Data Article

Concentration and size distribution data of silicon nitride nanoparticles measured using nanoparticle tracking analysis

Saurabh Lal *, Richard M. Hall, Joanne L. Tipper

University of Leeds, UK

ARTICLE INFO

Article history:
Received 29 August 2016
Received in revised form 21 August 2017
Accepted 6 September 2017
Available online 15 September 2017

ABSTRACT

This article refers to the paper “A novel method for isolation and recovery of ceramic nanoparticles and metal wear debris from serum lubricants at ultra-low wear rates” (Lal et al., 2016) [1] and describes the concentration and size distribution data of silicon nitride nanoparticles measured using nanoparticle tracking analysis (NTA). A NanoSight LM10 instrument was used to capture the video data of silicon nitride nanoparticles moving under Brownian motion in the water. The video data was then analyzed using the NanoSight NTA software. This article also describes a methodology for calculating the percentage recovery of a nanoparticle isolation process.

© 2017 Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Specifications Table

| Subject area          | Nanoparticle Characterization |
|-----------------------|-----------------------------|
| More specific subject area | Ceramic nanoparticle characterization and particle recovery |

DOI of original article: http://dx.doi.org/10.1016/j.actbio.2016.07.004

* Corresponding author.
E-mail address: S.Lal@leeds.ac.uk (S. Lal).
Type of data
Brownian motion video of silicon nitride nanoparticles in water captured by the NanoSight LM10 instrument. CSV file containing the concentration and size distribution data of silicon nitride nanoparticles dispersed in water.

How data was acquired
NanoSight LM10 (Malvern Instruments, UK) and NTA v 3.00 software

Data format
Raw

Experimental factors
- Silicon nitride nanoparticles were sonicated for 10 min to aid particle dispersion before taking NTA measurements.
- The measurements were taken at room temperature.
- The viscosity of water was assumed to be 1 cP.
- Five measurements were taken for analysis of each sample.

Experimental features
Size distribution, concentration distribution and average concentration data of silicon nitride nanoparticles.

Data source location
University of Leeds, Leeds, UK

Data accessibility
Data are presented in this article

Value of the data
- Video data showed that nanoparticle tracking analysis (NTA) can be used to visualize silicon nitride nanoparticles dispersed in water.
- Concentration and size distribution data demonstrates that silicon nitride nanoparticles dispersed in water can be characterized by NTA.
- NTA is suitable for measuring particle characteristics at low particle concentrations ($10^7$–$10^9$ particles per ml).
- The concentration of particles before and after a process can be used for estimating the percentage loss or percentage recovery of particles.

1. Data

The video file (Nanosight_video_Si3N4_NPs.mp4) is a video of silicon nitride (Si$_3$N$_4$) nanoparticles moving under Brownian motion in the water. The concentration-size distribution data of the Si$_3$N$_4$ nanoparticles is reported in Table 1.

| Particle Size (nm) | Concentration (E6 particles/ml) |
|-------------------|-------------------------------|
| 0–00              | 110.94                        |
| 100–200           | 386.07                        |
| 200–300           | 162.26                        |
| 300–400           | 11.60                         |
| 400–500           | 1.63                          |
| 500–600           | 0.22                          |
| 600–700           | 0.15                          |
| 700–800           | 0.15                          |
| 800–900           | 0.01                          |
| 900–1000          | 0.00                          |
| Average total particle concentration | 673.07 |

Mean Size = 162.37 nm
Mode Size = 142 nm
Supplementary material related to this article can be found online at http://dx.doi.org/10.1016/j.dib.2017.09.011.

2. Experimental design, materials and methods

2.1. Preparation of the particles

Silicon nitride nanoparticles (< 50 nm; Sigma, UK) were added to sterile water (Baxter, UK) to make 1 mg ml\(^{-1}\) suspensions.

The suspensions were then diluted with sterile water to achieve an optimum concentration range of 10^7–10^9 particles per ml (approximately 20–100 particles in the field of view of the NanoSight video window). Nanoparticles were dispersed by sonication for 10 min in an ultrasonic bath (USC300T, VWR UK) before introducing them into the NanoSight flow cell.

2.2. Video capture and analysis

A minimum of five 30 s videos of the particles moving under Brownian motion were captured by NanoSight. The videos were then analyzed for size distribution and particle concentration using the built-in NTA v 3.0 software.

2.3. Measurement of particle concentration and percentage recovery

The concentration values obtained after analysis were averaged to obtain a mean concentration value, which was then multiplied by the dilution factor (described in Section 2.1) to obtain the initial concentration of silicon nitride particles dispersed in water.

When the size distribution of nanoparticles remains unaffected by a process, such as a particle isolation procedure described in Lal et al. [1], the percentage recovery of particles suspended in a liquid can be calculated using the following formula:

\[
\text{Percentage Recovery} = \frac{\text{Average Final Concentration (number of particles/ml)}}{\text{Average Initial Concentration (number of particles/ml)}} \times 100
\]  

Acknowledgements

The research leading to these results has received funding from the European Union’s Seventh Framework Programme for Research and Technological Development (FP7/2007-2013) under Grant agreement no. GA-310477 LifeLongJoints.

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2017.09.011.

Reference

[1] S. Lal, R.M. Hall, J.L. Tipper, A novel method for isolation and recovery of ceramic nanoparticles and metal wear debris from serum lubricants at ultra-low wear rates, Acta Biomater. 42 (2016) 420–428.