



Pharma



BioTech

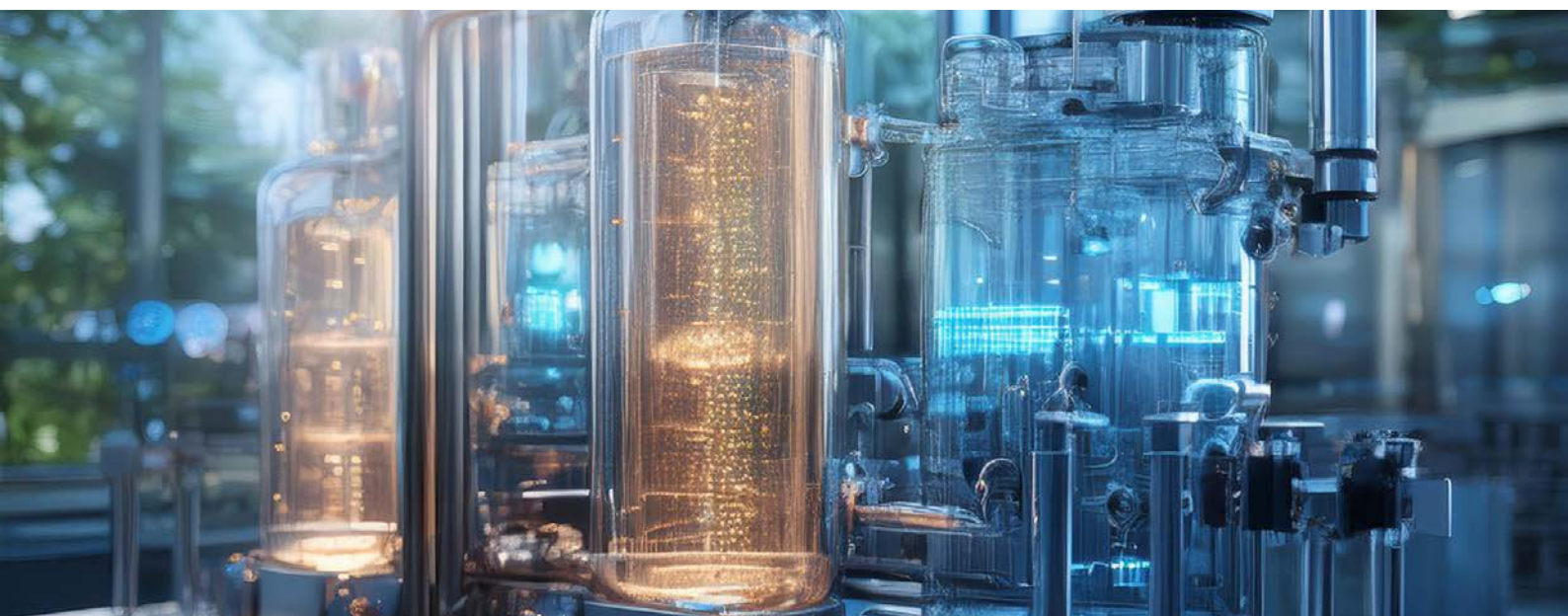


Chemicals



Agri-food

Raman spectroscopy: our portfolio of innovative configurable immersion probes



▪ Introduction

Raman spectroscopy is a non-destructive analytical technique relying on the inelastic scattering of light to provide detailed information on the molecular composition and chemical structure of samples. By illuminating a material with a laser, it can be used to detect specific vibrations from the chemical bonds, thus offering a unique characteristic spectrum for each substance. This technology is widely used in various fields, from the material sciences to biology and analytical chemistry.

Some applications, such as the analysis of biological or chemical systems in solution, require measurement in immersion. Indeed, the ability to analyze a sample *in situ* helps to preserve the integrity of the sample, avoid the problems linked to sampling and thus guarantee more accurate measurements which are also more representative. In this way, Raman spectroscopy in immersion offers an ideal solution for reliable, accurate measurements. This is why Indatech proposes a set of immersion probe tips which can be configured according to the physical and chemical characteristics of the product analyzed.



Measure up



• Several probe tip configurations

In Raman spectroscopy, backscattering is the most frequently-used probe configuration, while the configuration for transmission is reserved for specific cases where it is advantageous to have the light pass through the sample. However, the configuration for transflection, combining the advantages of transmission while increasing the optical path length, was not yet available on the market. This is why Indatech has developed this technology, alongside its classic probes, to draw on the advantages of each type. Each of these probes is available in a single configuration (which remains configurable), equipped with a screw-on probe tip which is interchangeable with other configurations, for R&D applications. Configurations without transflection are also available in welded form for use in production.

The principle of the probe with transflection involves a reflective surface enabling the light to pass through the sample, reflect off this surface and then pass once again through the sample before being detected. This doubles the optical path length, thus increasing the sensitivity for low-concentration samples. For Raman measurements, Indatech has developed a transflection probe tip which also significantly reduces the stray light inherent to the long integration times needed for Raman measurements in complex media such as cell cultures. This probe tip is highly effective for removing the ambient light in production, but also makes it more sensitive to increases in the density/turbidity of the medium analyzed, so this must be monitored.

A probe without transflection simply measures the light after passing through the sample a single time, reducing the optical path length so it is more suitable for more concentrated or opaque samples, for which an additional reflection might saturate the measurement, or on the contrary prevent certain photons from reaching the detector. The other advantage of the probe tip without transflection is the possibility of modulating the probe's working distance, thus allowing further adaptation to the medium measured. Indeed, this modulation of the working distance enables close adaptation to the physical and chemical nature of the medium, so that collection of the Raman data can be optimized according to its properties, such as its refractive index, transparency, concentration and viscosity. The range of probe tips proposed by Indatech allows users to adapt as closely as possible to any type of medium with varying physical and chemical properties and optical behaviors.

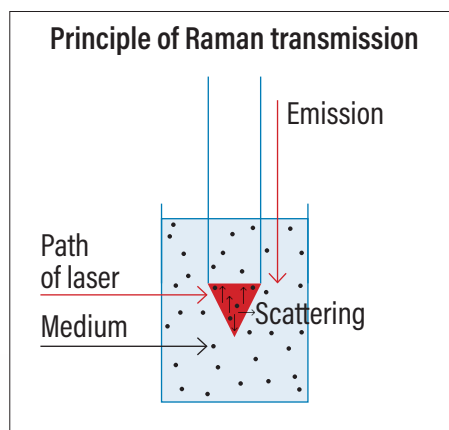
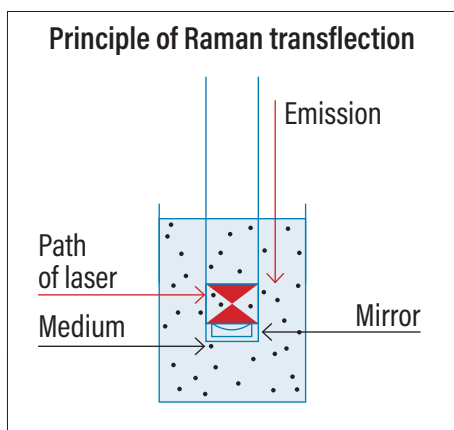
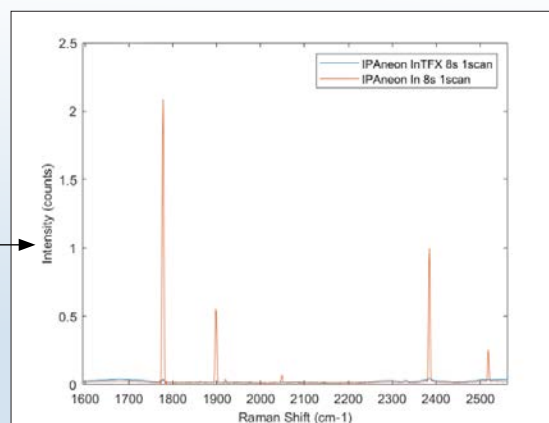
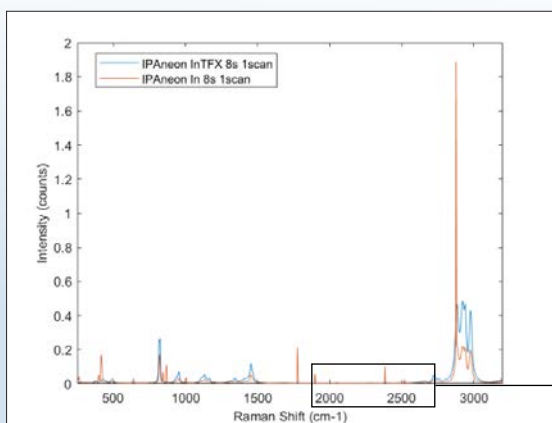


Diagram showing the principle of Raman measurement with transmission and transflection



Demonstration of the reduction in ambient light (neon) using a transflection probe tip (blue) compared with the same measurement using a classical probe tip without transflection (red)

▪ An adaptable probe

Our Raman probes have been designed in two distinct parts, the probe head (VSP-OH) and the immersion fitting (VSP-IM), so that these two elements are completely physically independent. This brings several advantages, with the major one being the modularity of the immersion fitting, providing greater adaptability for different types of applications, facilitating quick fitting changes according to the specific immersion requirements or the type of medium analyzed.

This also simplifies the sterilization and cleaning process, as the probe tip can be autoclaved, while the probe head remains protected. Lastly, this separation extends the life span of the equipment, because only the probe tip needs to be replaced in the event of wear or damage, facilitating maintenance and reducing costs.



Immersion fitting (VSP-IM) with its kit of interchangeable probe tips offering different working distances

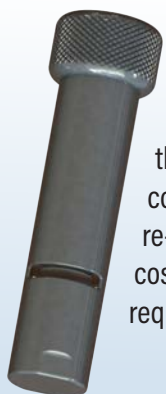


Probe head (VSP-OH)



Immersion fitting (VSP-IM)

▪ Autoclavable, reusable probe tips



Many applications in the biotech, pharmaceutical and food industries require sterile working conditions. This means the immersion probe must be sterilized before insertion in the sample matrix to be studied. For high added-value industrial products, the probe tip of the immersion probe may be thrown away once the batch has been completed, in the context of a single-use approach. Alternately, for a more cost-effective and environmentally-friendly approach, the contaminated probe tip can be sterilized using an autoclave. As they allow sterilization by autoclave, the probes can be re-used without any risk of cross-contamination, thus guaranteeing accurate, reliable measurements while reducing the costs linked to the use of disposable probes. Furthermore, this capability makes the probes easy to integrate in processes requiring real-time monitoring of chemical reactions while maintaining an aseptic environment.

▪ Possible applications

- In-line qualification/quantification of various steps in upstream bioprocesses (cell culture, etc.)
- Chemical, biotechnological or pharmaceutical production quality control
- Real-time monitoring of chemical reactions, analysis of the intermediate and/or final steps of a reaction
- Monitoring of the breakdown of pollutants in water, air or industrial waste, such as heavy metals or pesticides
- Monitoring of the crystallization of solid forms

▪ Numerous markets concerned



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▪ Technical specifications of the VSP-IM immersion probes

	Probe tip without transflection	Probe tip with transflection
Conditions of use	Temperature $\leq 200^{\circ}\text{C}$; Pressure ≤ 15 bar	
Probe immersion depth	220 mm*	
Probe diameter	12 mm	
Working distance	0.5; 1.5; 3; 5; 7 mm**	0.5 mm
Measuring point	220 mm	203 mm (slot width 2 mm)
Weight	280 g (with stainless-steel cap for autoclaving)	
Connection	PG 13.5	
Materials in contact	AISI 316L stainless steel; Kalrez®; Sapphire; Teflon®	
Autoclavability	Yes	
Compatibility	ROHS; REACH; USP class VI	

*Other shallower immersion depths available on request.

**Other Working Distances available on request.

