

Spectral Dimensions

NIR CHEMICAL
IMAGING SYSTEMS



Technical Information and Specifications

Chemical Imaging

NIR chemical imaging is an exciting and rapidly emerging analytical methodology that combines the strengths of both optical imaging and near infrared (NIR) spectroscopy; two technologies that independently have well documented value, and broad appeal, as analytical tools. By seamlessly combining traditional near infrared spectroscopy with microscopic and macroscopic imaging in a single unified product, analysts have available quantitative spatial and spectral information in the form of high resolution chemical maps. These chemical maps have proven invaluable for the analysis of a variety of chemically heterogeneous materials and products.

Most analytical techniques measure either chemical or physical properties, not both. For example to measure particle size, laser diffraction may be employed, but to measure chemical composition and purity of the sample, an entirely different technique, High Performance Liquid Chromatography (HPLC) is required. As manufactured products become more complex, they derive their function and performance from an often poorly understood combination of chemical and physical properties. As a result, analytical technologies that capture both of these pieces of information can provide unique insights into products and materials in a number of industries. Spectral Dimensions NIR chemical imaging system non-destructively provides this powerful combination of chemical and physical characterization.

Industries ranging from the pharmaceutical, agrochemical, food, polymer and material sciences have successfully applied the technology in research and development, quality assurance and quality control. In addition, its use as an in-process measurement tool for manufacturing in these industries also has tremendous value and potential.

For example, in the pharmaceutical industry, a typical solid dosage form is an agglomerate of the active pharmaceutical ingredient and multiple other chemical components, the excipients. Aggregate performance metrics such as the dissolution rate, and the ultimate bioavailability of the drug in-vivo, are strongly impacted by the interactions between and properties of the entire sample matrix, and not just the chemical and physical properties of the active ingredient or excipients independently. Drug delivery systems such as extended and controlled release products are designed to deliver the drug in a precisely controlled manner, and are extreme examples of how the chemical, physical and geometric properties of sample components are manipulated to impart desired behaviour. NIR Chemical imaging enables manufacturers to understand in greater detail the microscopic or macroscopic structure of their products and ultimately aids in understanding how changes in these structures impact product performance.

The unique design of the Spectral Dimensions product enables this information to be obtained rapidly and with unprecedented ease from a variety of sample types. The entire instrument platform is designed to provide an integrated solution. The combination of a high resolution near infrared focal plane array detector with a solid-state spectrometer and a modular software package enables a variety of research and routine analytical measurements to be performed quickly and precisely.

The technology is well established in the pharmaceutical industry and is being used to understand and solve problems associated with the development and manufacture of solid dosage forms.

Applications include measuring

- Powder blend uniformity
- Domain sizes and concentration gradients of individual chemical components in finished products
- Polymorph localization and distribution
- Moisture content
- Coating and layer uniformity
- Screening and identification of contaminants

The technology can be applied in

- Formulation development
- Establishing root causes of manufacturing problems
- QA and QC of finished products and their intermediates
- In process testing and measurement (PAT)

The technology is broadly applicable and is also being used in the agricultural industry to screen for protein contamination in animal feedstock and also to perform high throughput, non-destructive determinations of the lipid, starch and protein content in grains and seeds.

Other applications in the chemical and polymer industry include measuring domain size and layer thickness and uniformity in co-polymeric and laminated products as well as blend uniformity and curing rates in adhesives.

An understanding of these characteristics enables: the manufacture of products with superior performance; identification of the critical characteristics that affect product manufacturability and scale-up; forensic examination of bad lots or failing batches of final product; identification of counterfeit products.

Spectral Dimensions' NIR Chemical Imaging systems are the fastest and most versatile available. Combined with ISys data manipulation and visualization software, the integrated system provides the most powerful tool available for the processing of chemical images into numerically and statistically robust analytical solutions.

At the heart of the system is a solid-state tunable filter covering the full NIR wavelength range from 1200-2450nm or 950-1720nm. There are now no compromises between spectral content and image quality. You get unprecedented data acquisition speed, without sacrificing chemical specificity or image quality. Scan the full wavelength range in a few minutes or randomly access critical wavelengths in seconds. These systems offer significant improvements over other approaches and, with no moving parts, are PAT ready.

The unique Stirling-cooled InSb or InGaAs focal plane arrays, provide exceptional sensitivity and are equally suited to laboratory or process environments. The camera's 81,920 pixels (320x256 array) can be directed at fields of view varying over several orders of magnitude from a few square millimeters to several square centimetres. This versatility is made possible by the use of easily interchangeable refractive objectives and an open, accessible sample area.

Rapid data acquisition is important, but add the most versatile chemical imaging software available, and you have the capability to turn data into answers. ISys provides all the sophisticated multivariate routines you would expect in a NIR spectral software package but in an easy to use, friendly environment. In addition, the software is capable of turnkey operation and has support for 21 CFR Part 11 compliance.

Spectral Dimensions NIR-CI systems provide the only comprehensive chemical imaging technology with complete product continuity from the laboratory to the process floor.

Specifications

	NIR-CI 2450	NIR-CI 1720
Spectrometer	Stirling cooled, InSb infrared focal plane array Solid-state random wavelength access tunable filter	InGaAs infrared focal plane array Solid-state random wavelength access tunable filter
Illumination	Computer controlled with adaptors for polarization and filtering	Computer controlled with adaptors for polarization and filtering
Sample stage	Precision manual XYZ stage	Precision manual XYZ stage
Software	Stand-alone data acquisition package and single copy of ISys data processing and analysis software (can be installed on separate work station for off-line analysis)	Stand-alone data acquisition package and single copy of ISys data processing and analysis software (can be installed on separate work station for off-line analysis)
Focal plane array	InSb Stirling cooled 320x256 pixels	InGaAs 320x256 pixels
Spectral range	1200 - 2450 nm	950 - 1720 nm
Spectral band-pass	6nm @ 1600 nm	6nm @ 1600 nm
Typical scan time (full spectral range & FOV)	~2 minutes*	~2 minutes*
Field of view	~ 12 x 10 mm optional ~ 3 x 2.5 mm optional ~ 6 x 5 mm optional ~ 25 x 20 mm optional ~ 38 x 30 mm	~ 26 x 21 mm ~ 16 x 13 mm ~ 40 x 32 mm ~ 56 x 45 mm ~ 64 x 51 mm ~ 80 x 64 mm
Dimensions	System size 97 (H) x 70 (W) x 45 (D) cm System weight ~ 50 Kg	97 (H) x 70 (W) x 45 (D) cm ~ 50 Kg
Power required	120/240 VAC, 50/60 Hz	120/240 VAC, 50/60 Hz
Operating environment	15 - 30°C, non condensing	15 - 30°C, non condensing
Accessories	Programmable sample stage for automated measurement of multiple samples Reference accessory automates background and reference data collection	Programmable sample stage for automated measurement of multiple samples Reference accessory automates background and reference data collection

* For targeted applications data acquisition times can be reduced to a few seconds using the random wavelength access functionality

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