

Determination & Visualisation of CMP Slurries by Nanoparticle Tracking Analysis

Introduction

NanoSight instruments can visualise, rapidly and accurately size slurry particles in liquid suspension used in Chemical Mechanical Polishing/Planarization (CMP) of microchip wafers.

Background

CMP slurries play an integral role in microchip fabrication. Polishing of the wafers between multiple depositions, photolithography and etching is vital to produce planar devices, yet each polishing stage risks potential wafer damage.

Characterising the size distribution of CMP slurry particles is of importance in determining the condition of CMP slurries before they are used in polishing tools, and also in investigating failures. Particle aggregation can be caused by settling in storage tanks, ageing of the slurry, or by shear as the slurry is pumped up to the CMP tool. Shifts in the size distribution can indicate the early onset of aggregation before large, hard aggregates are formed.

As device features head towards 32 nm it is becoming more important to prevent micro-scratches (around 50 nm - 100 nm) which may not cause device failure, but lead to instability and intermittent performance.

The Technique

The Nanoparticle Tracking Analysis (NTA) technique looks at individual nanoparticles and sizes them on a particle by particle basis. Inherent weakness in techniques such as DLS (Dynamic Light Scattering), or PCS (Photo-Correlation Spectroscopy), which produce an average particle size, are overcome. NTA can also go to much smaller particle sizes (down to 10 nm) than light obscuration techniques.

As the technique looks at the light scattered from individual nanoparticles as they move under Brownian motion in the path of a laser beam. The speed at which the particles move under Brownian motion is related to particle size, temperature and solvent viscosity. With knowledge of the temperature and solvent viscosity, individual particle -

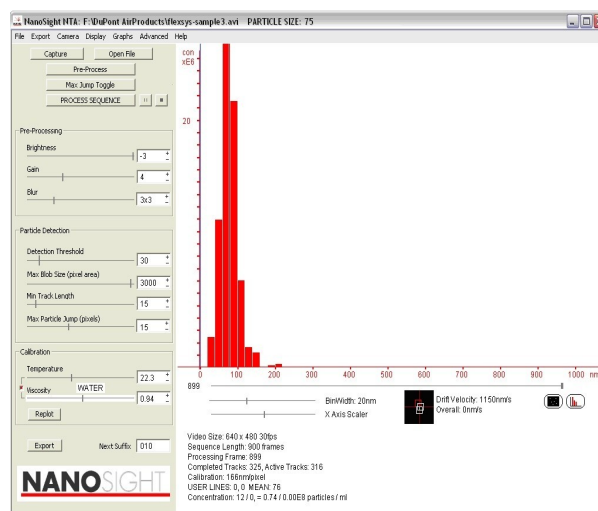


Figure 1: Particle size distribution produced from a silica CMP slurry (75 nm peak).

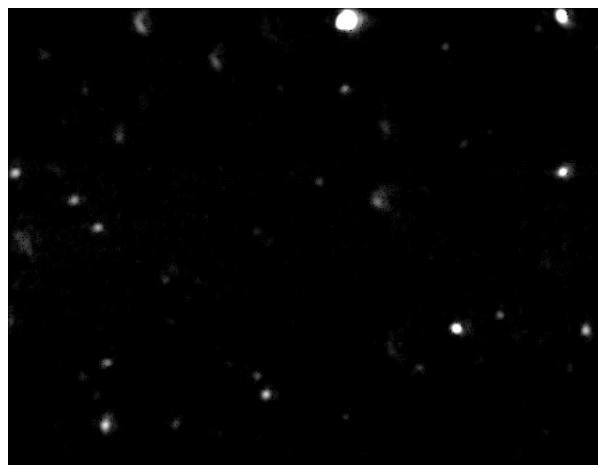


Figure 2: Image of CMP slurry particles produced by the NanoSight system. The broadness of the distribution can be seen, with some particles scattering light more intensely than others.



sizes can be directly calculated using the Stokes-Einstein equation.

The technique complements Electron Microscopy as it looks at the sample in its natural, unprepared state. Analysis time takes only 3-5 minutes from sample preparation to the particle size distribution result.

As the NTA technique visualises individual particles, it can also provide an estimate of the particle concentration within a sample. This allows the user to not only determine particle size but also relative concentrations within specific size classes.

Sample Preparation

In general, the technique requires sample dilution to approximately 10^9 particles/ml. From this, a sample of less than 500 μ l is taken and injected into the NanoSight unit.

Key Features

- Particles can be measured in natural state (without drying/vacuum)
- Greater ability to size polydisperse samples due to the insensitivity to intensity (associated with light scattering techniques)
- Small sample volume (500 μ l)
- Low cost of unit
- Visualisation of individual particles without any pre-treatment such as labelling
- Straight forward and rapid technique
- Allows the study of time-based changes, such as agglomeration, or stability
- Accurate particle sizing range from 10 nm - 1000 nm (larger particles present can be visualised)

Contact Details

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

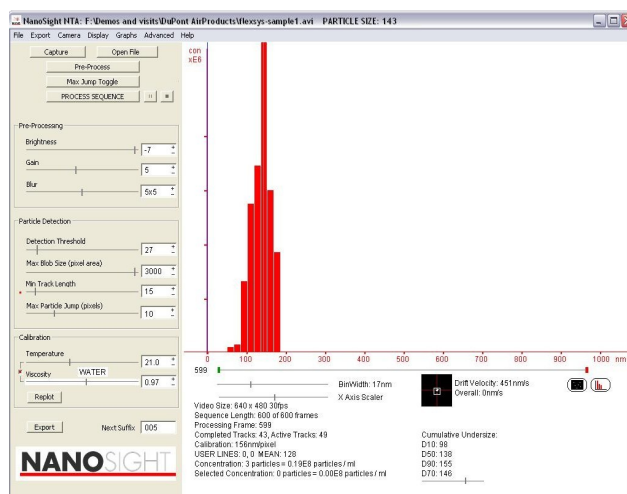


Figure 3: Particle size distribution produced from a CMP slurry with a 140 nm modal size.



Figure 4: Image of CMP slurry particles as produced by the NanoSight system.

