

Measurement of Particle Size Distribution (PSD) of Nanocellulose using Centrifugal Sedimentation Method

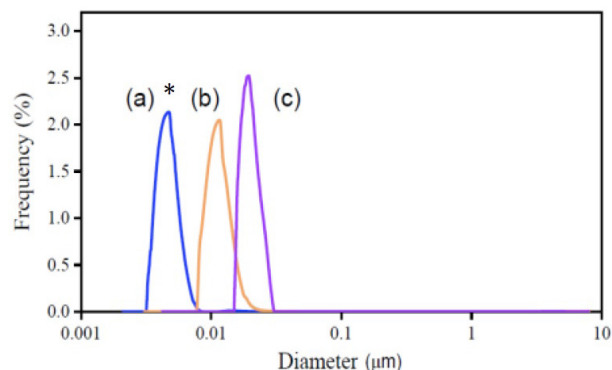
Introduction

Nanocellulose is a fibrous material derived from wood that is applied to composite materials and is attracting attention as an advanced material. Cellulose nanofibers (CNFs) are mechanically disintegrated materials with a diameter of 4~20nm, while cellulose nanocrystals (CNCs) are chemically disintegrated, needle-like materials with a diameter of 4~10nm. In order to actually utilize nanocellulose, it is important to understand the fiber diameter and dispersion state.

3 types of nanocellulose (one type of CNF and two types of CNC) were analyzed using the Partica CENTRIFUGE centrifugal nanoparticle analyzer. The results were correlated with fiber diameter (height) measurements by atomic force microscopy (AFM).

Measurement Condition

Sample	3 types of cellulose nanofibers (Density: 1500 kg/m ³ , RI: 1.84-0.00i) Concentration: 0.15 to 1 wt%
Dispersant	Water (Density: 996 kg/m ³ , RI: 1.333)
Method	Homogeneous • Sample volume: 1500 μL
PSD Basis	Volume
Calculation Setting	Custom, Smoothing: 4, Turbulence correction: OFF, Kamac: ON



*Note the result is below the lower detection limit (~11nm), which takes into account the effect of thermal diffusion as recommended by ISO 13318.

Comparison of Results

		a: CNF	b: CNC	c: CNC
Partica CENTRIFUGE	PSD	4.6 nm	11.2 nm	19.8 nm
	# of observation	87	46	58
AFM	Diameter	3.0 nm ±0.7 nm	5.8 nm ±1.5 nm	6.4 nm ±1.8 nm
	AFM image			

Measurements were performed on 3 different CNF/CNC dispersions and the differences could be distinguished. In addition, the correlation between the results of diameter measurement by AFM and the particle size distribution measured by Partica CENTRIFUGE was confirmed. As the result of (a) is smaller than the detection limit specified by ISO, it is necessary to be careful when handling the particle size, but it was confirmed that the particle size can be measured according to the fiber diameter.

Conclusion

Partica CENTRIFUGE can distinguish the difference in diameter of isolated CNFs and CNCs in dispersions, contributing to the performance evaluation and quality control of nanocellulose dispersions.