

Agilent 8700 LDIR Chemical Imaging System

Specifications for microplastic characterization and identification applications

Introduction

The Agilent 8700 Laser Direct Infrared (LDIR) Chemical Imaging System is a new approach to infrared (IR) imaging. The 8700 LDIR uses a proprietary Quantum Cascade Laser (QCL), a thermometrically cooled single-point mercury-cadmium-telluride (MCT) detector, and rapid scanning optics. This combination of features facilitates two useful modes of action that have reimaged microplastic particle analysis.

- In the first mode, the IR frequency is parked (i.e., a single wavelength is selected) while the optics move at high speed over the sample, reflecting the light back into the detector.
- In the second mode, the optics are parked at a single point over the sample while the QCL sweeps through the frequency range, obtaining a full spectrum.

Mode 1 may be used to locate particles in a sample and mode 2 to obtain a spectrum for identification through a library match.

Using the Agilent Clarity software for 8700 LDIR, these processes are achieved at a high speed and are fully automated. Techniques such as more traditional vibrational spectroscopy take significantly longer to achieve the same results as LDIR. The long data acquisition times of traditional techniques lead to delays in data reporting and limit the number of samples that can be measured in a working day. Depending on the analysis, the 8700 LDIR produces high-quality images and spectral data in minutes rather than hours, or hours rather than days. The 8700 LDIR is therefore suited to large-scale microplastic studies and monitoring activities, which require fast data provision.

General specifications of the 8700 LDIR

Parameter	Value
Light Source	Agilent Quantum Cascade Laser (QCL)
Spectral Range	1,800 to 975 cm ⁻¹
Pixel Size Range	Reflection: 1 to 40 µm ATR: 0.25 to 2 µm
Spatial Resolution	Reflection: Down to 5.5 µm ATR: Down to 1.5 µm
Speed of Spectra Collection	A single-point full spectrum can be collected in 1 s
Laser Polarization	Linearly polarized with fully automated 360-degree rotational control
Visible Cameras	Two dedicated visible imaging cameras: – Wide field camera – High-magnification camera with spatial resolution of 1 µm
Detector	MCT Detector (thermoelectrically cooled, does not require liquid nitrogen)
Maximum Sample Size	Width: 25 mm Depth: 75 mm Height: 20 mm
Measurement Modes	Transflection Reflection ATR
Physical Dimension	Width: 420 mm (16 inches) Height: 378 mm (15 inches) Depth: 615 mm (24 inches)
Weight	45.4 kg (100 lbs)
Laser Class	Class 1 (eye safe)
Key Software Features	Agilent Clarity software includes: – Purpose built and modern, image-centric user interface – Fully automated processes for sample profiling, visual and IR focus, scans, etc. – Fully automated microplastics workflow including an integrated library search – Easy file import/export

Microplastic workflow specifications

The 8700 LDIR with the included Clarity Particle Analysis software offers a fully automated workflow for microplastic particle detection and identification. The workflow described in Table 1 will detect particles in a selected area, generate IR and visible images, provide particle size information, and identify particles based on the library selected. Unless otherwise noted, the information in Table 1 relates to the automated Particle Analysis workflow for the 8700 and reflects instrument performance during internal testing.

Table 1. Agilent 8700 LDIR workflow for the detection and identification of microplastics.

Parameter	Value
Particle Size Range	– 20 to 500 µm – A larger size range may be possible; for example, several studies ¹⁻³ have shown accurate analysis of smaller-sized microplastic particles (down to 10 µm)
Automated Analysis of Sample	Yes (Particle Analysis workflow)
Reflective Substrate Compatibility	– Low-e IR reflective slides – Gold-coated 25 mm filters*
Sample Presentation Kit	– Low-e slide sample holder (25 × 75 mm) – Filter sample holder (25 mm diameter, two spaces per sample holder)
Library	Types of materials identifiable by LDIR: Core microplastics: – Polystyrene (PS) – Polypropylene (PP) – Polyethylene terephthalate (PET) – Polyvinyl chloride (PVC) – Polycarbonate (PC) – Polyamide (PA) – Polyethylene (PE) – Polyurethane (PU) – Polytetrafluoroethylene (PTFE) – Polyoxymethylene (POM) – Polymethyl methacrylate (PMMA) Non-core microplastics: – Polylactic acid (PLA) – Acrylonitrile butadiene styrene (ABS) Common non-microplastic contaminants: – Cellulosic – Carbonate – Chitin – Magnesium stearate – Naturally occurring polyamides – Rubber – Sand Library data have been sourced from open access libraries and modified as appropriate for use with LDIR. ^{4,5}
Custom or User Library Generation Capability	Users can quickly and easily modify or add spectra to existing libraries. They can also create custom libraries from LDIR-derived spectra.

* Some studies have determined that filters with a thicker top coating (for example, a 100 nm top and 0 nm bottom coating) demonstrate superior performance in this application to those with a 40/20 nm top/bottom coating. Users may also find satisfactory performance with filters coated with alternative infrared reflective coatings.

References

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