Improvements in sample introduction and calibration approaches for analysis of engineered nanomaterials by single particle ICP-MS

NATHALIE TEPE[1*], ADAM LAYCOCK[1], THILO HOFMANN[1] AND FRANK VON DER KAMMER[1]

[1] University of Vienna, Department of Environmental Geosciences, Vienna, Austria
[*]nathalie.tepe@univie.ac.at

Single particle inductively coupled plasma-mass spectrometry (spICP-MS) is a powerful tool to quantify engineered nanomaterials. The analysis of engineered nanomaterials by spICP-MS provides information on their size, size distribution and particle number concentration. To avoid measuring bias it is anticipated that high transmission efficiencies will provide the most accurate characterisation of samples. It is also recognised that the signal intensities of elemental calibrations performed with dissolved standards are suppressed relative to particulate standards. As particulate standards are unavailable for many materials appropriate correction factors are required. Here we present optimised sample introduction and calibrations methods to improve the transmission efficiency and size determination of engineered nanomaterial suspensions when analysed by spICP-MS.

In this work three experimental set-ups for sample introduction were evaluated; i) a conventional pneumatic nebuliser combined with a double pass spray chamber, ii) two configurations using a CETAC DS-5 microflow concentric nebuliser in conjunction with iia) a low volume, single pass total consumption spray chamber and iib) a modified spray chamber with the option of an additional dilution gas. Furthermore, commonly applied calibration approaches with dissolved element standards are compared to a forward-thinking particle calibration approach.

Well-characterised gold (Au) and platinum (Pt) particle suspensions in a range of primary particle sizes were purchased from BBI Solution and nanoComposix europe, respectively. These suspensions were used as in-house particle standards to evaluate transmission efficiencies and to compare calibration approaches.

With the optimised sample introduction transmission efficiencies of up to ~70% were achieved, in comparison to up to ~5% for the conventional set-up. Appropriate calibration approaches with standard particles in a range of sizes offered the possibility to calculate reliable correction factors for dissolved standard calibrations.