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Accurate identification, examination, and differentiation of multielement nanoparticles using time of flight ICP-MS and sub-millisecond spectral acquisition times

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The use of nanoparticulate materials has been increasing with large amounts being released into the environment each year. Therefore, sensitive methods are needed to detect these particles. While the size detection limit has been decreasing over the years with more sensitive detection methods becoming available, completely new instrumentation capable of simultaneous multi-element detection is necessary to examine the composition of individual particles.

The Vitesse TOF-ICP-MS can measure the full mass spectrum continuously at acquisition speeds down to 80 µs per spectrum. Together with powerful peak integration and identification methodologies, the data from individual nanoparticles can be identified and reduced efficiently and easily.

The accuracy of measurement of nanoparticle composition depends on a variety of parameters related to certain performance characteristics of the TOF-ICP-MS including;

- the effect of tuning on the signal peak shapes obtained for nanoparticles,
- the necessity of collecting spectral data at least 5 times faster than the duration of the particle signals
- the dynamic range of measurement for particle size
- the algorithm used to determine whether measured signals of different isotopes are due to multi-element particles or coinciding particles of different elements
- the importance of mass spectral quality and baseline correction methods on measured particle signals
- the limitations of dynamic range and ionic background noise on determination of particle composition relative to particle size

Data is presented which showcase the powerful capabilities of TOF-ICP-MS for the detection multiple isotopes in single particles to give statistically useful numbers of measured particle compositions and masses in each sample within one or two minutes.