

#### Measuring Quantum Dot Size Distribution with the Photo-Centrifugation Method

#### Introduction

Quantum dots are synthesized nanoparticles that have many promising applications in medicine, photovoltaics, and LED's. They usually range between 2-10 nm, and depending on their size, they will emit different wavelengths of light when illuminated by a UV light.

Determining the size distribution of quantum dots is important in helping determine synthesis routes. Historically, quantum dots have been difficult to measure because of the emission interfering with many instrument techniques. In this application note, the Partica CENTRIFUGE centrifugal nanoparticle analyzer was used to measure the size distribution of a 645 nm emitting red quantum dot sample (10 mg/mL).

#### Analytical Test Method

- Method: Homogeneous
- Sample Information:
  - o Sample: 645 nm emitting red quantum dots
  - o Material: CdSe
  - o Density: 5820 kg/m<sup>3</sup>
  - o Refractive Index: 2.59 - 0.38i
- Dispersion medium information
  - o Dispersion Medium: Toluene
  - o Density: 857 kg/m<sup>3</sup>
  - o Viscosity: 0.530 mPa • s
  - o Refractive Index: 1.496
- Correction Settings
  - o Extinction Coefficient Correction: Off
  - o Turbulence Correction: On
  - o Smoothing: 1
  - o Cut off: 0.001

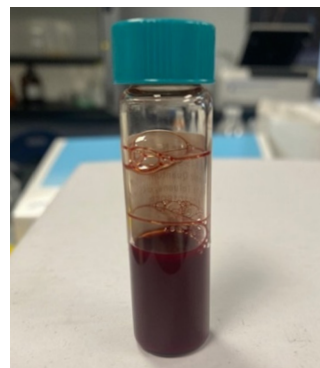


Figure 1. Sample of 645 nm emitting red quantum dots.

#### Test Procedure:

1. Perform the blank step with toluene.
2. Dilute sample 10x in toluene to 1 mg/mL.
3. Add diluted sample to cuvette.
4. Perform measurement with a target diameter to stop measurement at 4 nm.
5. Repeat measurement.

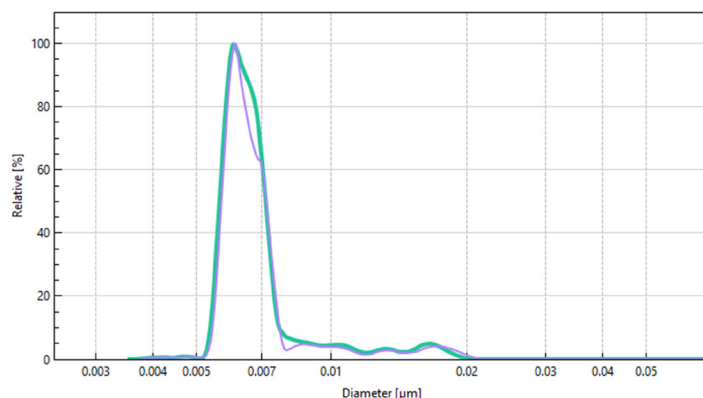


Figure 2. Overlay of two Partica CENTRIFUGE measurements on 645 nm emitting red quantum dots.

#### Data Table

	Mean [nm]	Mode [nm]	D50 [nm]
Measurement 1	7.1	6.1	6.4
Measurement 2	7.1	6.1	6.4

## Results

The results show the ability of the Partica CENTRIFUGE to measure quantum dots without any issue due to the excess emission, as the technique measures the absorption rather than the intensity of scattered light. There is excellent repeatability between the two different measurements, and high resolution in ability to see the tail of agglomerates larger than the expected peak of 6 nm. The results also show the instrument's sensitivity in ability to measure samples below 10 nm. The high density of the sample makes it a suitable material to measure by photo-centrifugation.



**Figure 3. The Partica CENTRIFUGE CN-300 Centrifugal Nanoparticle Analyzer.**