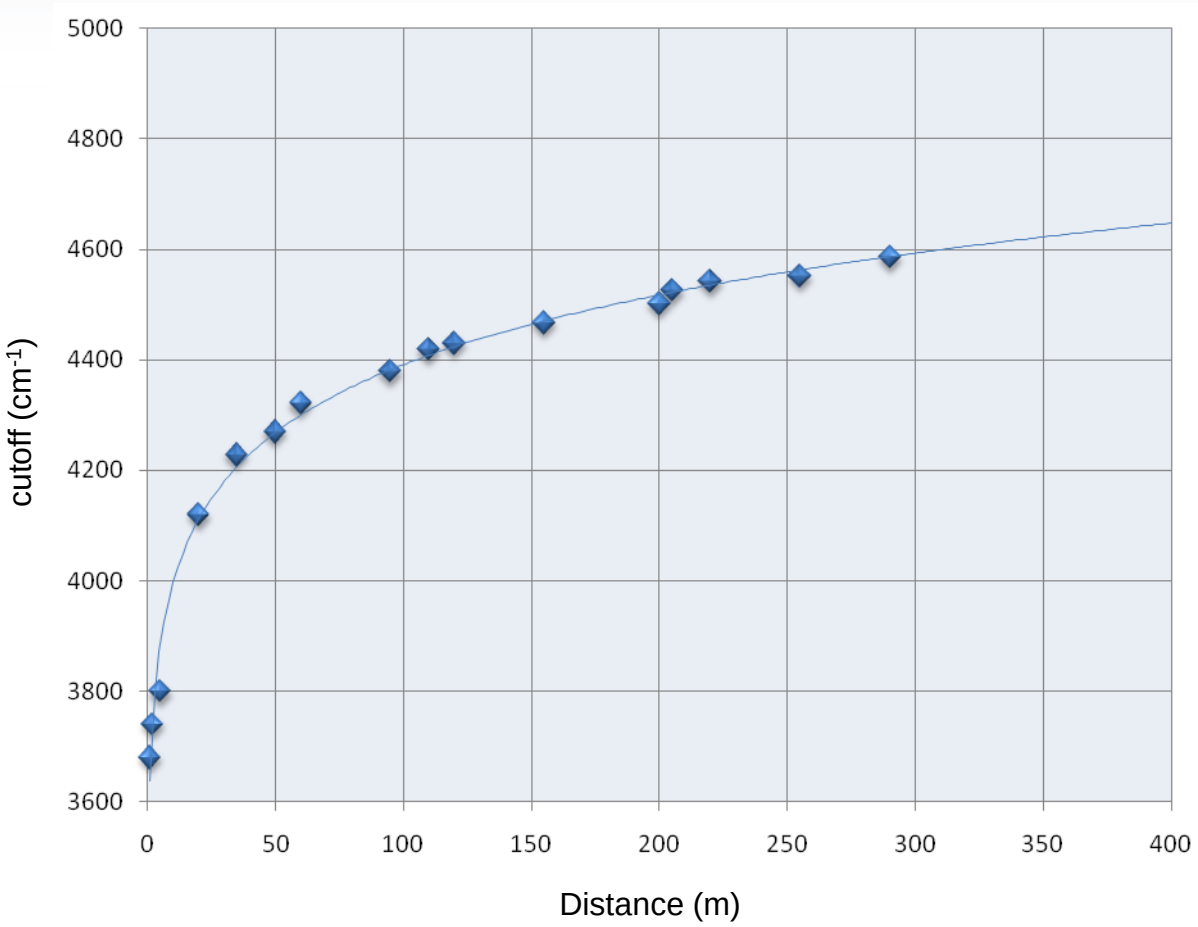


- Attenuation profile



- length

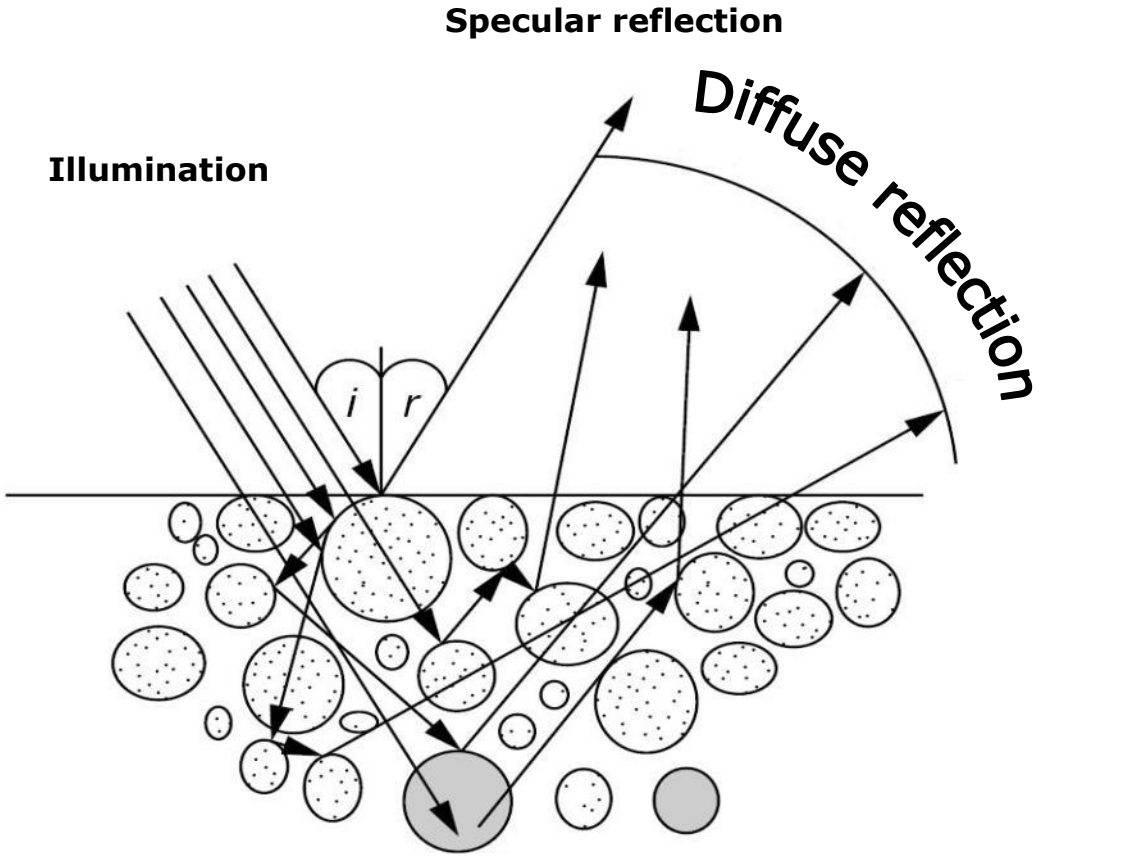
Cutoff frequencies



Fiber Optic Process Probes
Reflection Probes for Solids

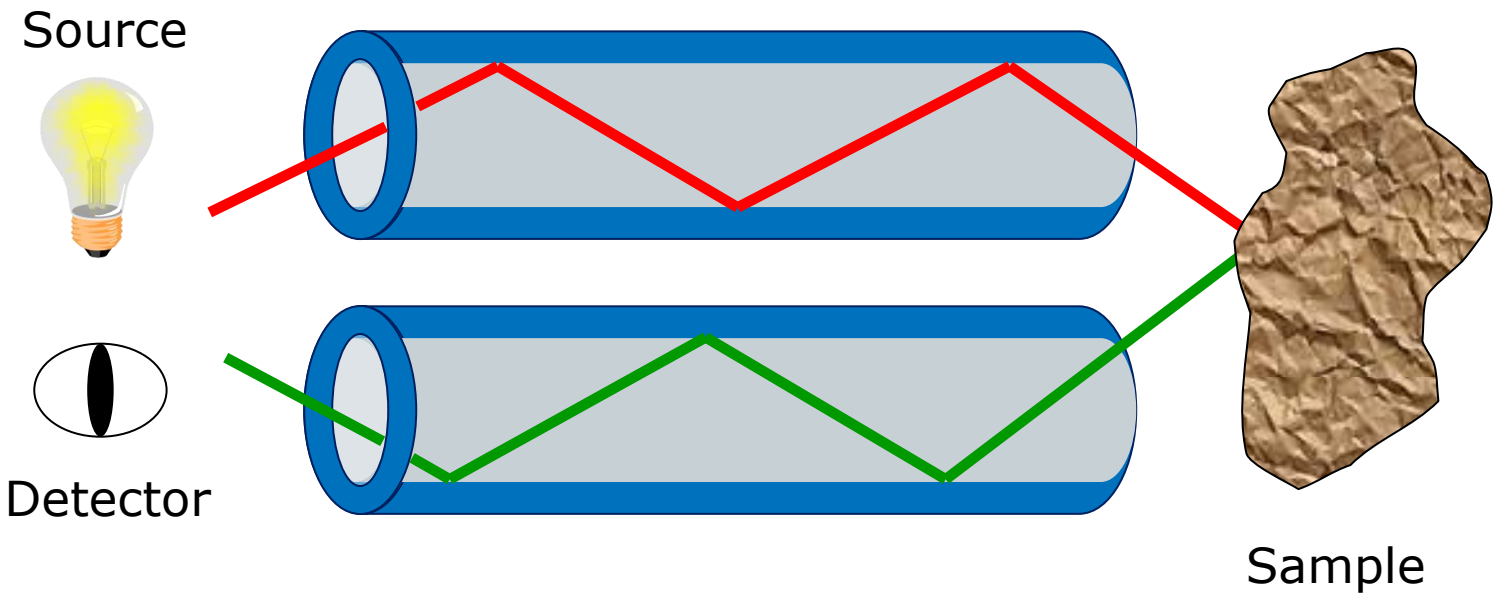
- Functional Principle of Reflection Probes: Diffuse Reflectance
- Types of Solid Immersion Probes:
  - IN264 – TURBIDO: Monofiber Reflection Probe
  - IN268 – REFLECTOR (7+7): Multifiber Reflection Probe
  - IN269 – ALBEDO (7+7): Multifiber Reflection Probe with Separate Flange
  - IN270 – Hellma 668.008 (7+7): Multifiber Reflection Probe

Principle of diffuse reflectance

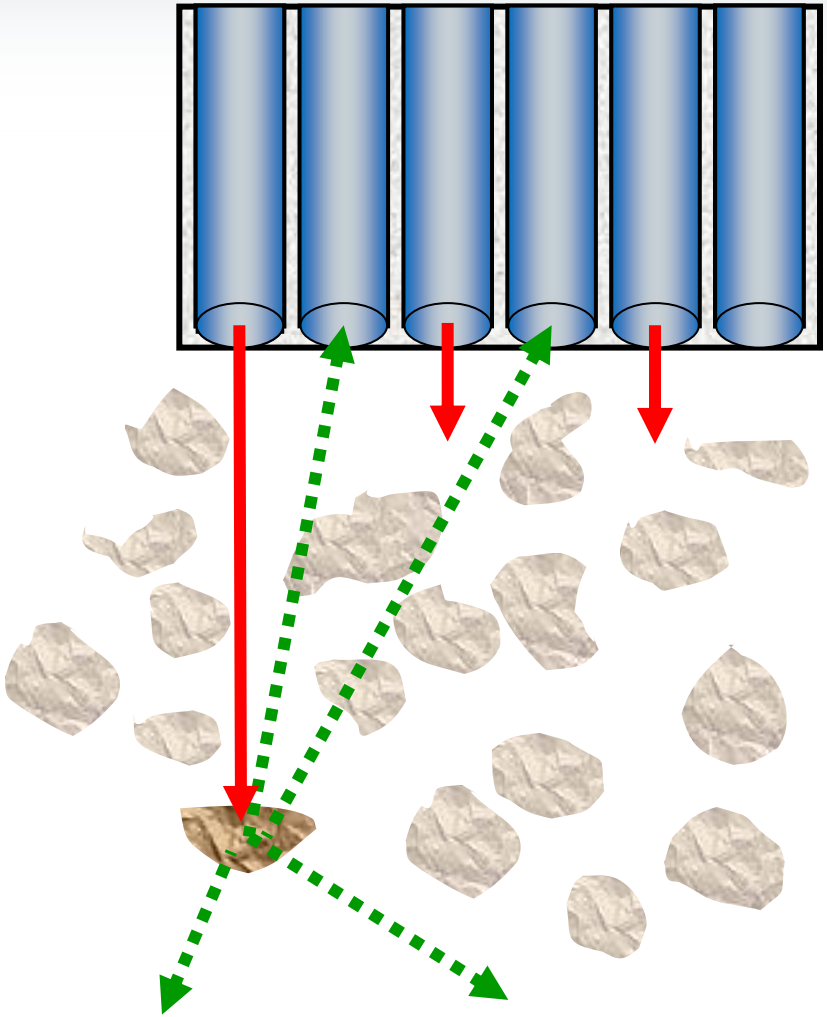


Kubelka P., and Munk,F., Z.tech.Phys.12,593 (1931)

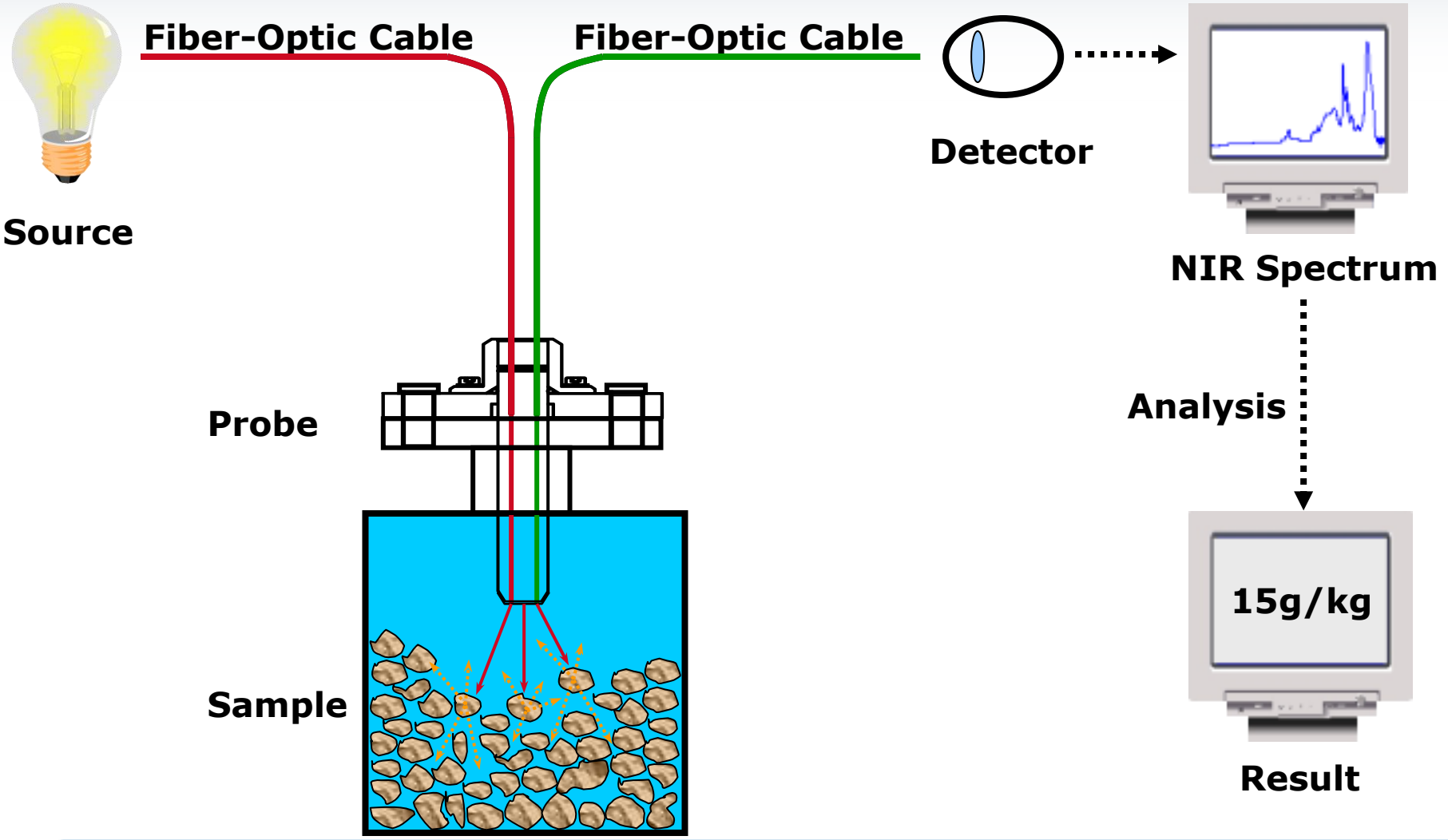
Functional Principle of Reflection Probes



Reflection Probes:
Principle of Diffuse Reflectance



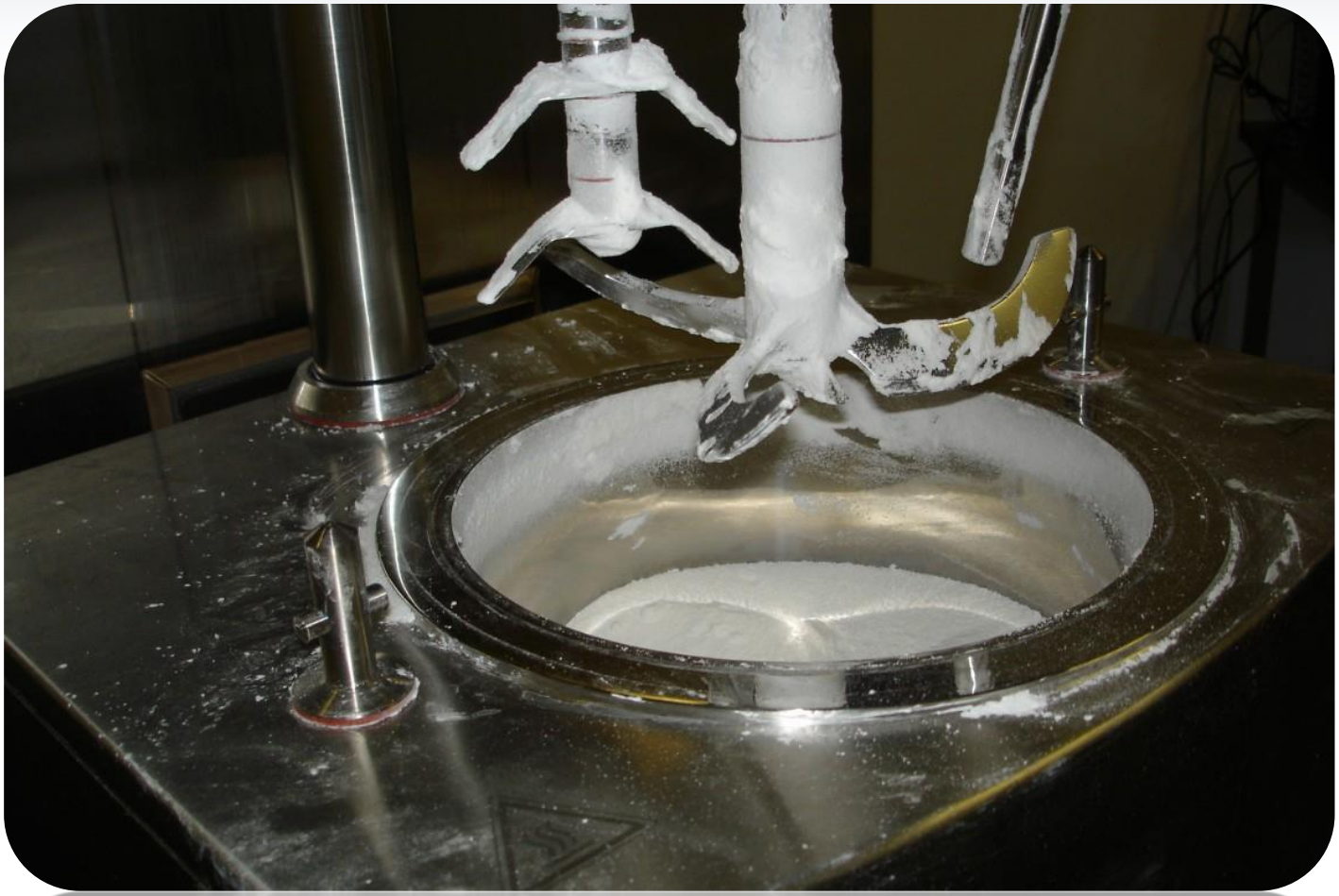
Reflection Probes:
Setup for In-Line-Measurements



Reflection Probe IN263

- Immersion depth: 325 mm
- Temperature range: -40ºC to 200ºC
- Diameter of probe: 10mm
- Connection: Fiber Bundle, BQC Adapter

Reflection Probe IN263: Installation in a Mixer



Reflection Probe IN264 Turbido: *Monofiber* Reflection Probe

Reflection Probe IN264 Turbido: *Monofiber* Reflection Probe

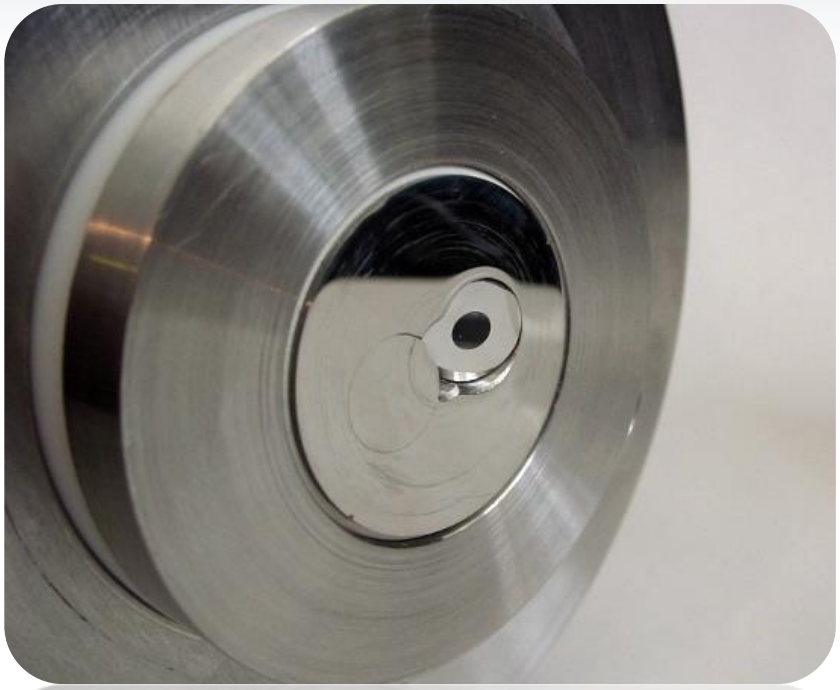
- Materials: Stainless Steel 1.4435 (316L) or on request: Hastelloy, stainless steel 1.4571 (316Ti), Titanium, PTFE
- Sapphire window, sealing by epoxy glue
- Optical fiber: 600 µm, 3 m, 2 x SMA connector
- Illuminated spot: Ø 1 mm
- Probe diameter: 12 mm
- Immersion depth 300 mm
- Temperature: max. 130 ° C (continuous use)

Reflection Probe IN268 Reflector: *Multifiber* Reflection Probe

Reflection Probe IN268 Reflector: *Multifiber* Reflection Probe

- Materials: Stainless Steel 1.4435 (316L) or on request: Hastelloy, stainless steel 1.4571 (316Ti), Titanium, PTFE
- Sapphire window, sealing by epoxy glue
- Optical fiber: 7+7 600 µm, 2 m
- Illuminated spot: Ø 3 mm
- Probe diameter: 12 mm
- Immersion depth 300 mm
- Temperature: max. 130° C (continuous use)
- Pressure range: 0-16 bar, vacuum-resistant

Reflection Probe IN268 Reflector:
Variation Reflector FLUSH



Reflector Flush Plane

Reflector Flush

Cleaning Nozzle

Reflection Probe IN269 Albedo: *Multifiber* Reflection Probe with Flange

Reflection Probe IN269 Albedo: *Multifiber* Reflection Probe with Flange

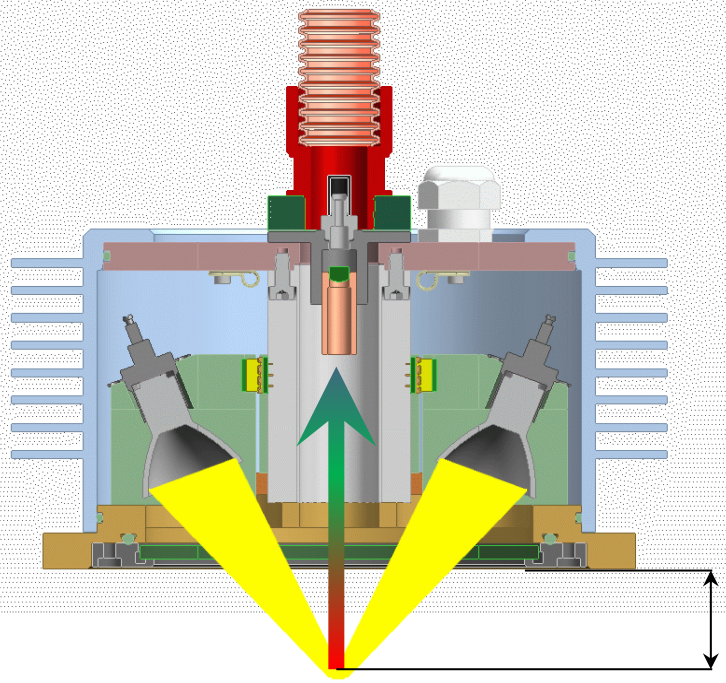
- Materials: Stainless Steel 1.4435 (316L) or on request: Hastelloy, stainless steel 1.4571 (316Ti), Titanium, PTFE
- Sapphire window, O-Ring sealing (Kalrez®)
- Optical fiber: 7+7 600 µm, 2 m,
- Illuminated spot: Ø 5 mm
- Probe diameter: 50 mm
- Immersion depth 100 mm
- Temperature: max. 130oC (continuous use)
- Pressure range: 0-16 bar

Reflection Probe IN270: Hellma 668.008
Multifiber Reflection Probe

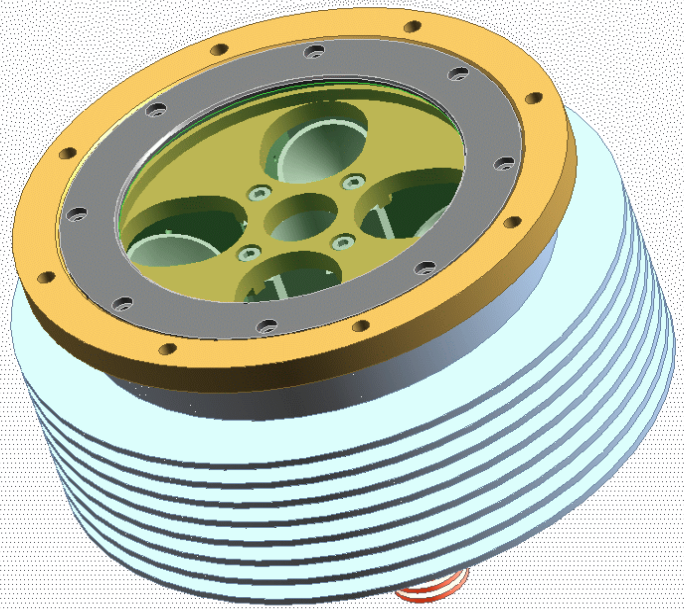
Reflection Probe IN270: Hellma 668.008
Multifiber Reflection Probe

- Materials: Stainless Steel 1.4435 (316L), other materials on request
- Sapphire window, EPDM, Kalrez® or brazed sealing
- Optical fiber: 7+7 600 µm
- Illuminated spot: Ø 2-4 mm @2.5 mm distance
- 30° illumination reflection
- Probe diameter: 30 mm
- Immersion depth 250 mm
- Temperature: 5 to 140 ° C (continuous use)
- Maximum pressure: 10 bar
- Hygienic design, FDA conforming seals

Non contact system



100÷400 mm



Non contact system

Non contact system

- SS 1.4301, quartz window
- 2 NIR sources 5 W (or 4x20W)
- Working distance: 10 ÷40 cm
- Sample spot: 10 mm approx.
- Internal BKG
- Max distance to spectrometer: 100m

Non contact system

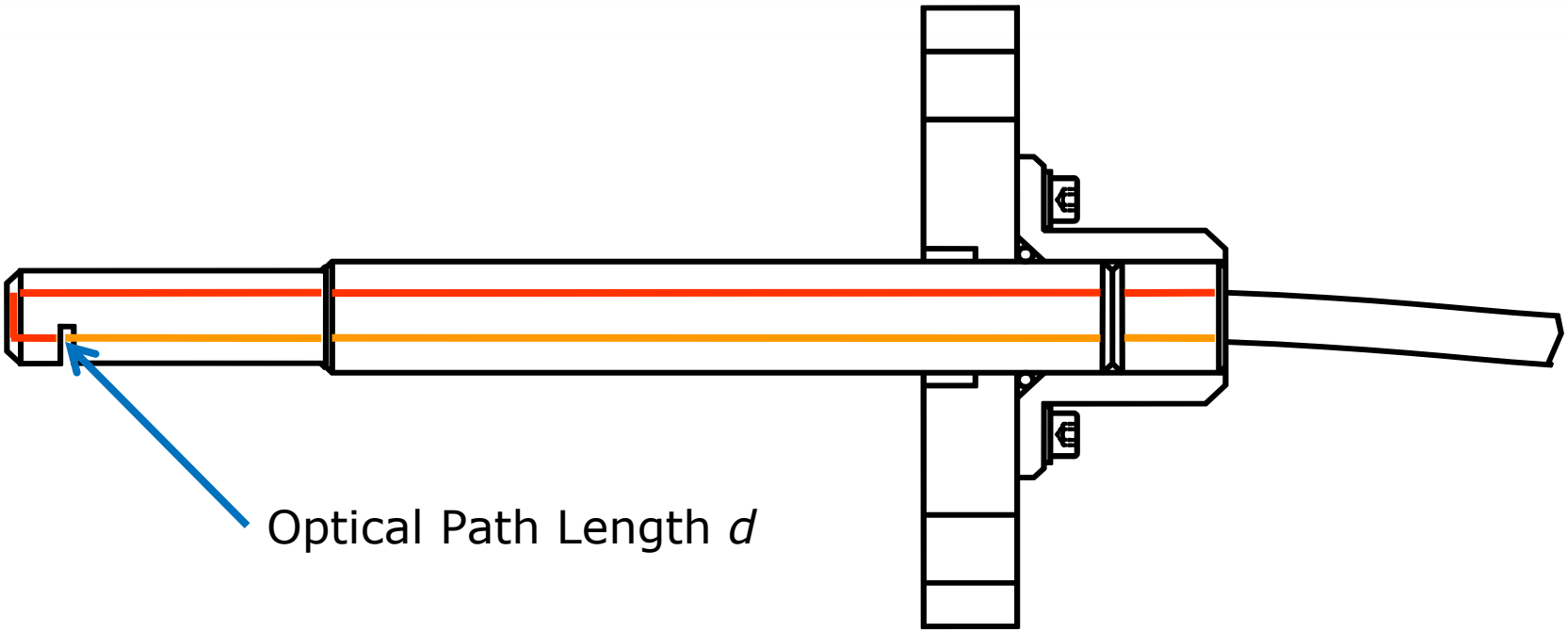
- Air blade
- Vortex cooler (T > 40° C)

Installation on Cement Kilns
Moisture and Calorific power

Fiber Optic Process Probes
Liquid Probes & Flow Cells

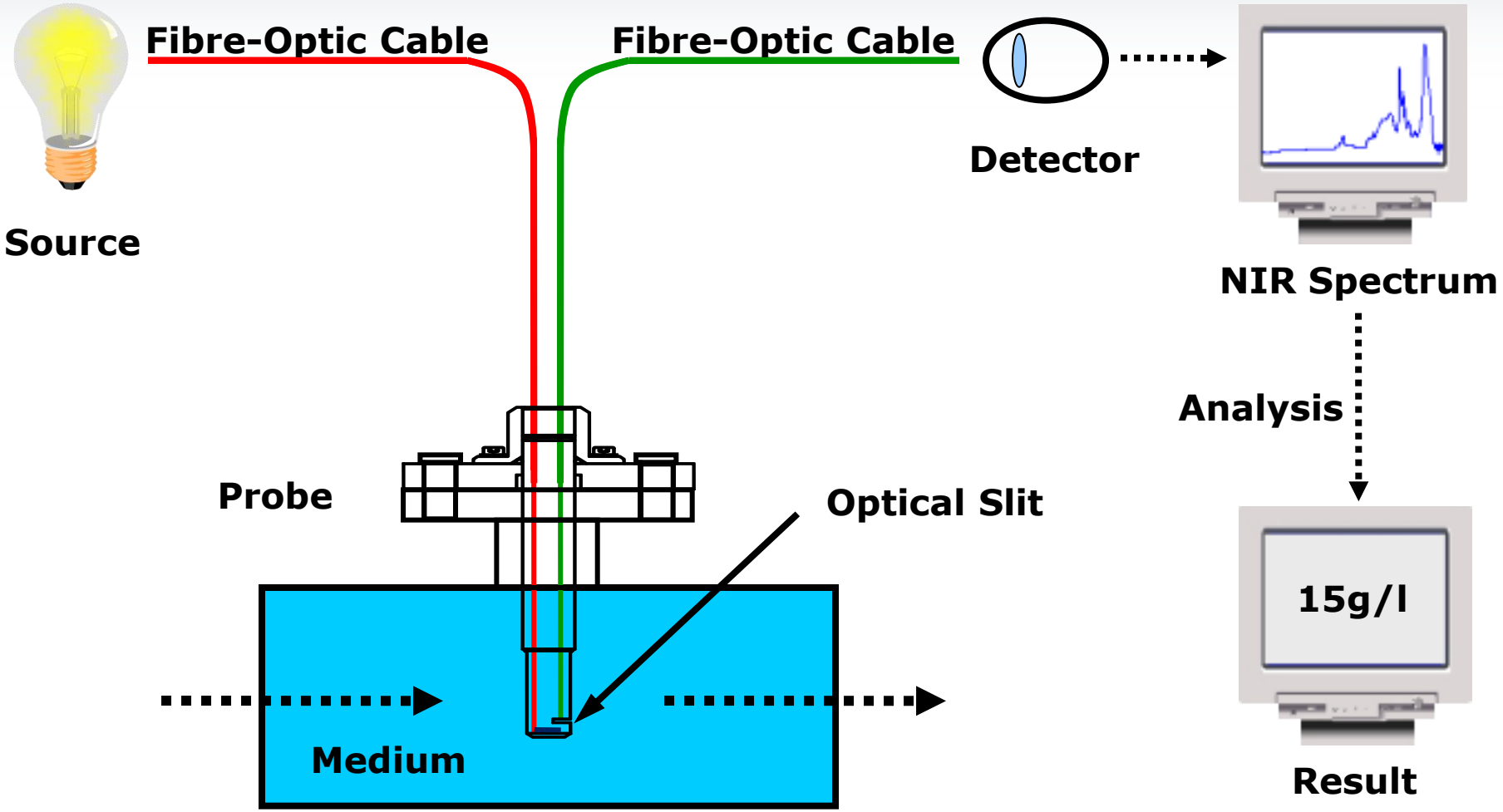
- Types of Probes and Flow Cells:
- IN237 Series – Transmission Probe with or without flange
- Total Quartz Flange Immersion Probe

Fiber Optic Process Probes
Liquid Probes & Flow Cells



Beers Law: AB ~ ε·c·*d*

Transmission Probes:
Setup for In-Line-Measurements



Transmission Probe IN237 Series: Hellma 661.790 – 793

Transmission Flow Cells by PLS: ProTec TM50 and ProTec TM80 Series

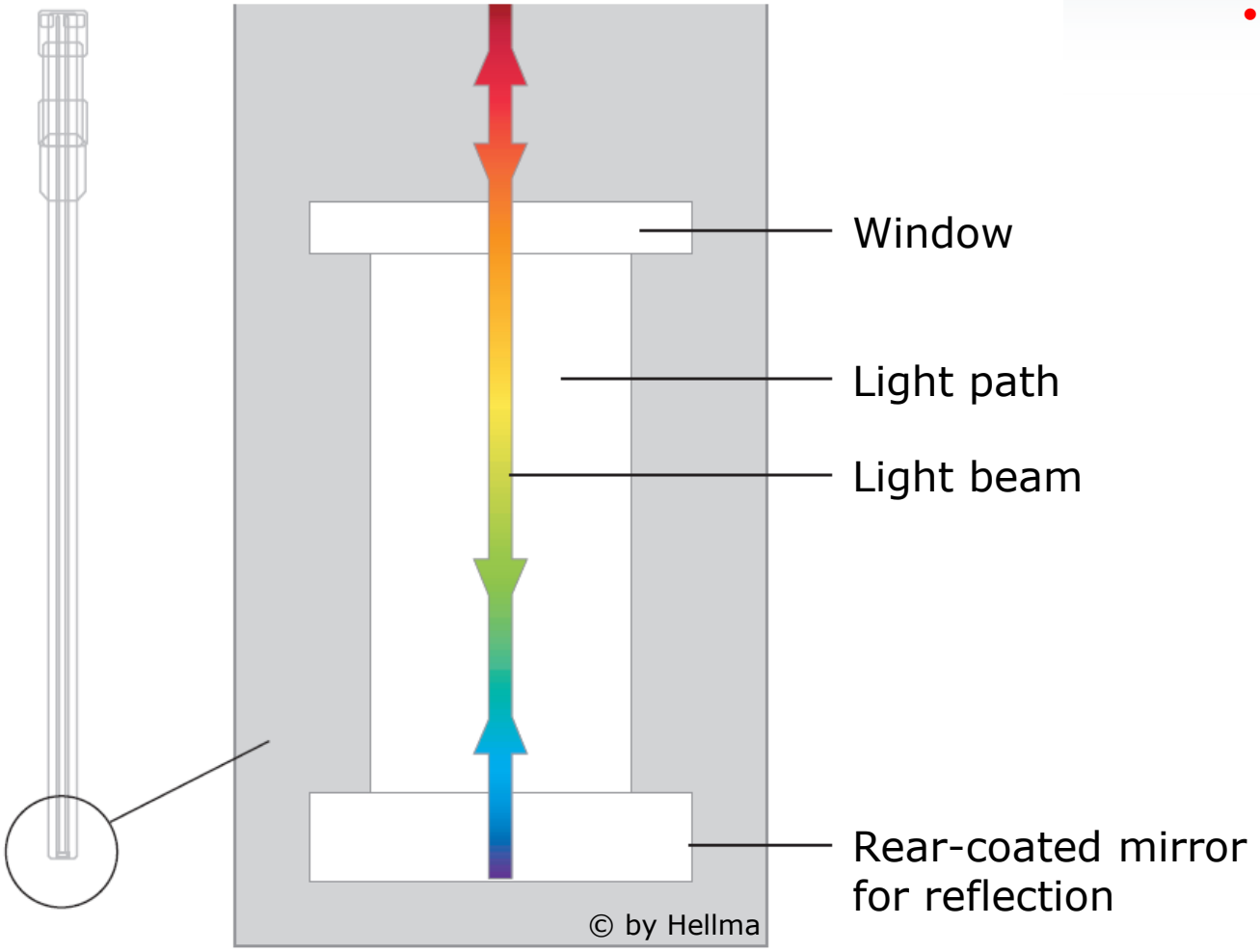
Transmission Flow Cells by PLS: ProTec TM50 and ProTec TM80 Series

- Materials: Stainless Steel 1.4571 (316Ti) or on request: Hastelloy, stainless steel 1.4435 (316L), Tantalum, PTFE or PVDF
- Sapphire windows and Isolast® O-ring seals, other sealing materials on request
- Optical path length: 1 to 100 mm
- Optical fiber: 600 µm, 2 x SMA-905
- Temperature range: -20 to 230° C (depending on sealing material)
- Pressure range up to 250 bar (depending on flange)
- Connection: DIN or ANSI flanges, others on request

Fiber Optic Process Probes
Transflection Probes for Emulsions etc.

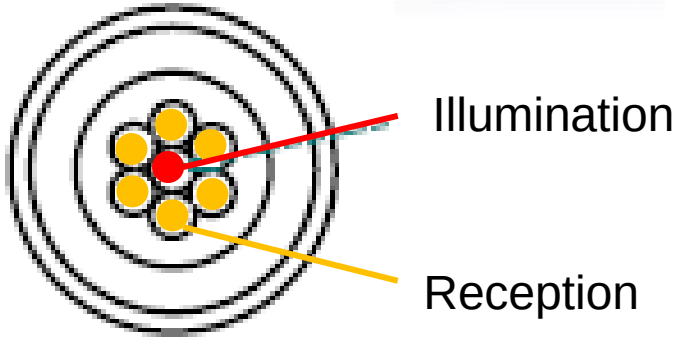
- Principle of transflection combines transmission and reflection components.
- Types of Transflection Probes:
  - IN271X-02 (6+1):
    Multifiber Transflection Probe

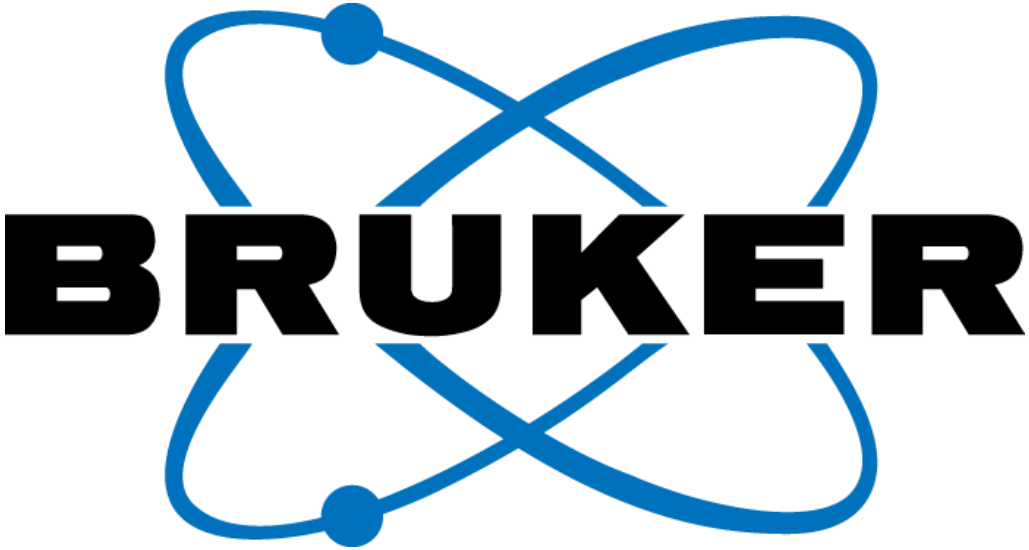
Fiber Optic Process Probes
Transflection Probes for Emulsions etc.



- The light passes the medium, is reflected by a rear-coated mirror and passes through the solution a second time. Additionally, diffuse reflectance takes place in emulsions, dispersion etc., e.g. during crystallization.

Probe IN271X-02:
Multifiber Transflection Probe





Innovation with Integrity

www.bruker.com