ITEM OPPORTUNITY SYNOPSIS

Name of the item to be scouted: Laser Direct Infrared (LDIR) Chemical Imaging System

State item to be used in: Florida

Describe the Item:

Please describe the item application/the end use of item. Chemical Imaging System with Nitrogen generator comparable to Agilent 8700 LDIR manufactured in Australia.

Supplier Information:

Type of Supplier being sought (select from list below)

Manufacturer

Contract Manufacturer

Distributor

Other (please specify)

Reason for scouting submission (select from list below)

2nd Supplier

Price

Re-Shore

Past supplier no longer available

New Product Startup

BABA

Other (please specify)

Summary of Technical Specifications and Performance Requirements:

Describe the manufacturing processes (elaborate to provide as much detail as possible). Electro-mechanical assembly

Provide dimensions / size / tolerances / performance specifications of the item. • Perform microplastic polymer identification, particle size measurements and particle count. within one system to eliminate the need for external data processing. • Detect microplastic particles in water, sediments, and biotic tissue sample medium. • Process samples without damage. • Be capable of analyzing particles from 10 µm - 5000 µm. •

Obtain single particle spectra in 1-2 seconds, instead of 30-60 seconds, such that data for a 10mm x 10mm area can be acquired within <5 minutes at a 5 µm pixel size. • No required liquid nitrogen.

List required materials needed to make the product, including materials of product components, if applicable. unknown

Are there applicable certification requirements?

Yes

No

Please Explain:

Are there any applicable regulations that apply to the production of this item?

Yes

No

Please Explain:

Are there any other standards, requirements?

Yes

No

Please Explain:

Additional Comments:

Additional technical comments:

Volume and Pricing:

Estimated Potential Business Volume (i.e. #Units per day, month, year): One-time Purchase of equipment.

Estimated Target Price / Unit Cost Information: $309,039.18

Delivery Requirements:

When is it needed by? (Immediate, 30 days, 6 months, etc) 1 Month

Describe packaging requirements (i.e., individually/ group packaging). N/A

Where will this item be shipped? Gulf Breeze, Florida

Additional Comments:

Is there other information you would like to include? Vendor/company must be registered or will register in SAM.gov (https://sam.gov/content/home). This inquiry does not guarantee award of a contract. EPA requires a commercial off the shelf instrument that is immediately available that meets the technical specifications attached. Vendors shall provide documentation that their proposed product meets or exceeds the technical specifications attached.

Agilent Technologies

Quotation

Cheryl Hankins
US Environmental Protection Agency
1 Sabine Island Dr
GULF BREEZE FL 32561-5239

Quote No.	Create Date	Delivery Time	Page
4410835	06/22/2023	13 Weeks	1 of 4

Contact	Phone no.	Valid to
Edwin Quintana	9544947254	09/20/2023

To place an order: Visit **www.agilent.com/store** to place online order using a purchase order or credit card and track your order status.

Product	Email	FAX
Consumables	cag_sales-NA@agilent.com	302-633-8901
Genomics	orders@agilent.com	512-321-3128
Pathology	customer.service@agilent.com	800-566-3256
Instruments	Lscainstrumentsales@agilent.com	302-633-8953

1-800-227-9770 Option 1

Item	Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
1000	**M7301AA**	1.000 EA	**383,634.00 USD**	**95,908.50-**	**287,725.50**

Agilent 8700 LDIR Chemical Imaging System microplastics bundle with HP PC with Clarity SW, monitor, and sample presentation kits.

With the following configuration:
Ship-to Country : USA
Installation (44K)
Introduction (44L)

Item not included on Federal Supply Schedule Contract.

Special discount of 25.00 % is applied.

2000	**NON AGILENT PROD**	1.000 EA	**18,313.68 USD**		**18,313.68**

Non Agilent Product

Peak Scientific Solaris Nitrogen Generator(P/N: 65-0001) and Solaris Air Compressor(P/N: 65-0004).

Item not included on Federal Supply Schedule Contract.

Please note that above product Non Agilent Product is not manufactured by
Agilent Technologies which hereby disclaims any liability for the performance,
quality, reliability or delivery of the items. The standard warranty,INCLUDING INDEMNIFICATION FOR INTELLECTUAL

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
4410835	06/22/2023	13 Weeks	2 of 4

Contact	Phone no.	Valid to
Edwin Quintana	9544947254	09/20/2023

To place an order: Visit **www.agilent.com/store** to place online order using a purchase order or credit card and track your order status.

Product	Email	FAX
Consumables	cag_sales-NA@agilent.com	302-633-8901
Genomics	orders@agilent.com	512-321-3128
Pathology	customer.service@agilent.com	800-566-3256
Instruments	Lscainstrumentsales@agilent.com	302-633-8953

1-800-227-9770 Option 1

Cheryl Hankins
US Environmental Protection Agency
1 Sabine Island Dr
GULF BREEZE FL 32561-5239

Item	Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price

PROPERTY INFRINGEMENT, is to be supplied by manufacturer unless otherwise specified on the Agilent Technologies quotation.

Gross Amount	: $		401,947.68
Total Discount	: $		95,908.50
Net Amount	: $		306,039.18
Shipping	: $		3,000.00
Total	**: $**		**309,039.18**

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
4410835	06/22/2023	13 Weeks	3 of 4

Contact	Phone no.	Valid to
Edwin Quintana	9544947254	09/20/2023

Cheryl Hankins
US Environmental Protection Agency
1 Sabine Island Dr
GULF BREEZE FL 32561-5239

To place an order: Visit **www.agilent.com/store** to place online order using a purchase order or credit card and track your order status.

Product	Email	FAX
Consumables	cag_sales-NA@agilent.com	302-633-8901
Genomics	orders@agilent.com	512-321-3128
Pathology	customer.service@agilent.com	800-566-3256
Instruments	Lscainstrumentsales@agilent.com	302-633-8953

1-800-227-9770 Option 1

Ask about our attractive payment options and how we can help you acquire the latest innovations while minimizing the upfront costs. Contact your Agilent sales representative today or visit us online at **www.agilent.com/en/technology/agilent-financial-solutions** to learn why more and more labs are choosing these flexible payment plans and identify which works best for you.

To place an order: Visit **www.agilent.com/store** to place online orders using a purchase order or credit card and track your order status.

Product	Email	FAX
Consumables	cag_sales-NA@agilent.com	302-633-8901
Genomics	orders@agilent.com	512-321-3128
Pathology	customer.service@agilent.com	800-566-3256
Instruments	Lscainstrumentsales@agilent.com	302-633-8953

1-800-227-9770 Option 1

To place an order, the following information is required:

- Purchase order number or credit card, delivery date, ship to, invoice to, end user, and quote number.
- GSA customers please provide GSA contract #.

EXCLUSIVE OFFERS FOR NEW INSTRUMENT CUSTOMERS, go to **www.agilent.com/chem/exclusiveoffers**

TO CHECK THE STATUS OF AN ORDER:

1) Visit **agilent.com/store** to check the status of your order.
2) Call 1-800-227-9770 (option 1) any weekday between 8 am and 8 pm Eastern time, in the U.S., Canada & Puerto Rico. You will need to know the purchase order or credit card number the order was placed on.

TERMS AND CONDITIONS:

- Pricing: Web prices are provided only for the U.S. in U.S.dollars. All phone prices are in local currency and for end use. Applicable local taxes are applied.
- All Sales Tax is subject to change at the time of order.
- Shipping and Handling Charges: Orders with a value less than $4000 or those requiring special services such as overnight delivery may be subject to additional shipping & handling fees. Some of these charges may be avoided by ordering via the Web
- Payment Terms: Net 30 days from invoice date, subject to credit approval.

* Quotation Validity: This quotation is valid for 90 days unless otherwise indicated.
* Warranty period for instrumentation is 1 year. The Warranty period for columns and consumables is 90 days.

Visit **www.agilent.com/chem**

- For Training course information and registration including e-Seminars, select Education.
- For Literature, Application notes, and other information, select Library.
- For Online Technical Support including the Technical Support Assistant and Frequently Asked Questions, select Technical Support.

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
4410835	06/22/2023	13 Weeks	4 of 4

Contact	Phone no.	Valid to
Edwin Quintana	9544947254	09/20/2023

To place an order: Visit **www.agilent.com/store** to place online order using a purchase order or credit card and track your order status.

Product	Email	FAX
Consumables	cag_sales-NA@agilent.com	302-633-8901
Genomics	orders@agilent.com	512-321-3128
Pathology	customer.service@agilent.com	800-566-3256
Instruments	Lscainstrumentsales@agilent.com	302-633-8953

1-800-227-9770 Option 1

Cheryl Hankins
US Environmental Protection Agency
1 Sabine Island Dr
GULF BREEZE FL 32561-5239

Agilent Technologies is neither a small business concern nor a minority business enterprise.

The quoted prices reflect discounts granted in accordance with GSA Federal Supply Schedule Terms and Conditions. Your order must reference GSA Contract Number GS-07F-0564X and only GSA Terms and Conditions shall apply to your order. Should a GSA approved price increase occur during the quote validity period, this quotation shall remain valid for 30 days from the effective date of the price increase.

The items identified as not on a Federal Supply Schedule are incidental to the order and may be included in the order for ordering convenience per FAR 8.401(d).The GSA contract terms will apply to all such items and the pricing for such items is firm for 90 days from the date of this quotation.

It is Agilent Technologies intent to ship product at the earliest available date unless specified otherwise.

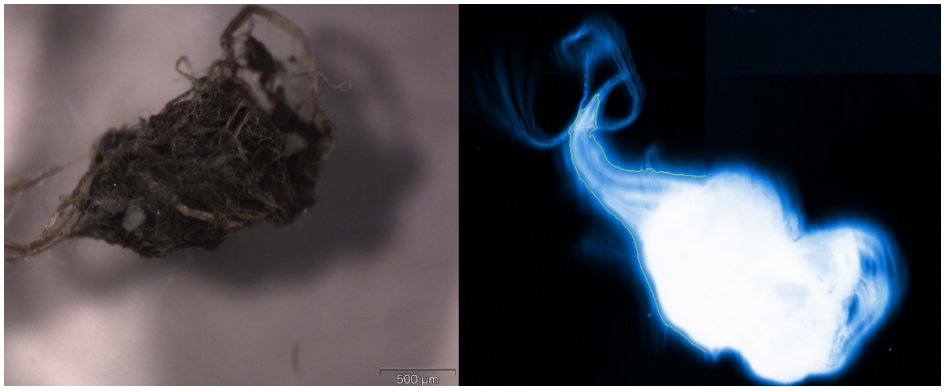
Agilent Payment Method: ACH
Credit card accepted only at the time of order placement.
Agilent will charge 3% of the invoiced amount, when term invoices are paid with a credit card.

Application Note
Environmental
Water analysis

Agilent
Trusted Answers

Fast, Automated Microplastics Analysis Using Laser Direct Chemical Imaging

Characterizing and quantifying microplastics in water samples from marine environments



Authors

Lars Hildebrandt, Fadi El Gareb, Tristan Zimmermann, Ole Klein, Kay-Christian Emeis, Daniel Proefrock[1]
Andreas Kerstan[2]

[1]Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Germany
[2]Agilent Technologies

Introduction

It is estimated that more than 75% of the 8.3 billion metric tons of plastic produced over the last 65 years have turned into waste (*1*). Up to 13 million metric tons of this waste ends up in the ocean every year (*2*) and recent calculations estimate that more than 5.25 trillion plastic particles float in the world's oceans (*3*).

Scientists have demonstrated the alarming environmental ubiquity and persistence of particulate plastic in aquatic ecosystems (*4*). Models predict that approximately 14% of the plastic debris in the ocean surface layer can be classified as so-called microplastics (often referred to as particles between 1 µm and 5 mm in size) (*5*). These ingestible and potentially harmful particles have been formed by UV-induced, mechanical, or biological degradation of larger debris items (*6*). To verify the estimates and to meet upcoming regulatory measures (e.g., California Senate Bill 1422) and directives (MSFD, 2008/56/EC), accurate, time-efficient, and robust analytical workflows and techniques are required.

Suitable techniques should determine the size, shape and polymer type of microplastic particles and provide fast quantification of each type. At the time of writing, a lack of harmonization and standard operation procedures (SOPs) has led many studies to rely on either visual identification, or manual Fourier Transform Infrared (FTIR) or Raman-based analysis of suspected particles. These techniques are very time-consuming and may be prone to operator bias. In this work, we present an innovative microplastics analysis workflow using laser direct infrared imaging.

Experimental

The lack of standard operating procedures for microplastics sample preparation and analysis has resulted in many applied methods that are prone to contamination, not time-efficient, or that only enable processing of non-representative low water volumes (7). Procedures covering all stages of the analytical chain were developed and applied in this study, including sampling, matrix digestion and micro-spectroscopic analysis utilizing LDIR. Extensive contamination prevention measures and deposition controls were undertaken. Procedural blanks were utilized to quantify remaining contamination. All laboratory work was carried out on clean benches (laminar flow cabinets) both in the lab and on board the research vessel. The benches had approximately 99.995% air filtration efficiency for particles larger than 0.1 microns (according to the EN1822 1 standard). Additionally, Dustbox air purifiers[1] were run in all laboratories to filter the air.

Sampling

Samples were collected in the Indian Ocean during the Sonne 270 (2019) cruise from Hong Kong to Port Louis (Figure 1). The area sampled covered a large area of ocean, spanning from a region to the west of Indonesian Sumatra through to an area to the east of Madagascar.

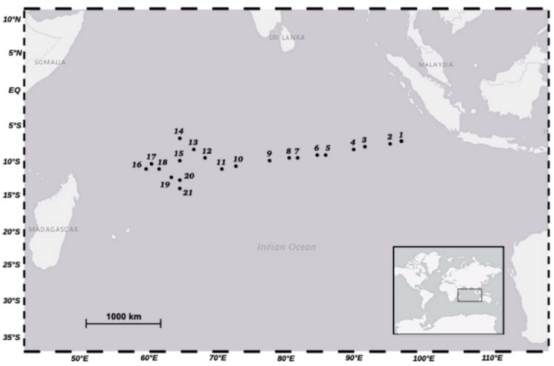


Figure 1. The sampling location stations along the transect in the Indian Ocean.

[1] *www.dustbox.de*

Sampling was conducted utilizing the Geesthacht Inert Microplastic Fractionator (GIMPF), as shown in Figure 2, to filter high volumes of suspended particulate matter (SPM, 10 µm ≤ d_{SPM}) from ocean water. The dual-channel GIMPF enabled online SPM fractionation (by two different mesh sizes of stainless steel cartridge filters) into the size classes > 300 µm and 10 µm ≤ d ≤ 300 µm. The flow-through system was fed with seawater from the ship´s moon pool at 6 m below sea level. The entire sampling system was constructed of stainless-steel parts (AISI-316L) and mounted on an aluminum plate. All seals were PFA-sheathed to minimize risk of contamination by the sampling system. After every sampling location, the system was backflushed over a 2 µm filter on the backside of the GIMPF. Up to 61 m^3 was sampled in total. From the cartridge filters, the samples were vacuum-filtered onto PTFE and PC membranes (5 µm pore size) and stored in amber glass bottles.

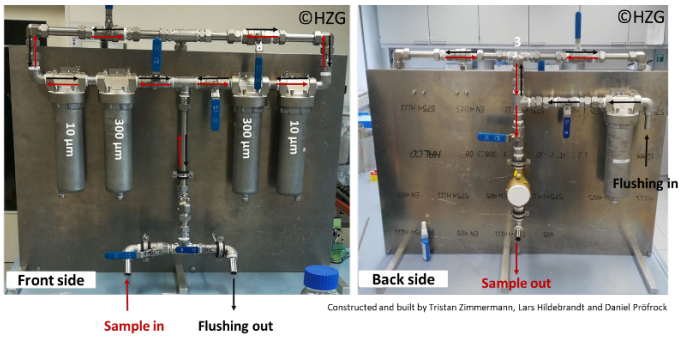


Figure 2. Front and back of the Geesthacht Inert Microplastic Fractionator (GIMPF).

Sample preparation and method validation

All glassware was rinsed three times with Milli Q water and pre-filtered ethanol (30%) before usage. In order to remove interfering natural organic and inorganic matrix constituents, the size fraction with 10 µm ≤ d ≤ 300 µm was subjected to an enzymatic and oxidative digestion protocol. Briefly summarized, the samples were treated with Proteinase K, H_2O_2 in conjunction with Fe^{2+} catalyst and chitinase (Figure 3) followed by density separation using $ZnCl_2$ solution (ρ = 1.7 g mL^{-1}).

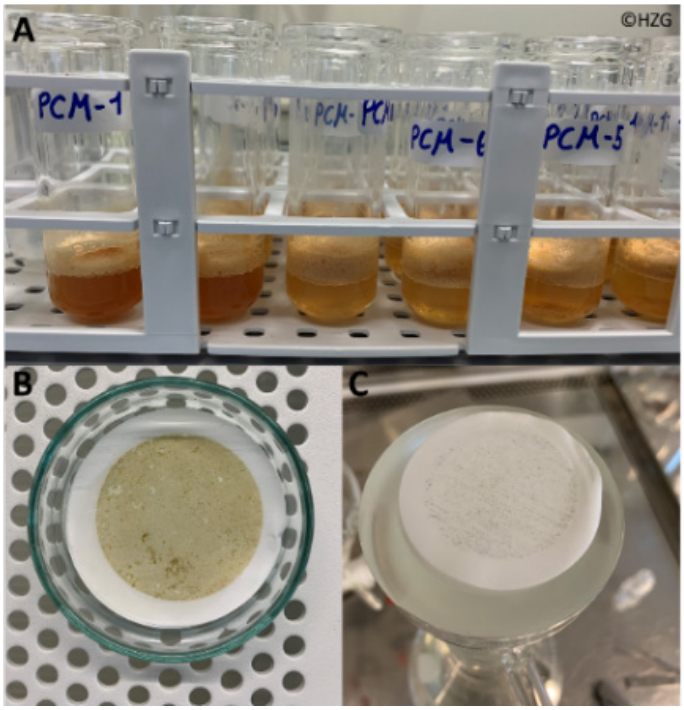


Figure 3. Enzymatic and oxidative digestion. **A**: Catalytic decomposition of remaining H_2O_2 by Fe^{2+}. **B**: Sample before matrix digestion (on a PTFE membrane). **C**: Sample after matrix digestion.

Instrumentation

To identify and quantify microplastics in the samples, an Agilent 8700 LDIR Chemical Imaging System was used. The LDIR, a name derived from its mode of operation, laser direct infrared imaging, utilizes a Quantum Cascade Laser (QCL) as the source. The QCL is a semi-conductor-based laser in which electrons tunnel through a series of quantum wells and emit light, allowing it to be rapidly tuned through the wavenumber (λ^{-1}) range, in this case 1800 cm^{-1} to 975 cm^{-1}. When combined with a single-point mercury cadmium telluride (MCT) detector (thermometrically cooled) and rapid scanning optics, two useful modes of action arise. In the first, the LDIR selects a single wavelength and scans through the objective as it moves over the sample at a very high speed. In the second mode, the objective is parked at a single point, while the QCL sweeps through the range, obtaining a full spectrum in less than one second.

The microplastics analysis workflow utilized both modes. The scanning mode was first used to rapidly scan the sample area at a single wavenumber. The resulting IR image was used to both locate particles in the sample and describe their size and shape. Once located, the LDIR then rapidly and automatically moved to each particle and acquired a full spectrum in the covered range. Once a spectrum was acquired from a particle, it was immediately, and in real-time, compared to a microplastics spectral library. The best fit match for the spectrum was determined and reported for each particle. The library was derived from well-established sources and included a range of spectra relevant to the analysis of microplastics in marine water derived samples.

The instrument utilized a large field of view camera to obtain an entire view of the sample and a microscope-grade objective to capture high magnification visual images as needed. Fully automated analysis of 800 particles and comparison of the generated spectra to the database took about 1 hour to complete.

Sample analysis

Purified samples (< 300 µm) were suspended in ethanol (50%) and deposited on infrared reflective glass slides (7.5 × 2.5 cm; MirrIR, Kevley Technologies). The glass slides were analyzed in transflection by automated LDIR (QCL) Imaging (8700 LDIR, Agilent Technologies). The automated particle analysis protocol within the Agilent Clarity software (version 1.1.2) that operates the LIDR was used for all analysis. Sensitivity was set to the maximum and the spectral resolution to 8 cm^{-1}. Particles in the size range 20 - 5000 µm were analyzed, but can be extended down to approximately 10 µm in the automated mode.

The automated workflow within the Agilent Clarity software acquires IR spectra from each particle and, in real-time, conducts the spectral database comparison (> 420 reference spectra) and data processing. The statistics as well as the thresholds for a positive assignment were adapted according to the analysis. After running the automated workflow, the results were manually checked in transflection mode and partially by means of the LDIR's µ-ATR function.

Potential microplastics particles and fibers with *d* >300 µm were analyzed by ATR-FTIR spectroscopy (on a diamond or germanium crystal) and also by the LDIR using both transflection mode and its µ-ATR unit. The ATR-FTIR spectra were compared to the siMPle database (https://simple-plastics.eu). However, the fraction >300 µm will not be discussed in detail in this note.

Method validation

As yet, there are no certified reference materials of microplastics available on the market. Thus, validation was conducted by means of in-house reference PE, PET, PP and PVDC particles (20 - 500 µm) (*7*). More than 95% of the particles were correctly identified using the workflow described above. A matrix-matched certified reference material (Plankton, BCR-414, JRC) was also analyzed (Figure 4). Both analyses were used to extend the spectral library of the LDIR 8700, with IR spectra of natural and anthropogenic particles being added.

Figure 4. False-color IR image and polymer type statistics of reference certified reference plankton material (BCR-414) derived from automated LDIR analysis workflow.

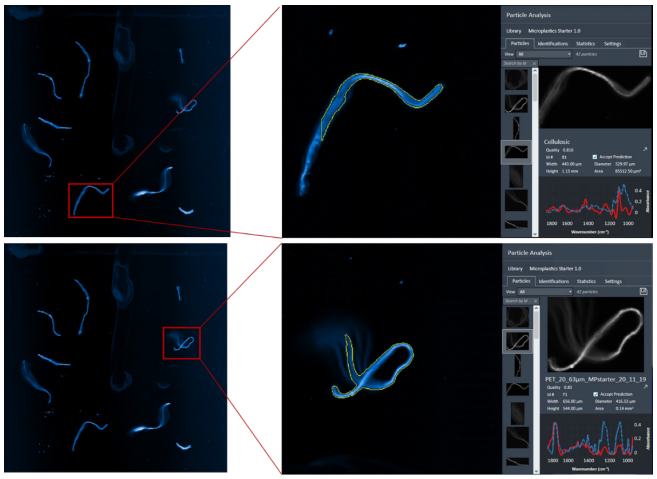


Figure 6. These fibers, > 300 µm, were identified to be cellulosic (upper image; containing indigo dye confirmed by Raman analysis), PET (lower image) and PP (not shown). There was 100% agreement between ATR-FTIR spectroscopy and LDIR Imaging for these fibers.

Results and discussion

Microplastic concentrations (>20 µm) for the sampling locations 1 - 7 ranged from 10 to 226 particles/fibers m^{-3} (Table 1). 30,471 natural, 635 synthetic particles and 14 different polymer clusters were identified in the 7 samples. The most abundant polymer clusters were acrylates/polyurethanes/varnish (39.2%) PET (26.0%), PE-Cl (7.1%), PVC (6.0%), PE (5.2%), PP (5.2%) and rubber (4.3%). 94.9% of the microplastics particles/fibers had a diameter <100 µm (Figure 5).

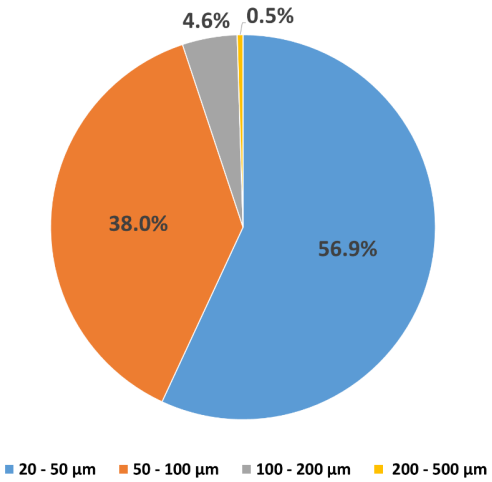


Figure 5. Percentages of the different size classes of the identified microplastic particles/fibers.

Even after almost complete matrix removal, 97.4% of the identified particles had a natural origin (cellulosic, silicate, coal, chitin and natural polyamide IR spectra), whereas only 2.6% were assigned to synthetic polymer types (Figure 7). Domogalla-Urbansky *et al.* (2018) describe microplastics particle / natural particles ratios between 1:100 and 1:1000 (also after sample preparation) (*8*).

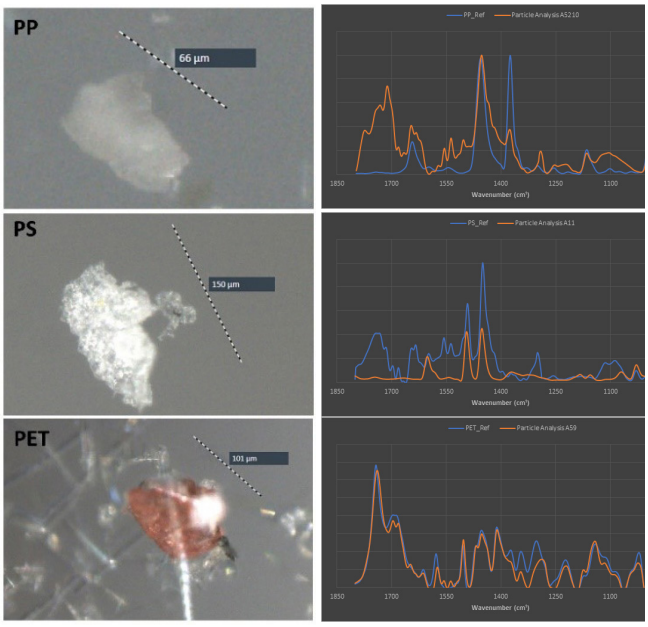


Figure 7. Different types of microplastics detected in water samples (<300 µm) from the Indian Ocean. The polypropylene (top) and polystyrene (middle) spectra were manually recorded, whereas the polyethylene terephthalate (bottom) spectrum was from the automated analysis.

Table 1. The filtered volume, sample location and the number of microplastics detected for each station. The most abundant polymer types for each is also listed.

Station	Sampled Volume [m³]	Coordinates	Number of Particles/Fibers	Number of Microplastics Particles/Fibers	Most Abundant Microplastics Type (#)	Microplastics Concentration [MPs m-3]
1	2.3	07°17.86'S, 97°45.85'E	3150	47	PET (20)	21
2	5.7	07°33.607'S 95°59.252'E	524	54	PET (32)	10
3	1.1	08°08.165'S 92°05.016'E	2112	67	PP (22)	62
4	1.3	08°20.93'S 90°38.76'E	16687	293	Acrylates/ Polyurethanes/ varnish (116)	226
5	1.3	08°55.25'S 86°45.32'E	2938	109	PET (40)	86
6	1.4	09°06.639'S 85°27.92'E	5110	239	Acrylates/ Polyurethanes/ varnish (69)	165
7	1.4	09°32.11'S 82°34.58'E	857	15	PS (5)	11

In contrast to other studies, where only a percentage of the sample suspension or a small area of filtered sample was analyzed (*9, 10*), the digestion protocol and LDIR imaging of a large microscope slide enabled analysis of each entire sample. This measurement technique reduced the uncertainty introduced by any extrapolation.

As Figure 8 shows, it is important to use spectroscopic particle analysis and not just visual identification, as natural and colorless synthetic particles often have a similar appearance (even for beads).

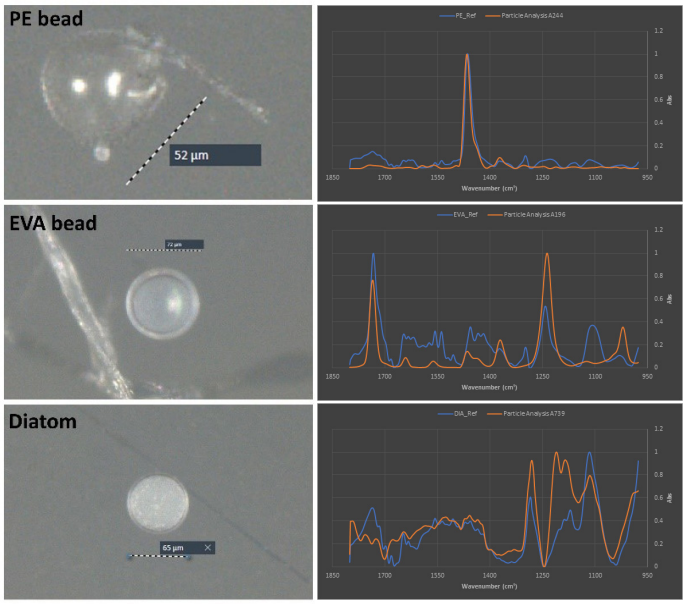


Figure 8. Visual images (left) and IR spectra (compared to the best-fit library spectrum) of two microplastic beads (PE and EVA). The lower image shows a diatom identified by LDIR analysis in the samples.

Figure 9 shows an example of how microplastic particles can be attached to natural particles e.g. diatoms. In this case, the LDIR's µ-ATR function was used to verify the polymer type (very good agreement with library spectrum). It was even possible to position the crystal directly on the particle attached to the diatom to cross check the result of the automated analysis.

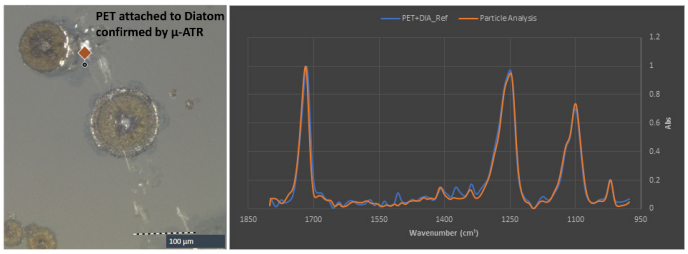


Figure 9. Visual images (left) and µ-ATR-IR spectrum (compared to the best-fit library spectrum) of a PET particle (indicated by the orange marker), attached to a diatom.

Based on a elongation factor (aspect ratio) of 3 (11), the majority of the microplastics were identified as fragments and not microfibers. Fiber recognition is quite challenging—especially for single-point imaging-based approaches, but LDIR Imaging can easily identify fibers (as shown in Figure 6) in environmental samples.

There is scientific consensus on the problem of measurement contamination due to airborne fibers (12). Consequently, the strict use of clean benches might explain the lower share of microfibers compared to other studies.

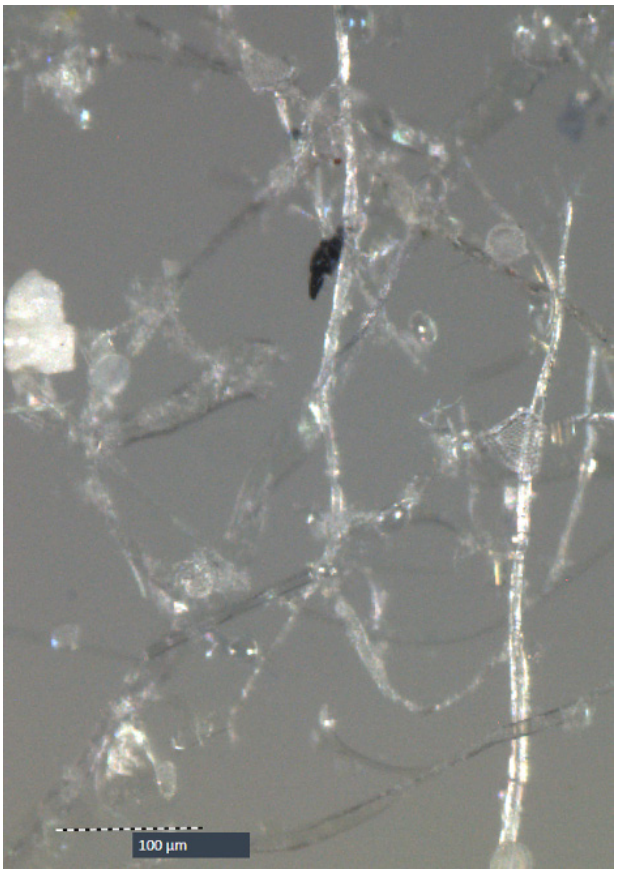


Figure 10. Visual image of an aggregate of the cellulose fibers and natural particles recorded by the LDIR.

To analyze entangled fibers (for included polymers) as well as particle aggregates (Figure 10), the manual single-peak (Figure 11) or hyperspectral imaging functions of the LDIR were applied.

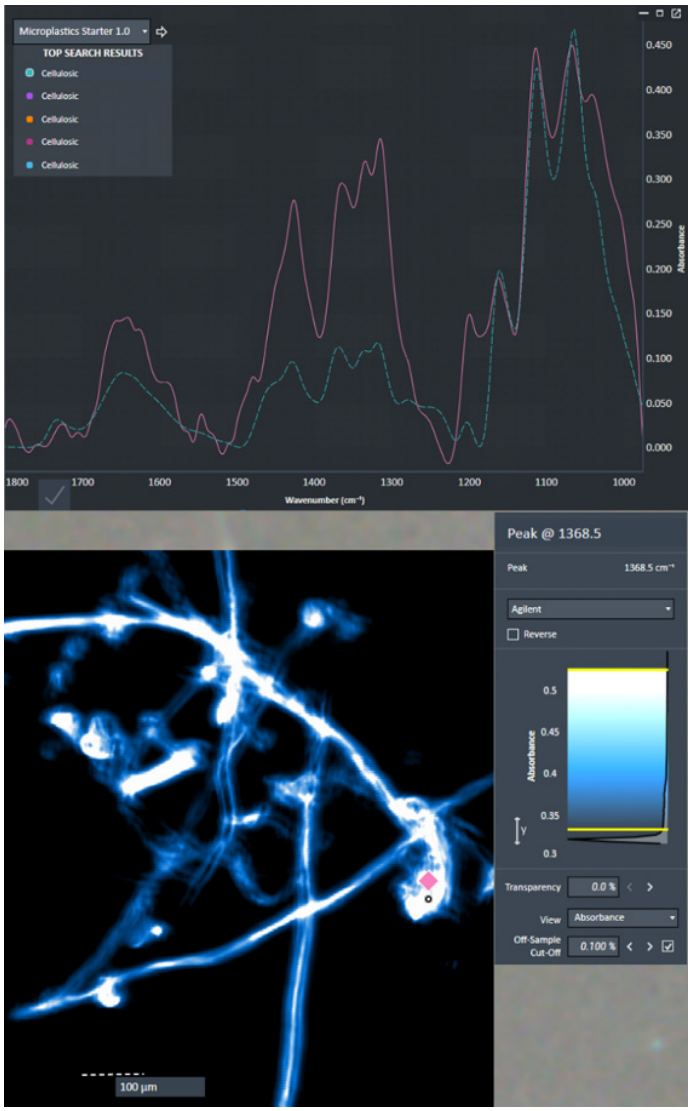


Figure 11. The IR single peak image at $\tilde{\nu}$ = 1368.5 cm^{-1} (lower, right) and IR spectrum (upper) of the aggregate of the cellulose fibers and natural particles shown in Figure 10.

Multi-peak analysis, in conjunction with the µ-ATR, proved valuable for particles containing biofilm-populated areas. Figure 12, for instance, shows a large polyurethane (PU) particle that exhibits areas showing clear cellulosic IR spectra and good PU and acrylate spectra. Both were confirmed by manual transflection and µ-ATR analysis. The LDIR enables good spatial differentiation between such different domains of environmental aggregates, but is also useful with respect to particles consisting of polymer blends and composites. Multi-peak can help to identify the different components of such mixtures in environmental microplastics.

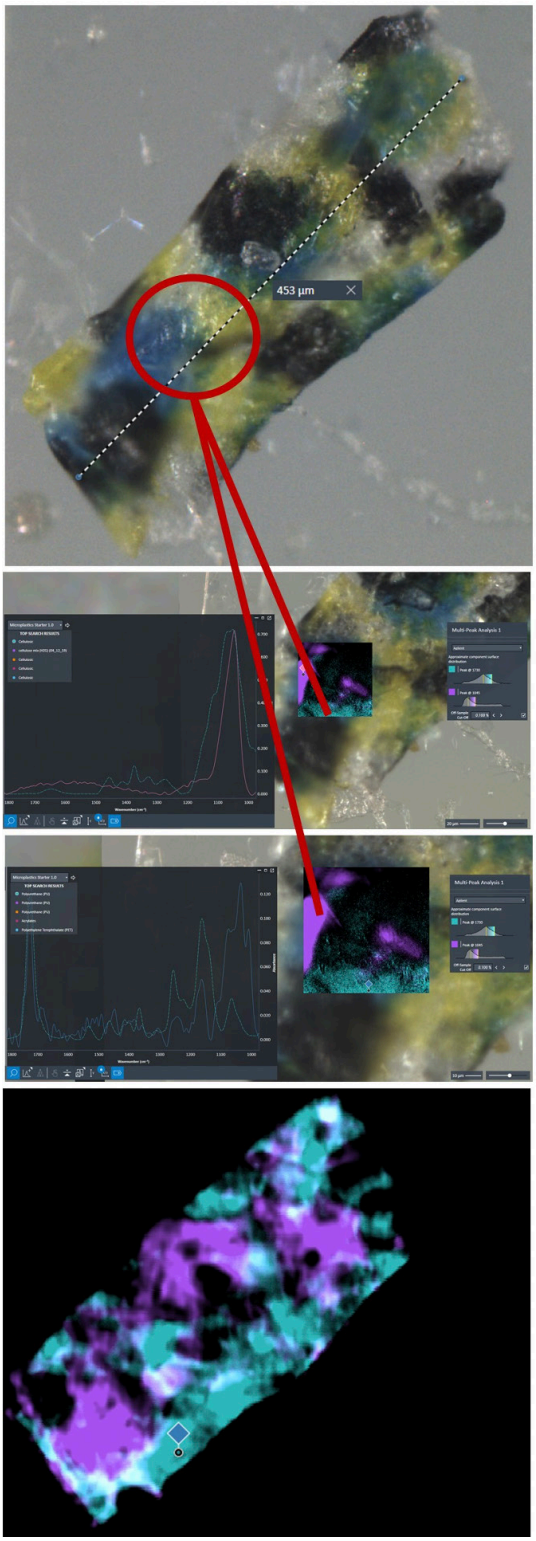


Figure 12. Presumably biofilm-populated PU particle (top) analyzed by multi-peak imaging (bottom) showing strong absorption at $\tilde{\nu}$ = 1045 cm^{-1} and $\tilde{\nu}$ = 1730 cm^{-1} (middle). Violet domains show good agreement with cellulosic reference spectra (2nd picture), whereas turquoise domains correspond to PU and Acrylate spectra (3rd picture).

Comparison to other microplastic studies

Even though inter-study comparison is hampered by the application of different methods (sampling and detection), the reported concentrations (10 - 226 MPs m^{-3}) are well in line with other studies based on either FTIR or Raman micro-spectroscopy. Lorenz *et al.* (2019) found between 0.1 and 245.4 microplastics particles m^{-3} in manta net samples from the southern North Sea (surface water) (9). Enders at al. (2015) detected between 13 and 501 MPs m^{-3} in samples taken with a fractionated filtration device in the Atlantic Ocean (3 m below water line) (*13*). According to modeling and monitoring data, microplastics concentrations in surface water can be up to 30-times higher compared to the water column (*14-16*). Therefore, it is likely that the sampled area exhibits a comparably high particulate plastic contamination, with high concentrations at the sea surface.

Polymer types detected in the study do seem to support this hypothesis. The 2nd (PET), 3rd (PE-Cl) and 4th (PVC) most abundant polymers found in this study have typical densities exceeding the density of seawater (first most abundant acrylates/polyurethanes/varnish can have a larger density spread). It is remarkable that the lower density polymers PE and PP (~ 50% production volume) both make up only 5.2% each of the found microplastics. These polymers remain at the surface until biofouling leads to sinking and transport to the seafloor. However, this hypothesis must be proven in the future by sampling at different depths (depth profiling).

Conclusion

LDIR imaging was successfully used to detect and characterize microplastic particles and fibers in high-volume marine water samples. Results indicated comparably high microplastic contamination.

The results of the automated workflow were thoroughly rechecked by visual inspection, at least 5 manual transflection IR measurements, and partially by µ-ATR IR analysis. For the fraction >300 µm, good agreement was achieved between LDIR imaging, using a well-established microplastics spectral database, and conventional ATR-FTIR analysis. Extension of the database with typical matrix spectra helped to further increase the accuracy of the workflow.

Due to its time-efficiency and high degree of automation, the technique has a great potential to become the micro-spectroscopic method of choice, e.g. during large scale microplastics studies or for monitoring activities, which require fast data provision.

References

1. Geyer, R., J.R. Jambeck, and K.L. Law, *Production, use, and fate of all plastics ever made*. Science Advances, **2017**, 3(7): p. e1700782.
2. Jambeck, J.R., R. Geyer, C. Wilcox, T.R. Siegler, M. Perryman, A. Andrady, R. Narayan, and K.L. Law, *Plastic waste inputs from land into the ocean*. Science, **2015**, 347(6223): p. 768.
3. Eriksen, M., L. Lebreton, H. Carson, M. Thiel, C. Moore, J. Borerro, F. Galgani, P. Ryan, and J. Reisser, *Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea*. PLoS ONE, **2014**, 9.
4. Ivleva, N.P., A.C. Wiesheu, and R. Niessner, *Microplastic in Aquatic Ecosystems*. Angewandte Chemie International Edition, **2017**, 56(7): p. 1720-1739.
5. Koelmans, A., M. Kooi, K. Law, and E. Sebille, *All is not lost: Deriving a top-down mass budget of plastic at sea*. Environmental Research Letters, **2017**, 12.
6. Song, Y.K., S.H. Hong, M. Jang, G.M. Han, S.W. Jung, and W.J. Shim, *Combined Effects of UV Exposure Duration and Mechanical Abrasion on Microplastic Fragmentation by Polymer Type*. Environmental Science & Technology, **2017**, 51(8): p. 4368-4376.
7. Hildebrandt, L., N. Voigt, T. Zimmermann, A. Reese, and D. Proefrock, *Evaluation of continuous flow centrifugation as an alternative technique to sample microplastic from water bodies*. Marine Environmental Research, **2019**, 151: p. 104768.
8. Domogalla-Urbansky, J., P.M. Anger, H. Ferling, F. Rager, A.C. Wiesheu, R. Niessner, N.P. Ivleva, and J. Schwaiger, *Raman microspectroscopic identification of microplastic particles in freshwater bivalves (Unio pictorum) exposed to sewage treatment plant effluents under different exposure scenarios*. Environ Sci Pollut Res Int, **2019**, 26(2): p. 2007-2012.
9. Lorenz, C., L. Roscher, M.S. Meyer, L. Hildebrandt, J. Prume, M.G.J. Löder, S. Primpke, and G. Gerdts, *Spatial distribution of microplastics in sediments and surface waters of the southern North Sea*. Environmental Pollution, **2019**, 252: p. 1719-1729.
10. Domogalla-Urbansky, J., P.M. Anger, H. Ferling, F. Rager, A.C. Wiesheu, R. Niessner, N.P. Ivleva, and J. Schwaiger, *Raman microspectroscopic identification of microplastic particles in freshwater bivalves (Unio pictorum) exposed to sewage treatment plant effluents under different exposure scenarios*. Environmental Science and Pollution Research, **2019**, 26(2): p. 2007-2012.
11. Cole, M., *A novel method for preparing microplastic fibers*. Scientific Reports, **2016**, 6(1): p. 34519.
12. Prata, J.C., J.L. Castro, J.P. da Costa, A.C. Duarte, T. Rocha-Santos, and M. Cerqueira, *The importance of contamination control in airborne fibers and microplastic sampling: Experiences from indoor and outdoor air sampling in Aveiro, Portugal*. Marine Pollution Bulletin, **2020**, 159: p. 111522.
13. Enders, K., R. Lenz, C.A. Stedmon, and T.G. Nielsen, *Abundance, size and polymer composition of marine microplastics ≥10μm in the Atlantic Ocean and their modelled vertical distribution*. Marine Pollution Bulletin, **2015**, 100(1): p. 70-81.
14. Kooi, M., J. Reisser, B. Slat, F.F. Ferrari, M.S. Schmid, S. Cunsolo, R. Brambini, K. Noble, L.-A. Sirks, T.E.W. Linders, R.I. Schoeneich-Argent, and A.A. Koelmans, *The effect of particle properties on the depth profile of buoyant plastics in the ocean*. Scientific Reports, **2016**, 6(1): p. 33882.
15. Brunner, K., T. Kukulka, G. Proskurowski, and K.L. Law, *Passive buoyant tracers in the ocean surface boundary layer: 2. Observations and simulations of microplastic marine debris*. Journal of Geophysical Research: Oceans, **2015**, 120(11): p. 7559-7573.
16. Lenaker, P.L., A.K. Baldwin, S.R. Corsi, S.A. Mason, P.C. Reneau, and J.W. Scott, *Vertical Distribution of Microplastics in the Water Column and Surficial Sediment from the Milwaukee River Basin to Lake Michigan*. Environmental Science & Technology, **2019**, 53(21): p. 12227-12237.

More Information

This application contains a share of ongoing work comprising method development and a large dataset, which are planned to be published in peer-reviewed scientific journal.

www.agilent.com/chem

DE.6083912037

Printed in the USA, October 12, 2020
5994-2421EN

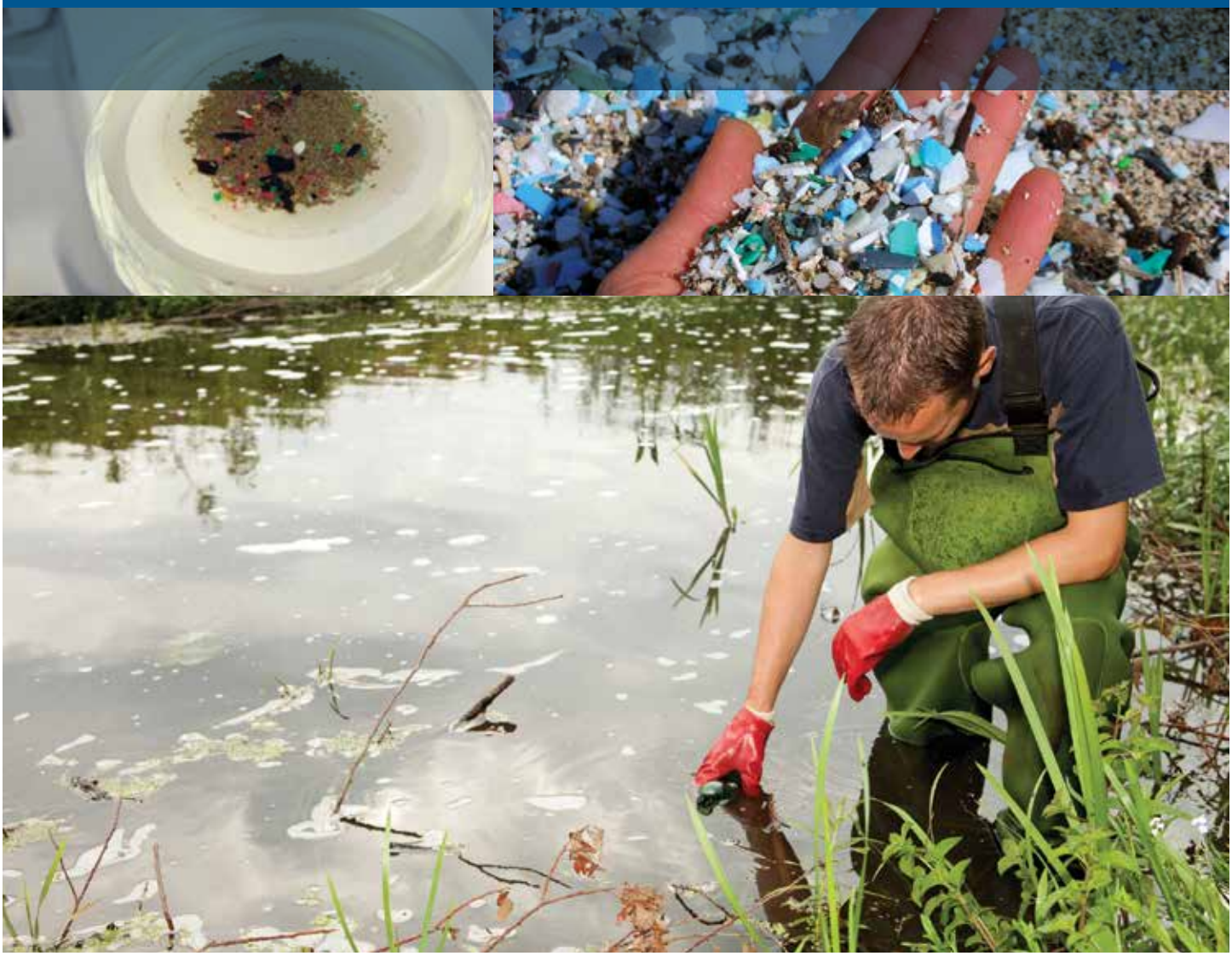
Agilent
Trusted Answers

Agilent

Trusted Answers

Analyzing Microplastics

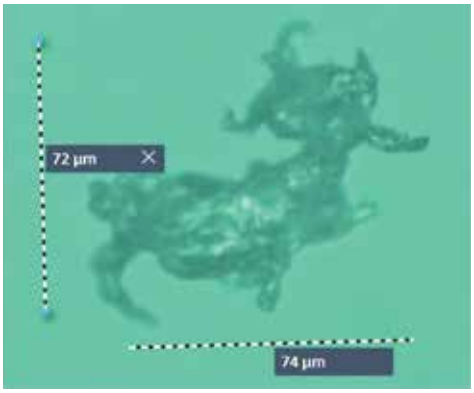
Using the Agilent 8700 Laser Direct Infrared Imaging system for fast and automated analysis of microplastics in environmental samples



Microplastics

Contamination in our waterways, soil, air, and drinking water from microplastics is gaining significant public interest due largely to its emergence as an environmental threat. Researchers are now working towards standardized analytical solutions to best characterize these small particles in terms of chemical identity, size, shape, and total mass.

Organizations such as the National Oceanic and Atmospheric Administration define a microplastic as any particle of a plastic polymer that is less than 5 mm in size. However, it is smaller microplastic particles, less than 100 µm in size, that are often of the most interest. They are not visible to the naked eye and can make their way into the food chain.



Analyzing microplastics

Smaller microplastic particles are most biologically and toxicologically relevant—the smaller the particle, the higher the risk.

Chemically identifying these very small microplastics has typically been done using vibrational spectroscopy. However, this approach is often slow. For example, FTIR point-mapping microscopes require very small apertures for this work. The small aperture degrades the signal-to-noise ratio and each microplastic particle requires more than one minute to analyze. FTIR array microscopes and Raman microscopes are also very slow for this type of analysis.

Identifying and semi-quantifying microplastics down to 10 µm in minutes

The Agilent 8700 Laser Direct Infrared (LDIR) chemical imaging system is a laser-based imaging and spectroscopy technique. It overcomes most of the drawbacks of the techniques used to analyze microplastics. 8700 LDIR uses a Quantum Cascade Laser (QCL), developed by Agilent. When combined with a point detector and rapidly scanning optics, the instrument can obtain the IR spectrum of a microparticle and identify it in seconds.

The 8700 LDIR is a fast automated solution for smaller microplastic identification, size measurement, semi-quantitation and report generation.

LDIR microplastics analysis workflow

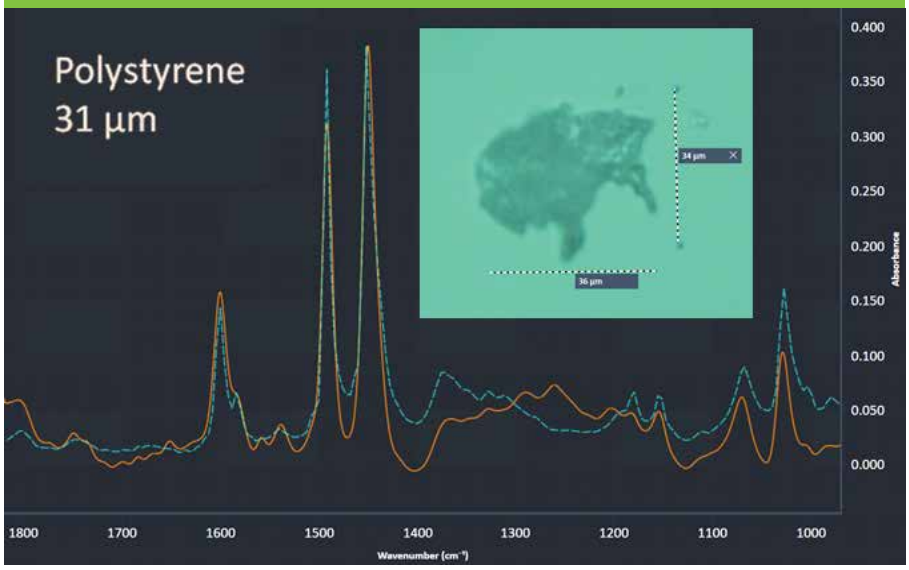
After suitable sample preparation to extract microplastics from a sample, the microplastics are suspended in high purity ethanol. Chemical identification of each microplastic is then done, using the following steps:

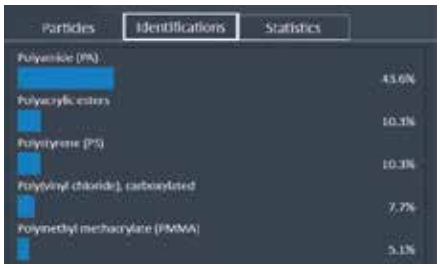
Step 1. Spread the microplastics onto a flat, reflective surface e.g. kevley slide or IR reflective filter.

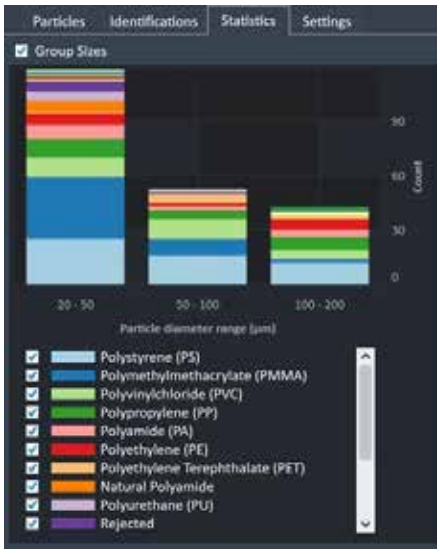
Step 2. Place the slide into the LDIR and close the door. The Agilent Clarity software will automatically start the analysis.

Step 3. The instrument will scan an area using light of a single wavenumber to locate all the particles. It takes only 4 minutes to scan an area 10 x 10 mm at 5 µm pixel size. The instrument then targets the identified particles (appearing as bright spots) and collects an IR spectrum of each one.

Step 4. Each spectrum is then compared against a spectral library to identify the chemical composition of each particle. The LDIR has a high-magnification visible camera to photograph particles. In this case, a polystryene microplastic particle, identified in sewerage.







The 8700 LDIR will report what percentage of the total number of microplastic particles each type of plastic represents (top). It will also report a range of statistics, like the number of particles of each plastic type that fall into different particle size ranges (bottom).

Agilent CrossLab: Real insight, real outcomes

CrossLab goes beyond instrumentation to bring you services, consumables, and lab-wide resource management. So your lab can improve efficiency, optimize operations, increase instrument uptime, develop user skill, and more.

Agilent CrossLab
From Insight to Outcome

Learn more:
www.agilent.com/chem/8700-ldir

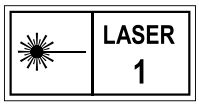
Buy online:
www.agilent.com/chem/store

Get answers to your technical questions and access resources in the Agilent Community:
community.agilent.com

U.S. and Canada
1-800-227-9770
agilent_inquiries@agilent.com

Europe
info_agilent@agilent.com

Asia Pacific
inquiry_lsca@agilent.com



Published in the USA, August 23, 2019
5994-1052EN

Agilent
Trusted Answers

Data Sheet

Agilent

Trusted Answers

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 reimagined 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

1. Jia, W. *et al.* Automated Identification and Quantification of Invisible Microplastics in Agricultural Soils. *Science of The Total Environment* **2022**, *844*, 156853.
2. Samandra, S. *et al.* Microplastic Contamination of an Unconfined Groundwater Aquifer in Victoria, Australia. *Science of The Total Environment* **2022**, *802*, 149727. https://doi.org/https://doi.org/10.1016/j.scitotenv.2021.149727
3. Samandra, S. *et al.* Assessing Exposure of the Australian Population to Microplastics through Bottled Water Consumption. *Science of The Total Environment* **2022**, *837*, 155329. https://doi.org/https://doi.org/10.1016/j.scitotenv.2022.155329
4. Primpke, S. *et al.* Reference Database Design for the Automated Analysis of Microplastic Samples Based on Fourier Transform Infrared (FTIR) Spectroscopy. *Anal. Bioanal. Chem.* **2018**, *410*, 5131, https://doi.org/10.1007/s00216-018-1156-x
5. De Frond, H.; Rubinovitz, R.; Rochman, C.M., μATR-FTIR Spectral Libraries of Plastic Particles (FLOPP and FLOPP-e) for the Analysis of Microplastics. *Anal. Chem*. **2021**, *93(48)*, 15878–15885, https://doi.org/10.1021/acs.analchem.1c02549

www.agilent.com

DE17136349

Printed in the USA, May 10, 2023
5994-5992EN

Agilent
Trusted Answers

MARKET RESEARCH REPORT
August 2023

This report documents the actions taken and the results of market research performed for the subject acquisition. This report meets all requirements for conducting and documenting market research described in FAR 7.102 and FAR Part 10.

I. Description of Requirement

1. Acquisition Information

Title of Acquisition: Agilent 8700 Laser Direct Infrared (LDIR) Chemical Imaging System bundle with HP PC Clarity Software, monitor, sample planer and sample preparation kit with 2 sample holders (1x3 inch)
Program Office: ORD, CEMM, Gulf Ecosystem Measurement & Modeling Division (GEMMD)
Project Officer/COR: Elizabeth Moso
Contracting Officer: TBD
Contract Specialist: TBD
Other Acquisition Planning Team Members: Alternate COR, Jim Harvey, Technical Point of Contact, Cheryl Hankins
Requisition Number (if available): PR-ORD-23-02345
Advanced Procurement Plan Number (if available): APP-ORD-23-00016
Estimated Value including options ($): $309,039.18

2. Description

The purpose of this acquisition is a capital equipment purchase for a LDIR chemical imaging spectrometer to be delivered to the EPA's GEMMD in Gulf Breeze, FL. The system is not a GSA schedule order, though the sole manufacturer of the LDIR (Agilent Technologies) has an active registration in SAM.gov.

3. Performance Requirements

Performance/quality requirements are outlined in the Specifications attached to the PR. Technical capability requirements (performance, specifications, precision and compatibility) are more important than cost and this will be reflected in evaluation of offers.

4. Historical Information

LDIR spectroscopy is a new type of chemical imaging. Currently, the only company to manufacturer a LDIR is Agilent Technologies.

5. NAICS / PSC Code Determinations

NAICS Code Determination - Based on a search of available North American Industry Classification System (NAICS) Codes and considering the guidance at FAR 19.303, the most appropriate NAICS code and title for this acquisition is: 334516

PSC Code Determination - Based on a search of available Product Service Codes (PSC), the most appropriate PSC code and title for this acquisition is AH91.

II. Conducting Market Research

In accordance with FAR Part 10, market research has been conducted for this acquisition. The following techniques were used. *(If a certain technique was not used, state "N/A".)*

1. Knowledge Gathering (FAR 10.002(b)(2)(i))

I had email and in-person conversations with an extramural management specialist and a COR to determine the best way to do market research pricing.

2. Similar Market Research (FAR 10.002(b)(2)(ii))

I had email and phone conversations with researchers using other methods of chemical imaging to determine the type of spectroscopy best suited for GEMMD's research needs. Once determine, I had phone conversations with an EPA researcher currently using this technology.

3. Request for Information (RFI) / Sources Sought Notice (FAR 10.002(b)(2)(iii))

A web-based search concluded that no other manufacturers have LDIR technology. This was confirmed the LDIR EPA researcher.

4. Contract Database Inquiries (FAR 10.002(b)(2)(iv))

The following databases were reviewed for sources and available contract vehicle information *(check as applicable)*:

X	***Mandatory Sources (FAR 8.002)***	*X*	***Optional Sources (FAR 8.004)***
	EPA Strategic Sourcing Vehicles *(First)*	**X**	GSA Federal Supply Schedules
	GSAXcess		GSA Federal Strategic Sourcing Initiative
	Federal Prison Industries, Inc. (UNICOR)		Interagency Contract Directory
	AbilityOne Program		GWAC (GSA, SEWP, NITAAC)
	EPA Recovered Materials Products		Other EPA Contract (Active Contract List)
	USDA Biobased Products		Other EPA Contract (FPDS-NG search)
	Other:		Other:
	Other Mandatory Sources: utilities, printing, leasing vehicles, strategic materials, helium		

5. Communications with Industry (FAR 10.002(b)(2)(v) and (viii))

Agilent Technologies also confirmed that they were the only manufacturer currently using LDIR technology.

6. Source Lists (FAR 10.002(b)(2)(vi)

Agilent is the only company producing this equipment to the best of our knowledge.

7. Published Product/Service Literature (FAR 10.002(b)(2)(vii)

Agilent is the only company producing this equipment to the best of our knowledge. Specification were only acquired for Agilent's 8700 LDIR.

III. Determinations

Commented [HC1]: Did not edit section 1-3- not 100% on what it is saying

As a result of market research conducted as described above, the following determination is made IAW FAR Part 10 policy:

1. Existence of Sources (FAR 10.001(a)(3)(i)

As a result of market research, sources capable of satisfying the agency's requirements do exist, and fulfilling the stated requirement through a procurement action is appropriate.

2. Commercial Item Determination (FAR 10.001(a)(3)(ii)

As a result of market research, and after reviewing the definition of "commercial item" for both supplies and services found in FAR 2.101, it has been determined that *(check one)*:

X	Commercial items or nondevelopmental items are available that could meet the agency's requirements and this acquisition should be conducted as a commercial item acquisition.
	Commercial items or nondevelopmental items are available that, *if modified*, could meet the agency's requirements and this acquisition should be conducted as a commercial item acquisition.
	Commercial items or nondevelopmental items are available that, if the agency's requirements were reasonably modified, could meet the agency's requirements and this acquisition should be conducted as a commercial item acquisition.
	Commercial items or nondevelopmental items are not available to meet the agency's requirements despite possible modifications, and this acquisition should be conducted as a noncommercial item acquisition.

3. Commercial Item Components / Subcontracts (FAR 10.001(a)(3)(iii)

As a result of market research, and after reviewing the definition of "commercial item" for both supplies and services found in FAR 2.101, the contracting officer has determined that *(check one)*:

X	Commercial items or nondevelopmental items are likely available to be used as system components and/or subcontracts to meet the agency's requirements under this acquisition.
	Commercial items or nondevelopmental items are not likely available to be used as system components and/or subcontracts to meet the agency's requirements under this acquisition.

4. Industry Practices and Considerations (FAR 10.001(a)(3)(iv)

As a result of market research, the following industry practices and considerations will exist for this requirement: The instrument is available through GSA vendors. GSA Advantage was used

to determine a fair and reasonable price for the instrument.

5. Sustainability Factors (FAR 10.001(a)(3)(v)

As a result of market research, and after reviewing the requirements for sustainable acquisitions in FAR Part 23, it is anticipated the following sustainability factors will apply to this requirement *(check all that apply)*:

	This requirement can be acquired as energy-efficient (e.g., ENERGY STAR).
	This requirement can be acquired as water-efficient.
	This requirement can be acquired as biobased.
	This requirement can be acquired as environmentally preferable (e.g., EPEAT).
	This requirement can be acquired as non-ozone depleting.
	This requirement can be acquired as made with recovered materials.
x	This requirement cannot be acquired with any sustainable attributes.

6. Contract Bundling (FAR 10.001(a)(3)(vi)

As a result of market research, and after reviewing the definition of "bundling" found in FAR 2.101, it is determined that *(check one)*:

X	This is not a bundled requirement.
	This is a bundled requirement. Bundling is necessary and justified (see FAR 19.202-1).

7. E&IT Accessibility

As a result of market research, and after reviewing the requirements for electronic and information technology (E&IT) accessibility requirements in FAR 39.2, *(check one)*:

	E&IT to be acquired will meet federal accessibility requirements.
	E&IT to be acquired cannot meet one or more federal accessibility requirements.
X	There is an exception to accessibility requirements for E&IT to be acquired.
	This acquisition includes no E&IT.

IV. Potential Sources

As a result of market research, the following list of vendors have been identified as providing the required supplies or services and appear capable of fulfilling this requirement. (*List potential*

sources and identify their size and socio-economic status. Add additional rows and include additional documentation as necessary.)

		Size		Socio-Economic Status					
Contractor	**DUNS**	**Large**	**Small**	**8(a)**	**SDB**	**HUBZone**	**SDVOSB**	**WOSB**	**EDWOSB**
Agilent Technologies, Inc.									

V. Conclusions and Recommendations

Based on the documentation above, it has been determined that the instrument can be obtained through GSA using FAR Part 8, Required Sources and FAR Part 13, Simplified Acquisition Procedures. The known potential sources are both small and large businesses. This procurement will not be set aside for small business because only one known source is a small business. Therefore, the procurement will be solicited through GSA eBuy as full and open.

Salient Characteristics for GEMMD Laser Direct Infrared (LDIR) Chemical Imaging System

Plastics are a world-wide pollution problem. In our Oceans, plastics break down into smaller plastic fragments and eventually become microplastic particles. The adverse effects of these particles are not well known on marine life such as fish, and corals. Because of the small size and varying composition of the microplastics, detection technologies have not been able to characterize and enumerate different types (composition) of these microplastic particles. LDIR is a new technique for IR spectroscopy. It combines a tunable quantum cascade laser (QCL) as the IR source with rapidly scanning optics. LDIR is more advanced than other microplastics imaging systems such as GC/MS, Fourier transform infrared (FTIR), and Ramen. Many of these alternative imaging techniques have a range of downsides due to limitations of instruments and methods which include destruction of samples, increased time of analysis, increased data output and processing time, lack of particle total mass measurement, high cost of systems, and required use of liquid nitrogen. The GEMMD Coral Laboratory research team requires an LDIR system to rapidly provide automated analysis of microplastic particles in environmental samples of water, sediments, and biotic tissues. The purchase of the LDIR system will enable key functions of analysis for microplastic polymer identification, particle size measurements, and particle counts. LDIR detects microplastic particles by rapid imaging of the area using IR light rather than visible cameras to determine the location, size, and shape of particles. Spectra can then be obtained from individual particles and compared to the onboard library, with results presented in real time.

The Imaging system shall:

- Perform microplastic polymer identification, particle size measurements and particle count. within one system to eliminate the need for external data processing.
- Detect microplastic particles in water, sediments, and biotic tissue sample medium.
- Process samples without damage.
- Be capable of analyzing particles from 10 µm - 5000 µm.
- Obtain single particle spectra in 1-2 seconds, instead of 30-60 seconds, such that data for a 10mm x 10mm area can be acquired within <5 minutes at a 5 µm pixel size.
- No required liquid nitrogen.