HORIBA Scientific

Application Note

Analysis of PSL Size Standards with the SZ-100

AN197

Dynamic light scattering provides fast, accurate, and repeatable nanoparticle size information. Applications include metal and oxide powders, latexes, drug delivery vehicles, and dozens of other materials. The SZ-100 is a dynamic light scattering instrument that is ideal for these nanoparticle samples. Here, standard materials are characterized with the SZ-100 in order to show the accuracy of the technique.

Introduction

Dynamic light scattering (DLS) is the technique of choice for analyzing the size of nanoparticles. The measurement is fast, often taking only a few minutes. It is repeatable. For many samples, the coefficient of variation on the so-called z-average size is better than 5%. And, it is precise, able to discern shifts in the z-average size of only a few percent.

Polystyrene latex (PSL) beads are popular size standards for particle analysis since they are well characterized, readily available, and relatively inexpensive. Thus, they are often used for instrument qualification. See, for example, reference (1) on system qualification. This note shows the ability of the HORIBA SZ-100 to characterize these samples.

Manufacturer Characterization of PSL

Submicron latex beads are typically characterized by a variety of techniques, including dynamic light scattering, electron microscopy, and disc centrifugation (sedimentation). Since these materials are spherical and have an extremely narrow size distribution, the results from all characterization techniques are quite similar, often differing by less than 10%. This is remarkable considering that such similar results are not observed for many practical samples. Nonspherical particles and broad size distributions tend to appear to have different sizes when measured by different particle sizing techniques. And, often, reconciling these differences gives the analyst the most complete picture of a sample.

Figure 1: SZ-100 Nanoparticle Size Analyzer.

One important consideration when using PSL standards to evaluate an instrument, operator, or laboratory is the technique used to evaluate particle size of the reference material. For example, the certified mean size obtained for a nominal 100 nm PSL standard is 102 nm +/- 3 nm. However, the hydrodynamic size determined by DLS and also presented on the certificate of analysis is 95-106 nm. The difference arises because the certified size is determined with a variety of techniques while the hydrodynamic size is determined only by dynamic light scattering. In order to accurately judge results from measuring a standard, it is important to read the manufacturer certificate of analysis and use the correct values, that is, DLS results for evaluation.

Sample Preparation

PSL suspensions are typically electrostatically stabilized. By using charged surfactants, the manufacturer ensures that the particles do not begin to flocculate. This significantly increases the material shelf life for the end user. However, the Stokes-Einstein relation used to convert dynamic light scattering data to particle size rests on the assumption of free diffusion. In other words, if the particles interact strongly, DLS doesn't give the correct size. Therefore, PSL latex concentrates should be diluted with 10 mM 1:1 electrolyte such as NaCl.

Materials and Methods

Nominal 100 nm (part number #3100A, lot #36489) and 20 nm (part number #3020A, lot #35820) polystyrene latex spheres were purchased from Thermo Scientific (2).

Concentrated PSL from the manufacturer was diluted with filtered aqueous 10 mM NaCl.

Dynamic light scattering data was collected and analyzed with an SZ-100 nanoparticle size analyzer. Measurements were repeated six times in order to find the coefficient of variation (standard deviation of the six measurements over mean of the six measurements).

	Mean determined z-average size (nm)	CoV
Hydrodynamic size on manufacturer certificate	95-106	N/A
15 ppm	105.8	0.7%
100 ppm	105.8	1.5%

Table 1: Measurement results for nominal 100 nm PSL

	Mean determined z-average size (nm)	CoV
Hydrodynamic size on manufacturer certificate	20-22	N/A
15 ppm	22	6.4%
100 ppm	21	1.5%

Table 2: Measurement results for nominal 20 nm PSL

Results and Discussion

The z-average diameter range stated by the manufacturer and the values obtained with the SZ-100 are listed in tables 1 and 2. The agreement between the two is excellent.

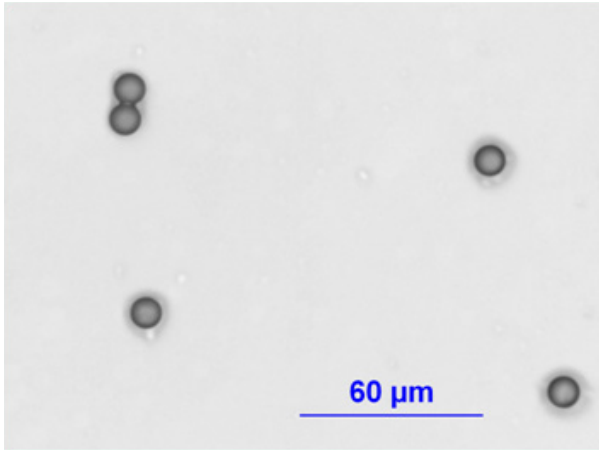

Figure 2: PSL dispersed on PSA300 slide. The nanoparticles discussed in this note cannot be reliably imaged like the larger particles shown in this image. Therefore, DLS is an important technique for their characterization.

Conclusions

The results of these measurements show that the SZ-100 can be validated with PSL latex standards.

References

(1) ISO 22412:2008 Particle Size Analysis – Dynamic Light Scattering

(2) www.thermoscientific.com