Brookhaven *90Plus* Nanoparticle Size Analyzer

Fast and sophisticated. Flexible and Reliable. These are important attributes of an instrument that satisfies the needs of an ever widening community. If you have polymers or proteins, nanodots or new adhesives, latexes or liposomes, cosmetics or colloids, the Brookhaven **90Plus** is the preferred tool to characterize your particles.

The **90Plus** performs fast, routine submicron particle size measurements on a wide variety of samples and concentrations. It is an ideal instrument for measuring colloids, latexes, micelles, microemulsions, proteins, and other nanoparticles. Based on the principles of dynamic light scattering, most measurements only take a minute or two.

Features at a Glance

- Particle sizing from <1 nm to 6 μm
- Accomodates wide concentration range for easy sample preparation.
- Multimodal and unimodal size distribution software.
- Two scattering angles.
- 35 mW laser with high sensitivity detector.
- Upgradeable for zeta potential measurements.
- 21CFR Part 11 option.
- Molecular weight feature.

Simply put, the **90Plus** puts the power of a highly sophisticated and easy to use instrument into your hands.

Imperfect Samples? The Brookhaven **90Plus** provides simple to use but powerful tools to extract the most information from your sample. Brookhaven's unique dust filter algorithm can remove the influence of a contaminating fraction of large particles (dust). Such particles can ruin a light scattering measurement; with the **90Plus** it is often possible to rescue the measurement and obtain reliable data.

The flexible and intuitive Brookhaven software allows you to quickly, simply, and interactively test the effects of changing parameters and evaluation methods. It is straightforward for the novice to obtain key data quickly and versatile enough for advanced users to design complex measurements and customize output.

Integrated Computer to Save Bench Space

The instrument is controlled by an integrated computer using an industry standard Windows™ operating system to reduce operator training. Parallel, serial, USB, and Ethernet communications ports allow integration with Laboratory Information Management Systems (LIMS).

In addition, an external computer is optional.

Friendly Application Software

Easy-to-use software allows rapid instrument set-up and user training. Sophisticated statistical analysis of multiple run measurements is updated and displayed continually during the experiment allowing the user to determine the best measurement duration. Data from all or any selection of runs can be combined to give a single result. Data can be presented in a variety of formats according to user

needs. Among the **90Plus** features are simple "Copy to Clipboard" and "Copy for Spreadsheet" buttons on each screen to facilitate moving graphs and tables to other applications for presentation and analysis.

Easy Operation

Prepare a dilute suspension with a concentration ranging from 0.0001% to 1% v/v using suitable wetting and/or dispersing agents. Choose a suitable sample cell. Disposable plastic cells are available for aqueous suspensions. Also, disposable glass cells with PTFE stoppers are used for aggressive solvent suspensions. To conserve valuable sample materials, our disposable 50 µL cells or our new 40 µL flow cells are available. Samples are unaffected by measurement and can be fully recovered or retained for further analysis. Then, with a click of the mouse data is collected, analyzed, and presented.

Principles of Operation

The sample materials (polymers, proteins, colloids, or nanoparticles) will scatter incoming laser light. Due to the random motion of these particles, the scattered light intensity fluctuates in time. Processing the fluctuating signal with a state-of-the-art digital autocorrelator yields the particle's diffusion coefficient, from which the equivalent spherical particle size is calculated using the Stokes-Einstein equation. Molecular weights can also be calculated from these fluctuations or from the scattered intensity.

Reproducibility

One important benefit for users is the reproducibility from sample-to-sample, operator-to-operator, and instrument-to-instrument. The optical design and quality control at Brookhaven ensures that every instrument performs the same. By automating much of the testing procedure and data analysis, effects due to different operators are dramatically reduced. Figure 1 shows the results from multiple runs on a test sample. Notice the standard error of the Effective (or Average) Diameter is much less than 1% of the mean of 10 repeated runs.

This excellent repeatability is typical of the **90Plus** and necessary for routine QC analysis to ensure product quality time-after-time.

Applications

Many processes and products involve dispersions where optimal results depend on particle size. The technology to produce these dispersions, to ensure that they perform according to specifications, and to solve problems which may arise in production or use requires knowledge of the particle size. The **90Plus** can handle many types of submicron samples. Quick routine measurements ensure that effects of process changes are rapidly measured and

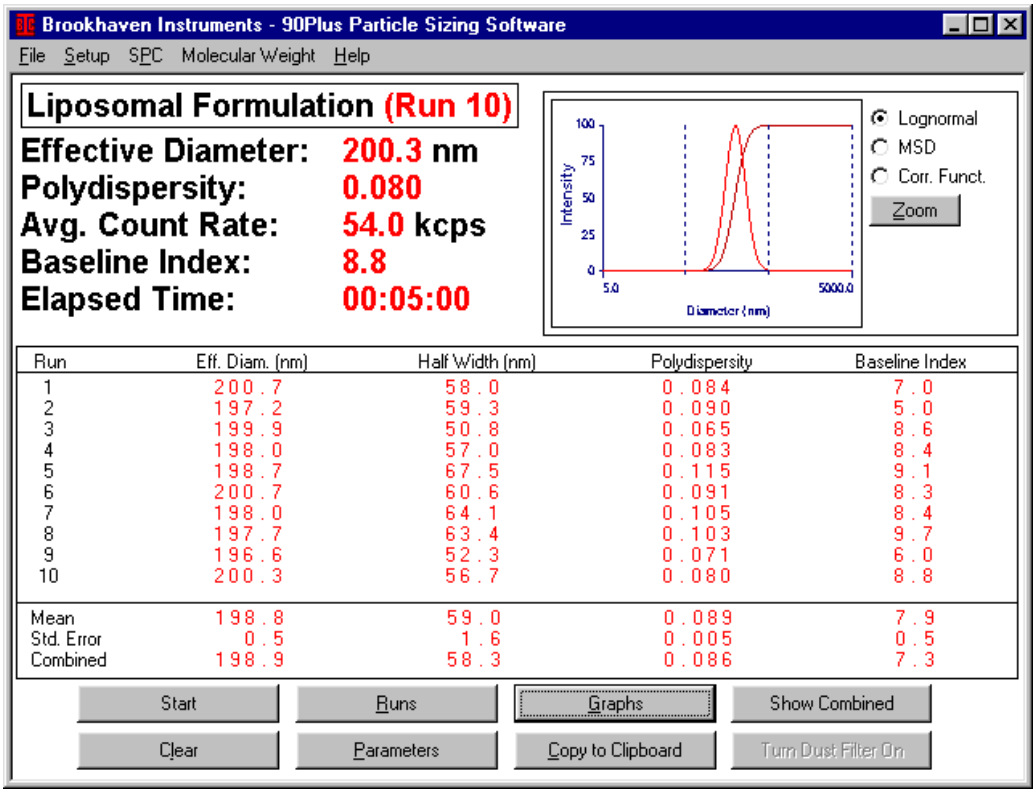

Figure 1 Run-to-run reproducibility of a liposomal formulation. Note <1% std. error.

enable optimal process development. QC of incoming materials where particle size is important is another vital application for these instruments. Whether deciding to accept shipment or send product, rapid measurement means timely, accurate decisions. In addition, R&D efforts where particle size is a key parameter will benefit from the **90Plus**.

Data Analysis and Presentation

The **90Plus** offers three choices. For routine determinations, an average diameter (Eff. Dia.) and a distribution width (Polydispersity) are sufficient and valuable for QC analysis. The second choice is to show a lognormal distribution using these values, allowing the user to visualize the size distribution and to display cumulative and differential results at 5% intervals. The third choice, suitable for more complicated, multimodal size distributions is the use of advanced algorithms to obtain the particle size distribution. Here, a numerical algorithm, including Mie theory, is used. Results of this analysis for a mixture of latex particles are shown in Figure 2.

During a measurement the display can be switched *interactively* between any one of these methods — correlation function, lognormal, or multimodal — each shown "live" as data is accumulated. The active display is particularly useful in determining the end-point of a measurement and minimizing the time required for rush jobs and time sensitive materials.

Evaluation of data is highly automated, but advanced features are a mouse click away. Therefore, what-if questions can get immediate answers giving the user complete insight into the sample and measurement.

Advanced Features:

Integrated Statistical Process Control (SPC)

Built-in SPC charts ease the recording, tracking, and statistical analysis of process changes.

Time Series Studies

The **90Plus** also includes the ability to measure changes in sample behavior with time. Measurements can be repeated at set time intervals to track evolution of sample aggregation.

Temperature Series Studies (protein melting)

Evaluating the evolution of particle behavior with temperature is another feature of the 90Plus. One example is the change in micelle size with temperature. Another is the effect of temperature on protein melting or denaturation.

Zeta Potential Option

Besides particle size, zeta potential is the next most common parameter needed to understand colloidal behavior. Zeta potential is a measure of surface charge on a particle and is readily measured with the **BI-Zeta** option.

Since zeta potential is a measure of the repulsive forces in electrostatically-stabilized systems, it is an excellent indicator of relative stability. The sign

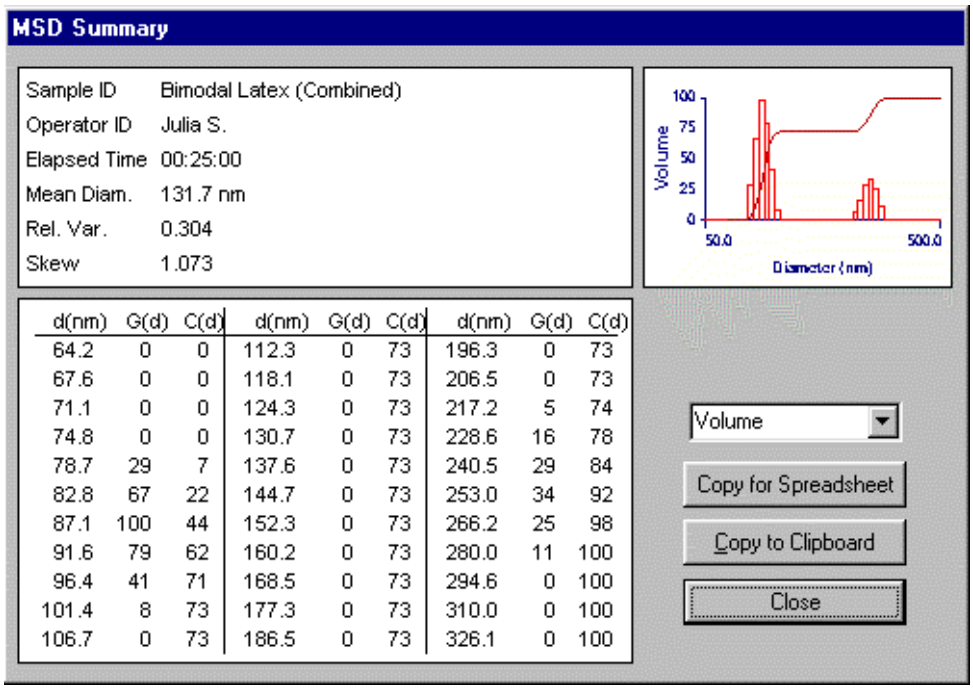

Figure 2 Bimodal particle size distribution obtained from the **90Plus**. Note that measured values agree with those expected from the prepared suspension.

Typical Applications

- Proteins/complexes/DNA
- Polymer Latexes
- Pharmaceutical Preparations
- Oil/Water and Water/Oil Emulsions
- Paints and Pigments
- Inks and Toners
- Cosmetic Formulations

and magnitude of zeta potential, as a function of pH, salt, or dispersing agent concentration are indicators of stability against flocculation or coagulation.

Applications include waste water treatment and stability of pigments, latexes, ceramics, and other colloidal dispersions.

Zeta potential determination in solvents, oils, high salt concentrations, or very near the isoelectric point require a very sensitive detection technique. In these cases, add the **BI-PALS** option to the **BI-Zeta**. Phase Analysis Light Scattering (**PALS**) is up to 1,000 times more sensitive than traditional light scattering techniques.

Options

BI-APD: High sensitivity avalanche photodiode detector for the weakest scatterers (proteins).

BI-Zeta: Optics/Mechanics/Software and electrode assembly that allow zeta potential determinations in water and other polar liquids.

BI-PALS: Performs zeta potential measurements in nonpolar or viscous liquids and in very high salt concentrations. Requires **BI-Zeta**.

BI-PSD21: 21CFR Part 11 software and validation material for the pharmaceutical industry.

90PDP: Absolute Molecular weights by the Debye plot method.

BI-DPSS: 50 mW solid state laser, 532 nm.

Specifications

Size Range: <1 nm to 6 μm, depending on sample.
Precision: 1%, typically.
Sample Type: Most colloidal-sized materials, suspended in any clear liquid.
Sample Volume: Cells from 50 μL to 3 mL; 40 μL flow cell available
Temperature Control: 6°C to 100° C, +/- 0.1° C, active control. No external circulator required.
Laser: 35 mW, solid state, standard. See options.
Scattering Angles: 15° and 90°.
Data Presentation: Average size & size distribution width, lognormal fit, and multimodal size distribution provided as standard.
Correlator: covers the equivalent of 10^7 linearly-spaced channels, 100% efficiency, and real-time operation over the entire delay-time range.
Computer: Built-in PC. Windows™ Software included. External computer optional.
Printer: Color inkjet, standard.
Monitor: Color, flat panel.
Power Requirements: 100/115/220/240 VAC, 50/60 Hz, 300 Watts.
Dimensions: (excluding monitor and printer) 267mm (H) x 625 mm (W) x 445 mm (D).
Weight: (excluding monitor and printer) 37 kg.
Environmental Characteristics:

Temperature	10^0 C to 75^0 C
Humidity	0% to 95%, non-condensing

CE **Marked**

Please inquire about our complete line of light scattering equipment for colloid and polymer characterization. Brookhaven also offers sedimentation devices for high resolution particle sizing and zeta potential devices for stability studies.

A policy of continual improvement may lead to specification changes

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