



Microplastics Analysis

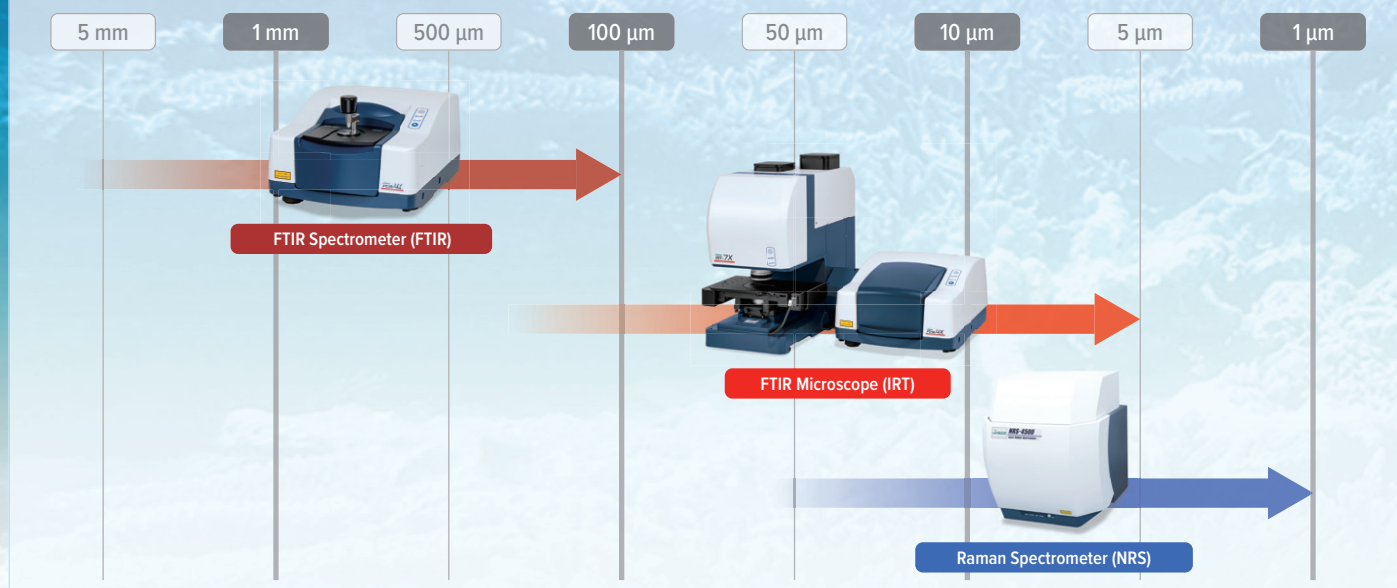
— Analytical Methods using FTIR and Raman Spectroscopy —

Microplastics Analysis

Microplastics, typically defined as plastic particles smaller than 5 mm, have raised significant concerns due to their potential ingestion by marine organisms, contamination of commercial drinking water, and possible health risks to humans. Consequently, there is growing interest in studying their environmental impact, distribution, and biological effects. JASCO FTIR and Raman spectrometers provide powerful and efficient tools for performing a wide range of microplastics analyses.

Use of Different Instruments Based on Particle Size

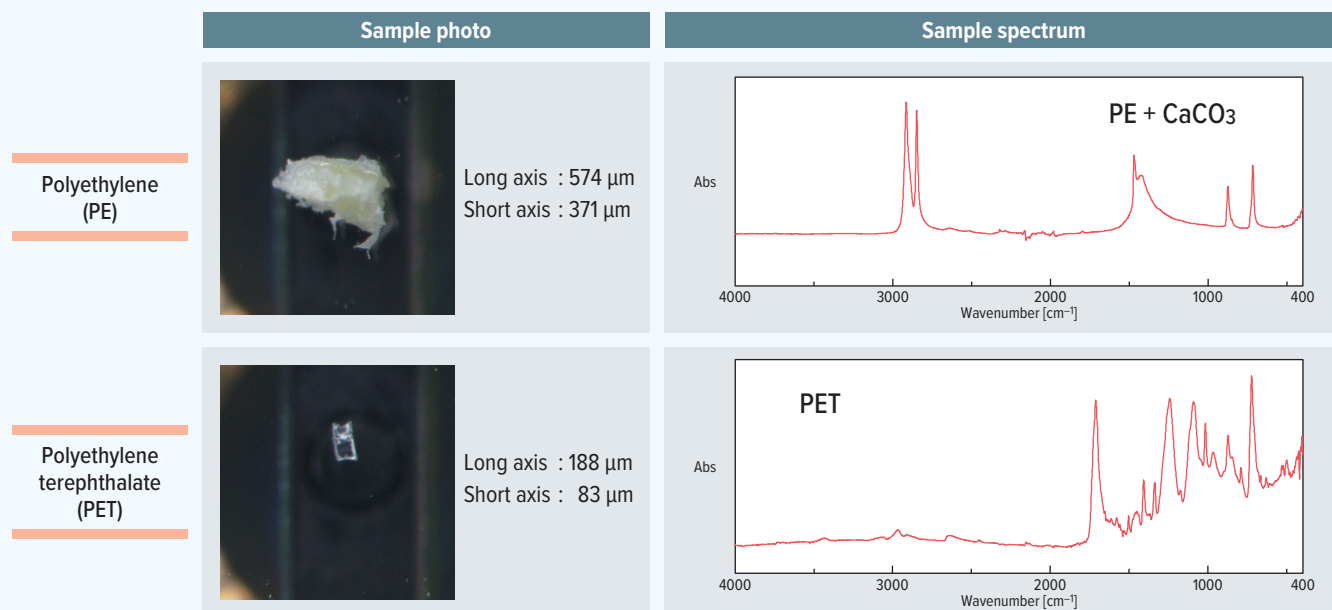
JASCO offers analytical instruments capable of characterizing microplastics across a wide range of sizes from several millimeters down to the submicron order.



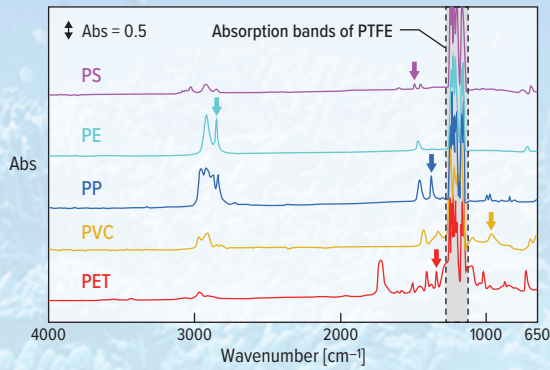
FTIR Spectrometer

FTIR

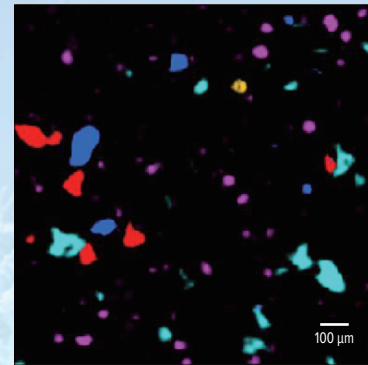
An FTIR spectrometer can be used for the qualitative analysis of microplastics over several hundred micrometers (μm). The measurement results of polyethylene (PE) and polyethylene terephthalate (PET) are shown below.



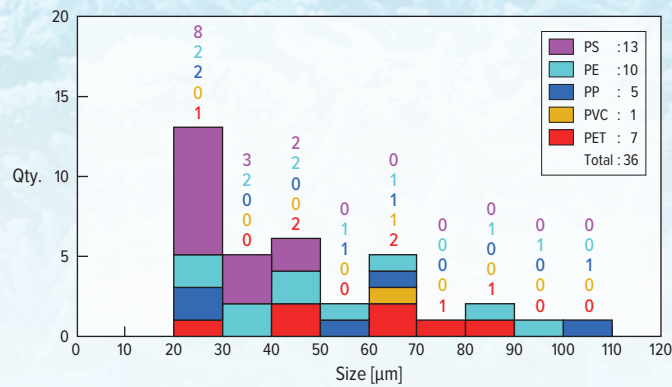
FTIR microscopes can be used to analyze microplastics as small as 5 to 10 μm in length. In addition to qualitative analysis, mapping measurements enable visualization of component distribution, allowing particle size analysis to be performed. The following example presents imaging analysis data for various filtered samples collected using a polytetrafluoroethylene (PTFE) filter, including polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), and polyvinyl chloride (PVC) particles in water.



Averaged spectra of each component



Chemical image (peak height)

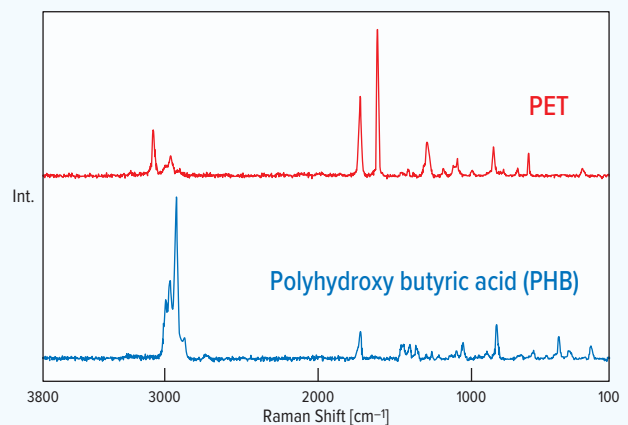
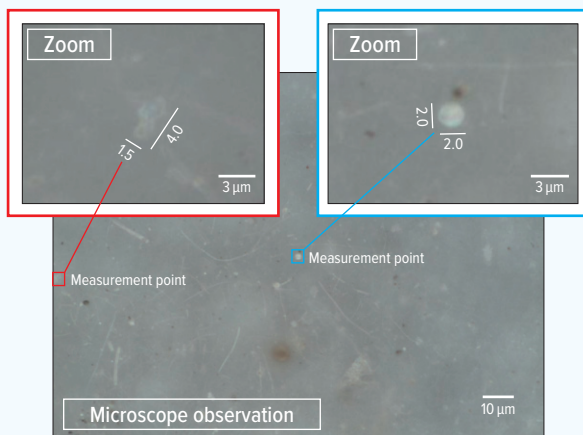


Samples and data were provided by TOSOH Analysis and Research Center Co., Ltd.

Application Data

100-MT-0262

Raman microscopes can be used for microplastics sample analysis at the sub-micron scale. In addition to qualitative analysis, mapping measurements enable visualization of component distribution, allowing particle size analysis to be performed, similar to FTIR microscopes. The following section presents the results of our measurements of Airborne Microplastics (AMPs).



Measurement results of airborne microplastics (AMPs)

Samples were provided by Prof. Okochi of Waseda University.

Application Data

100-AN-0031

Macro Analysis of Microplastics

Microplastics ranging from several mm down to several hundred μm can be readily analyzed using the FTIR-ATR method. ATR is a contact-based sampling technique that utilizes reflection measurements in FTIR spectroscopy.

Fourier Transform Infrared Spectrometer (FTIR)

The FT/IR-4X is a powerful mid-infrared (mid-IR) FTIR spectrometer that incorporates many features typically found in research-grade instruments. It delivers high resolution, excellent signal-to-noise (S/N), and high sensitivity, enabling accurate and reliable analytical measurements across a wide range of applications.



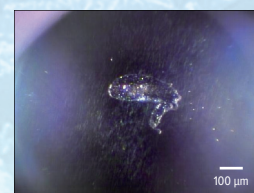
FT/IR-4X with ATR PRO 4X VIEW

ATR PRO 4X VIEW / ATR PRO ONE X VIEW

The ATR PRO 4X VIEW and ATR PRO ONE X VIEW are advanced ATR accessories designed for FTIR measurements that allow users to observe the sample surface directly through the ATR crystal during analysis. This integrated observation capability helps confirm proper sample contact conditions, even for samples with thicknesses on the order of several hundred μm , enabling efficient measurement while simultaneously capturing both images and spectra of samples in close contact with the ATR crystal. The images and spectra can be saved together in a single file for streamlined data management.



ATR PRO 4X VIEW and
ATR PRO ONE X VIEW



Observation image of PP in
close contact with ATR crystal

FTIR

Application Data

030-AT-0275

USB Microscope Kit

The USB Microscope Kit is a complete solution for microscopic observation when used with the FT/IR-4X spectrometer. When integrated with an ATR accessory, it provides a live observation view of the sample positioned on top of the ATR crystal prior to measurement. Both visual observation data and spectral data can be stored within the same file, enhancing documentation and analysis workflow. Even very small samples can be properly positioned on the ATR crystal for measurement by using the USB microscope to monitor the sample in real time during sample setting.

* The USB Microscope Kit requires the ATR PRO 4X, ATR PRO 4X VIEW, ATR PRO ONE X, or the ATR PRO ONE X VIEW.



FT/IR-4X with USB Microscope

FTIR

SWITCH with EASE
between

USB
microscope

**IMAGE
ACQUISITION**

&

ATR

MEASUREMENT

USB microscope
**IMAGE
ACQUISITION**



ATR
MEASUREMENT



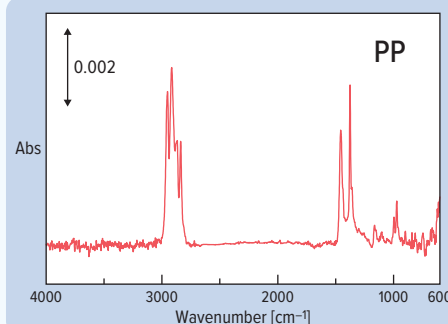
USB microscope image

Measurement spectrum

ATR close-up image*

**SAVE
in 1 FILE**

* An observation image of sample in contact with the ATR crystal can be obtained using the ATR PRO 4X VIEW or the ATR PRO ONE X VIEW.



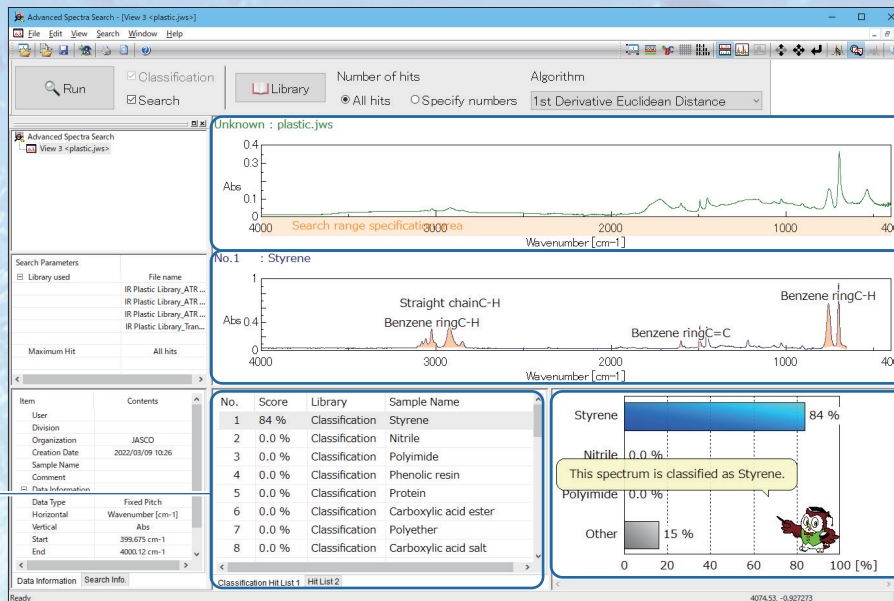
Sample: Microplastics collected from lake water

Samples were provided by e-kagaku Biwako Environment Project 2021 (SEP2021).

Application Data

030-AT-0275

The Advanced Spectra Search program has two primary functions, "Classification" and "Spectra Search", designed to support fast, accurate, and user-friendly spectral analysis for the identification of unknown samples. The "Classification" function classifies sample spectra into one of 39 categories based on the machine-learning results from analyzing approximately 10,000 spectra and highlights key spectral bands, allowing users to visually confirm the validity of the results. The "Spectra Search" function enables comparison against a spectral library containing approximately 600 reference spectra.



1 Measured spectrum

Easy to compare with 2

2 Reference spectrum

A reference spectrum of the selected category

3 Result list

Score and sample name are displayed

4 Advice function

Provides support to understand the result

Some microplastics undergo degradation in certain environmental conditions, which may cause spectral changes that can lead to incorrect search results during a traditional spectrum library search. In contrast, the "Classification" function remains effective under these environmental conditions because it focuses on key bands in the spectrum that are not affected by the degradation. The Advanced Spectra Search software provides a powerful tool for analyzing microplastics across a wide range of compound types and environmental conditions.

Application Data

280-AN-0274

IR Plastics Library

The IR Plastics Library is a dedicated microplastics reference library containing 39 material types consisting of 153 IR spectra. This specialized library improves identification accuracy during spectral searches by including cellulose and rubber materials commonly encountered in environmental samples to enable differentiation between plastic and non-plastic materials.

IR Plastics Library Classification Categories

Low-density polyethylene, LDPE	High-density polyethylene, HDPE	Polypropylene, PP	Polyvinyl chloride, PVC
Polystyrene, PS	Foamed polystyrene	Polyamide, PA	Polycarbonate, PC
Poly(ethylene terephthalate), PET	Polyester	Polyurethane, PU	Poly(methyl methacrylate), PMMA
Polyvinyl alcohol, PVA	Polyimide	Poly(butylene succinate)-poly(lactic acid) copolymer, PBS-PLA copolymer	Artificial turf
Polytetrafluoroethylene, PTFE	Acrylonitrile butadiene styrene, ABS	Epoxy resin, EP	Phenol formaldehyde, PF
Polyethersulfone, PES	Polyetherimide, PEI	Polyphenylene sulfide, PPS	Polybutylene terephthalate, PBT
Acrylic fiber	Cellulose acetate	Aramid	Cupro, Cuprammonium rayon
Polynosic, Modal	Viscose rayon	Silk	Wool
Cotton	Cellulose	Styrene-butadiene rubber, SBR	Ethylene-propylene rubber
Isobutylene-isoprene rubber, IIR	cis-1,4-Polyisoprene rubber	trans-1,4-Polyisoprene rubber	

Application Data

280-AN-0274

Microplastics Obtained by Filtration

Microplastics smaller than several hundred micrometers (μm) can be analyzed directly on membrane filters using micro-FTIR and micro-Raman spectroscopy. JASCO FTIR microscopes and Raman microscopes enable single-point, multi-point, and imaging measurements at precisely the same location and area between both instruments.

FTIR Microscope

FTIR microscope enables observation and measurement of small samples using its microscope functionality. It supports imaging measurements, chemical image generation, and particle analysis, providing material identification for polymers, such as polyethylene (PE) and polypropylene (PP).



IRT-7X with FT/IR-4X

Raman Microscope

Micro-Raman spectroscopy offers higher spatial resolution compared to micro-FTIR spectroscopy, allowing measurement of microplastics in the micrometer (μm) range that may be difficult to analyze using micro-FTIR spectroscopy by itself. In addition to identifying base polymer materials, Raman microscope can detect additives and pigments.



NRS-4500

VFS-25-1 Filtration Set

FTIR

IRT

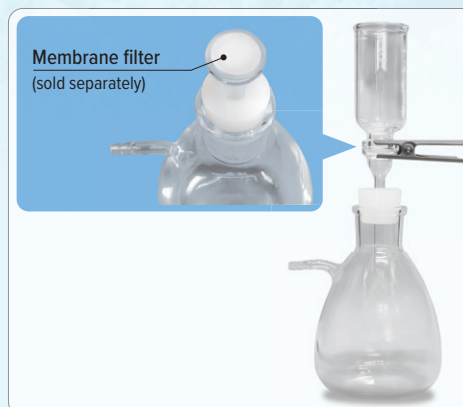
NRS

When the VFS-25-1 Filtration Set is used with a 25 mm diameter membrane filter, microplastics can be collected directly on the filter surface to be analyzed on the micro-FTIR or micro-Raman. Various membrane filter materials and pore sizes are available (sold separately).

* Aspirator or dry scroll pump is required separately.

Lineup of membrane filter

No.	Material	Pore size
1	P T F E	10 μm
2	P T F E	5 μm
3	P T F E	1 μm
4	Alumina	0.2 μm



Membrane filter (sold separately)

Filtration set

Application Data

110-MT-0271

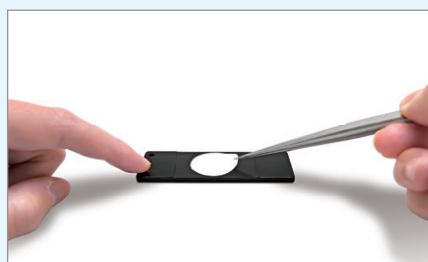
SH02-FH Filter Holder

IRT

NRS

The SH02-FH Filter Holder is a dedicated holder designed for 25 mm diameter membrane filters. It can be mounted on the SH02 Sharing Holder Plate to be used with both the micro-FTIR and micro-Raman.

* SH02 Sharing Holder Plate, SH02-IR Sharing Holder & iQ Frame for IR or SH02-RM Sharing Holder & iQ Frame for Raman is required.



Set the membrane filter.



Fix with the plate cover.



Set on the holder.

Application Data

030-MT-0276

030-AN-0040

Candidate measurement positions are automatically recognized in real time and can be registered as measurement positions. Measurement positions can be targeted by setting search parameters based on characteristics, such as size, shape, color*, and contrast. The acquired spectra are matched against JASCO's original database, and the identified substances are displayed on the observation image.

* Only the micro-Raman can narrow down the number of measurement points.

NARROW DOWN THE MEASUREMENT POINTS

TARGETING by

SIZE

AUTOMATIC RECOGNITION

SIZE **SMALL** ●---Detection parts

TARGETING by

COLOR*

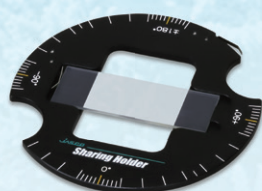
AUTOMATIC RECOGNITION

COLOR **RED** ●---Detection parts

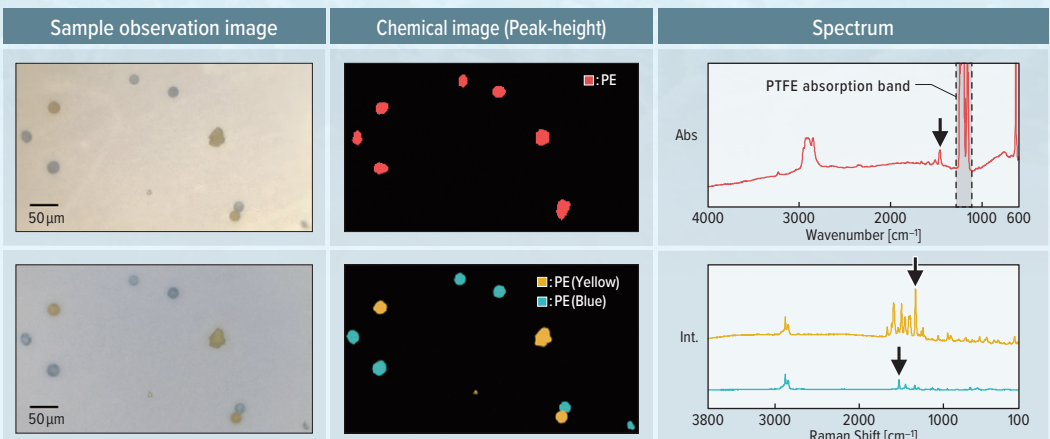
Real-time component identification

Application Data

260-AN-0018

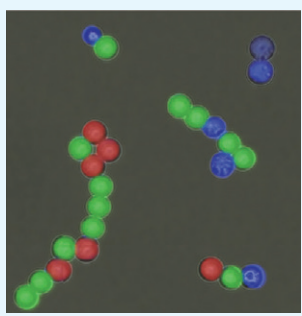


The iQ Frame enables precise measurement of the same microscopic region using both IR and Raman spectroscopy. As these techniques provide complementary molecular information, combining both methods allows for a more comprehensive and reliable analysis. By integrating IR and Raman measurements at the exact same location, the iQ Frame delivers enhanced, multidimensional analytical results.



Example of composite analysis of IR and Raman by the iQ Frame.

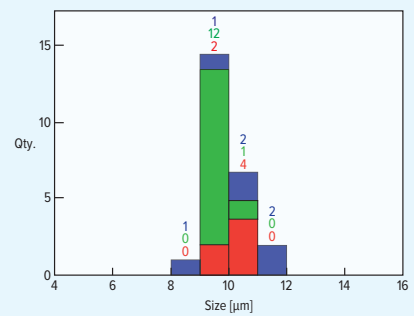
The JASCO Particle Analysis program enables the acquisition of particle shape and color information from sample observation images and color maps. Based on the collected data, stacked histograms, frequency tables, correlation graphs, and component ratios can be generated for each component, providing a powerful, compact way to illustrate the composition, distribution, or frequency of a dataset.



Measurement result

No.	Image	Centroid-X	Centroid-Y	Size
1		9.8	8.2	10.482
2		16.2	15.2	9.480
3		102.6	17.3	9.364
4		26.7	30.7	9.667
5		39.4	40.4	9.648
6		42.1	50.0	9.641

Search parameter results for each particle



Stacked histogram



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