

### Ultracentrifugal sample classification and particle diameter measurement of four-component mixed standard particles

CS-GXII series micro ultracentrifuge and S52ST swing rotor

In line with the rapid development of the modern nanotechnology industry, nano-order particle diameters are now being controlled in materials in various fields. Particle diameter control is a critical factor in the pretreatment process of separation and refinement, in order to achieve a targeted particle preparation and eliminate the effects of contamination.

This paper describes the use of the rate zonal centrifugation, one of the centrifugal separation methods, to separate mixed particles based on differences (typically in size) regarding the sedimentation coefficient (S-value), and confirm the particle diameter of each band of particles by means of a particle size analyzer.

#### Description

##### 1. Separated samples

•20nm, 50nm, 100nm, 150nm latex particles (made of polystyrene, density: 1.050 g/cm<sup>3</sup>, selling by Thermo Fisher Scientific Inc.)

##### 2. Centrifugation and measurement conditions

Centrifuge:	CS150GXII micro ultracentrifuge
Rotor:	S52ST swing rotor (four tubes)
Tube:	5PET tube
Speed:	52,000 rpm
Maximum RCF:	276,000 x g
Centrifugation time:	10 minutes
Density-gradient fluid:	5-20 wt% sucrose solution 4.5 mL
Particle size analyzer:	nano Partica SZ-100 (manufactured by HORIBA, Ltd.)
Measuring temperature:	25°C
Particle diameter distribution standard:	Scattered light intensity standard

##### 3. Results

Figure 1 shows a picture of a sample under test before centrifugal separation. Figure 2 shows the plotting of measurement results regarding the particle diameter distribution of the mixed sample before separation. Two kinds of particle diameter distribution have been confirmed by particle diameter measurement before separation.

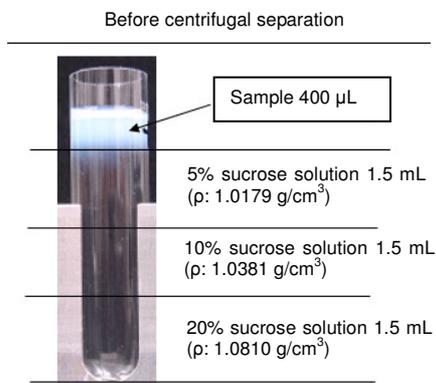


Fig. 1 Sample before centrifugal separation

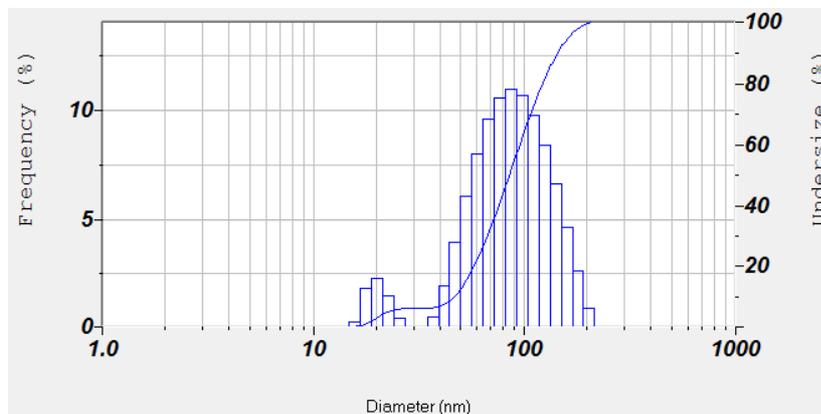


Fig. 2 Measurement results of particle diameter distribution before centrifugal separation (provided by HORIBA, Ltd.)

Figure 3 shows a picture of the sample under test after centrifugal separation. The mixed particles were subjected to ultracentrifugal separation and separated into four bands. Each band was collected and the particle diameter measured on the SZ-100 manufactured by HORIBA, Ltd. The four bands were found to have particle diameters of 20 nm, 50 nm, 100 nm and 150 nm in sequence from the top of the centrifuge tubes downward, thereby confirming the possibility of centrifugal separation by particle diameter using the rate zonal centrifugation.

After 10 minutes of centrifugal separation

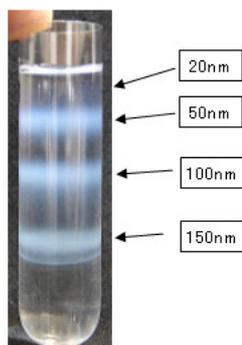


Fig. 3 Sample after centrifugal separation

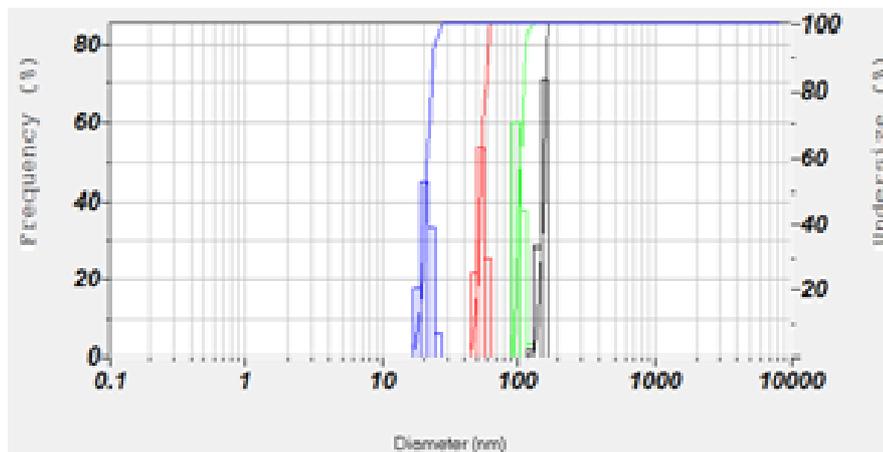


Fig. 4 Measurement results of each band's particle diameter distribution after centrifugal separation (provided by HORIBA, Ltd.)

#### 4. Discussion

Mixed particles varying in size have been separated using the rate zonal centrifugation, one of the centrifugal separation methods.

The present method offers a useful tool for refining carbon nanotubes or fractionating fine pigment particles contained in an ink or toner formulation.

If you have any inquiry of this application or products, please contact us through our web site.

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