

Characterisation of Carbon Nanotubes

Introduction

NanoSight instruments can be used to rapidly assess the quality of your carbon nanotube (CNT) dispersion method and sample concentration.

Background

Carbon nanotubes are carbon particles with an extremely high aspect ratio. They can have as little as several nm diameter but can be microns in length (single-walled nanotubes, SWNT).

This extremely high aspect ratio leads to astounding properties such as:

- very high thermal conductivity
- very high mechanical strength
- very high electrical conductivity

These properties make CNTs of interest for a large range of applications:

- VLSI interconnects
- membrane filters
- high frequency oscillators
- within clothes fabric
- and many more...

The size of the CNTs and how well these are dispersed is frequently critical in the preparation and manufacturing processes and also in the end-use of carbon nanotubes. The assessment of such dispersions is very hard, time-consuming and often ambiguous.

NanoSight supplies equipment that allows users to rapidly visualise and give a hydrodynamic size of their CNTs.

Whilst the equipment does not give any information about the morphology (for example the aspect ratio) of the CNTs, the measurement of concentration can be used as an indication of dispersion efficiency and the assessment of dispersions can be compared from sample to sample.

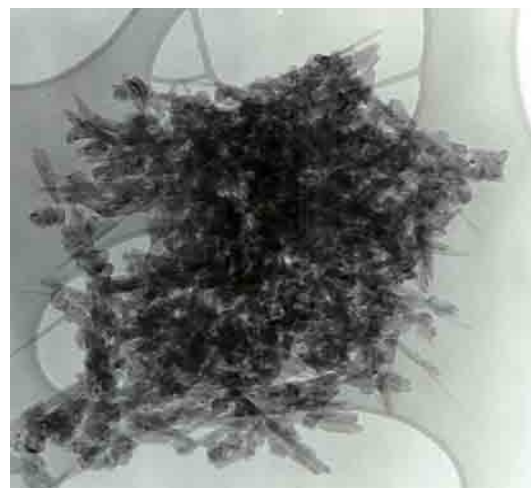


Figure 1: A TEM image of clustered carbon nanotubes

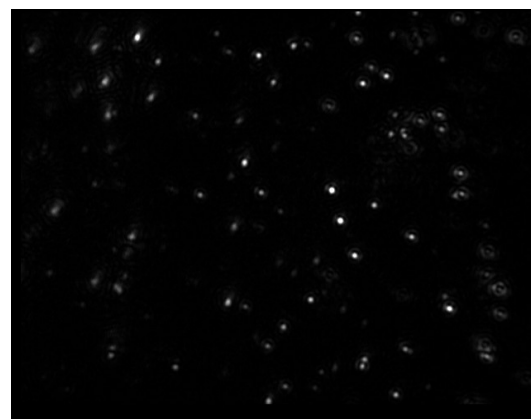


Figure 2: Typical image of CNTs provided by a NanoSight instrument. The system enables individual CNTs in suspension to be visualised and their Brownian motion tracked – enabling particle size distributions, based on individual particles, to be built up in a matter of seconds.



Sizing by NanoSight Systems

Whilst the NanoSight viewing unit provides a unique view of the nanoparticles (Figure 2), the Nanoparticle Tracking and Analysis (NTA) software suite is used to give some indication of the size of the CNTs (Figure 3).

Sample preparation requires dilution to approximately 10^9 particles/ml. From this, a sample of less than 500 μ l is taken and injected into the viewing unit. Aligning and focussing of the imaging unit is rapid, as are setting the capture and analysis settings.

The system provides the unique ability for providing a number or volume-based size distributions of the sample, a measurement of concentration and also a range of statistical measurements.

Key Features

- particles can be measured in their natural state (no drying/vacuum conditions required)
- greater ability to size polydisperse samples due to the insensitivity to intensity (commonly associated with other light scattering techniques)
- low cost of unit
- visualisation of individual particles without any pre-treatment
- ability to rapidly analyse time characteristics of the sample such as agglomeration/stability

Contact Details

For further information, contact NanoSight or your local distributor, listed at www.nanosight.com

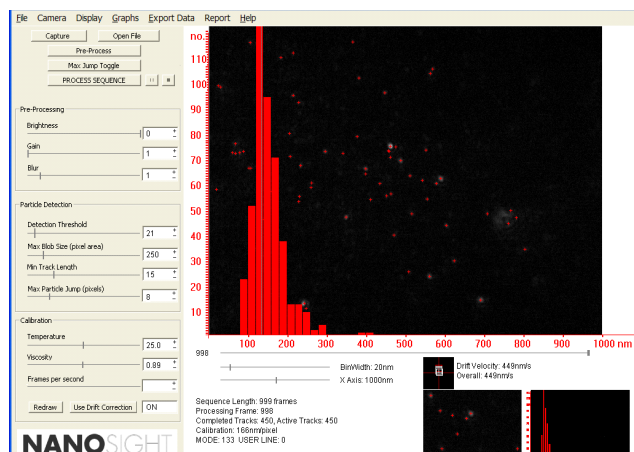


Figure 3: Particle size histogram obtained by NanoSight from a 30 second video of CNTs. Sample a) is relatively monodisperse with a modal size of 133 nm, sample.

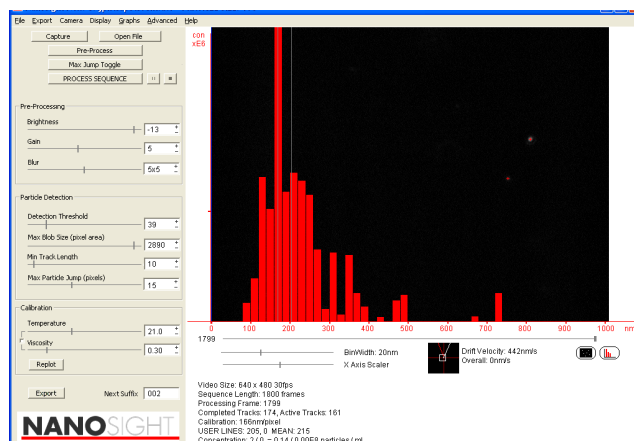


Figure 3: b) is more polydisperse with a greater mode (170 nm) and at a lower concentration.

