Particle Measurement by Laser Diffraction

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Fraunhofer diffraction, granulometry, static light scattering, laser diffraction. The terminology varies, the technique used is always the same: The light of a coherent light source scattered at particles creates a characteristic angle-dependent intensity distribution, the exact course of which is essentially determined by the particle size. So, take a laser beam (coherent light), place the particles at a defined position in the beam and place a suitable detector in the right place. The particle sizing instrument is ready. So far, so good.

But as so often, the devil is in the details

How exactly should the laser beam be shaped? Where exactly should the detectors be positioned? What geometry should the detector elements have? How and where do I place the particles in the laser beam? And very important: The particles have to be prepared so that they are available in the required concentration and desired mode - singly or bound in agglomerates. We are talking about the dispersion process. What has to be considered here?

All these questions - and a few more - are answered somewhat differently by each manufacturer of particle sizing instruments. A basic orientation is provided by the ISO standard 13320, which discusses not only general requirements for appropriate instruments and the quality of measuring results with standardised sample systems, but also the basic optical design of the measuring systems. A variant here is the Reverse Fourier design, which was invented by Fritsch GmbH in the 1980s and developed for the first time to market maturity. The newest generation of the ANALYSETTE 22 from Fritsch is also based on this design, which has now been adopted by numerous suppliers.

Figure 1. The ANALYSETT 22 NeXT Laser Particle Sizer.

Keep it simple

Based on the experience of over 35 years, this current instrument is characterised by a central approach: keep it simple.

Starting with the light source. In contrast to many other suppliers, Fritsch uses only one single light source with only one single wavelength. Several wavelengths, especially for very fine materials, theoretically offer the advantage of obtaining more information from the scattering processes for the Mie theory to be used. But anyone who has ever dealt with the practical implementation of these theoretical advantages has quickly had to realise that this is all too often associated with immense practical difficulties and that the theoretical advantages are negligible in comparison. Only briefly touched upon here: With the Mie theory, the refraction index and the absorption coefficient of the sample material must be known for the respective wavelength of the light used. Even for a single wavelength, this often presents a non-trivial challenge. With several different wavelengths, the matter can quickly become confusing.

Fritsch applies just one wavelength. A fibre-coupled green laser is used, which provides the ideal wavelength for the reliable detection of both: large particles down to the millimetre range as well as finest particles well below one tenth of a micrometre. In addition, the system does not use several beams that may come from different directions at different points in the measuring cell, but only a single beam that is easy to control.

Figure 2. The ANALYSETT 22 NeXT Laser Particle Sizer with 2 measuring ranges.

The facts

The facts and exact figures: in its full expansion stage, the ANALYSETTE 22 NeXT Nano provides a possible measurement range from 10 nm to 3800 µm. A slightly simpler version (NeXT Micro) allows particle size measurements between 0.5 and 1500 µm and is thus already equipped for a multitude of applications.

Reliable thoroughness

The dispersion unit for measurement in suspensions is also based on the same principle of maximum simplicity. Thus, this component of the ANALYSETTE 22 NeXT, which is immensely important for daily work and the success of measurements, works completely without valves in the sample circulation system. All wet dispersion units available on the market so far have either relied on rotating multi-port valves or on clamping elements, in which, for example, a hose branching in the circuit is squeezed either in one or the other direction and thus plugging. Both approaches have their specific weaknesses. Rotating systems are slow and can be damaged by particles that jam and get stuck in the sealing surfaces. Sluggishness or even leakage are the result. Clamping systems, on the other hand, usually have dead spaces in which particles can already settle during a measurement. In addition, particles can also get stuck in sealing surfaces. By completely dispensing without valves in the sample circulation system, these problems are elegantly avoided, and a reliable, fast, highly flexible and compact dispersion system is obtained.

Figure 3. (right) The ANALYSETT 22 NeXT Laser Particle Sizer with ultrasonic box.

Ultrasonic flexibly applicable

In many, if not most cases, the use of ultrasonic is the method of choice when agglomerates from the sample to be measured need to be degraded. Nevertheless, there are always cases where ultrasonic is not necessary or even harmful. Sometimes it also makes sense to precede an ultrasonic treatment before the actual measurement and then to dispense completely in the main measuring circuit.

The powerful and, of course, variably programmable ultrasonic box from Fritsch is offered as an independent module that can be simply inserted into the sample circuit system. Therefore, it is also possible to configure a system completely without an ultrasonic chamber in cases where this is required for the respective application.

The ANALYSETTE 22 NeXT represents a flexible and powerful system for particle size determination, which in its entry level version as the NeXT Micro model can also offer an extremely attractive price. And additionally, a later expansion with respect to dispersion (for example through the optional ultrasonic box) or an upgrade of the Micro-version to the NeXT Nano is basically possible.

Further information on the NeXT generation in particle sizing as well as an informative product video can be found under www.fritsch-international.com/a-22NeXT.

Assistance for particle sizing

Application Consultant Maik Paluga will be happy to assist you in all questions regarding the new Fritsch ANALYSETTE 22 NeXT Laser Particle Sizers as well as in particle sizing.

Please contact MSc (Phys) Maik Paluga on +49 67 84 70 188 / paluga@fritsch.de

You can also send Fritsch a sample of your choice. They will conduct, as part of a product recommendation, a particle size analysis and send you an individual analysis report. This request can be made at www.fritsch-international.com/service/sample-analysis.

Versatile Light Scattering System for Research Applications

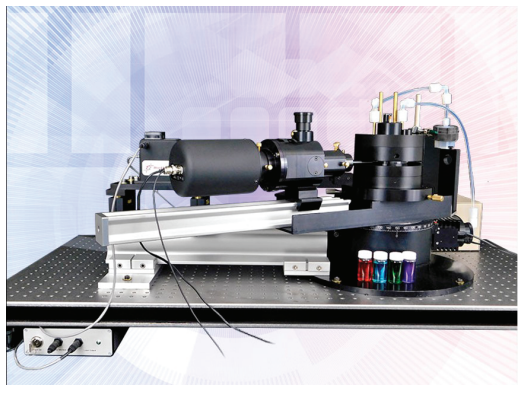
The BI-200SM goniometer from **Testa Analytical Solutions eK** has been designed to make it the finest instrument available for research applications of light scattering.

Offering unmatched performance for both Static Light Scattering (SLS) and Dynamic Light Scattering (DLS) experiments the BI-200SM research goniometer is a precision instrument for undertaking exacting measurements

Favoured by leading research groups around the world, the BI-200SM's modularity makes system expansion simple. Featuring a standard optical rail, the BI-200SM can be used with neutral density filters, polarisers, auxiliary analysers, additional lasers, and a reference detector. Research groups with special sample requirements can often be accommodated by changing the cell holder design or size.

Based on a special turntable with precision ball bearings and stepping motor, the BI-200SM's advanced design and quality construction guarantee precise measurements due to the wobble-free movement of the detector. The system is field proven in hundreds of laboratories and has become a light scattering research standard for macro-molecular studies and submicron particle sizing.

By taking advantage of the multiple inputs available on the BI-200SM's proprietary digital correlator a new capability of the BI-200SM system was created. By adding an optical signal splitter to the beam of scattered light and a second detector it is possible to eliminate the effects of very high-speed interference from the detector(s). This Cross Correlation System provides remarkably clean data.



More information online: ilmt.co/PL/1zQB

For More Info, email: 57943pr@reply-direct.com

A New Dimension in Particle Analysis

The **Microtrac** MRB SYNC Analyzer provides traditional users of laser diffraction technology with exciting new capabilities to characterise their materials. The proven tri-laser technology provides accurate and repeatable laser diffraction information from light detected over 163 degrees of angular scatter. When combined with state-of-the-art camera technology capturing images of the particle stream at the same time, the SYNC offers not only size data but significantly more information about the shape of the materials and the quality of the dispersion.

The patented Synchronous measurement technology of the SYNC allows users to make both a laser diffraction measurement and an image analysis measurement on a single sample, in the same sample cell at the same time: One sample, one optical bench, one flow path, one sample cell, one integrated GUI, one analysis.

This makes the SYNC ideally suited for both routine QC and research applications; it provides valuable information to researchers as they develop new materials and processes. The powerful software interface offers both particle size distribution information as well as a multitude of morphological parameters. The patented BLEND routine allows users to examine materials over a wide size range from 0.01 microns to 4000 microns

More information online: ilmt.co/PL/Bd9R

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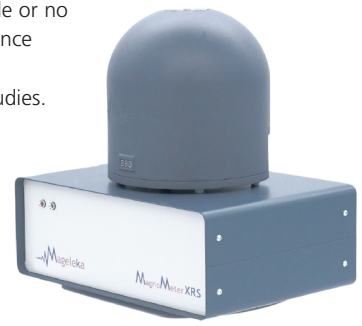
Low Field NMR Instrument for Complex Nanoparticle Suspension Characterisation

The **Mageleka** Magnometer XRS is ideal for routine analysis of complex multi-component nanoparticle solid-liquid and liquid-liquid formulations using non-invasive technology based on NMR proton relaxation.

In every industrial application a knowledge and understanding of the molecular structure and dynamics at the particle-liquid interface is critical to improving or optimising suspension and emulsion product performance at every stage from initial formulation to final manufacture. The Magnometer XRS provides direct information about the extent and nature of any particle-liquid interface of suspensions and emulsions in a matter of minutes.

Measurements with the Magnometer are simple and easy, the sample is placed into a standard NMR tube and then inserted into the MagnoPod©, the test sequence is then initiated and the result reported in under 2 minutes. An exceptionally wide concentration range of 0.01% to 90+% with small sample size of 0.1mL or less and with little or no sample preparation, the Magnometer is perfect for routine analysis of particles suspended in solvents and melts regardless of shape and size. With no prior NMR experience required, the Magnometer is suitable for chemists, technicians or plant workers. The separate magnet assembly allows for remote or glove box operation, an optional programmable temperature-controlled unit is idea for environments where temperature stability is required. The technique is non-destructive so perfect for long term studies.

Applications include batch-to-batch reproducibility in a manufacturing environment, formulation development, kinetic processes, surfactant and competitive surfactant adsorption, aggregation and flocculation, sedimentation studies, presence of para- and ferro-magnetic impurities, oxygen and water content of solvents, molecular weight of polymers in solution polymer and solvent viscosity and additive studies.



Industries served include catalyst, pharmaceutical and personal health care providers, paints. Pigments and coatings, ceramics, refractories, agro chemicals, cosmetics, batteries, electronics, nano medicine and graphene/graphene oxides.

More information online: ilmt.co/PL/1z99

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Absolute Molar Mass, Size and Conformation of Peptides, Proteins and Polymers

SEC-MALS is essential for accurate determination of molar mass and size. With the addition of one of **Wyatt Technology**'s DAWN®, miniDAWN® or microDAWN® MALS instruments downstream of the column, a standard HP-SEC systems becomes a SEC-MALS system - now capable of much more than just relative molar mass analysis. In fact, SEC-MALS is the foundation for determining multiple molecular properties, and Wyatt's MALS detectors are widely recognised as the gold standard for reliable characterisation of macromolecules in solution.

Molar mass: The MALS detector analyses each fraction independently of elution volume. Wyatt's ASTRA® chromatography software combines MALS signals with those from a concentration detector such as UV/Vis or differential refractometer (dRI) to calculate molar mass from first principles. The results include differential and cumulative distributions, moments and polydispersity. Unlike conventional SEC, SEC-MALS will immediately reveal if a chromatographic peak is homogeneous or polydisperse, regardless of peak width, since it determines molar mass absolutely, every second or so of elution time.

Wyatt's flagship DAWN MALS instrument measures molar mass from 200 g/mol to 109 g/mol with extraordinary sensitivity: it requires as little as 10 nanograms of 100 kDa polystyrene injected on a standard SEC column.

MALS also measures rms radius (a.k.a. radius of gyration), from 10 nm and up to 500 nm. It accomplishes this even without a concentration detector, since size is determined solely from the angular variation of the scattering.

When the analytes are below 10 nm in radius, Wyatt offers other options. One is online dynamic light scattering (DLS), embedded in the MALS instrument, which can measure hydrodynamic radii from 0.5 nm to 50 nm and beyond. The other is differential viscometry using Wyatt's ViscoStar detector, which is often added for polymer analysis. ASTRA determines hydrodynamic/viscometric radii of polymers by combining molar mass from MALS with specific viscosity from the ViscoStar.

ASTRA combines molar mass and size information to evaluate the conformation of polydisperse macromolecules such as polymers or polypeptides.

Combining MALS with two concentration detectors - UV and dRI - enables analysis of binary conjugates such as glycoproteins or block co-polymers. The molar mass of each constituent is determined along with the total molar mass for each eluting fraction.

More information online: ilmt.co/PL/EoLw

For More Info, email: 55770pr@reply-direct.com