Multi-element detection of nanoparticles with *icp*TOF

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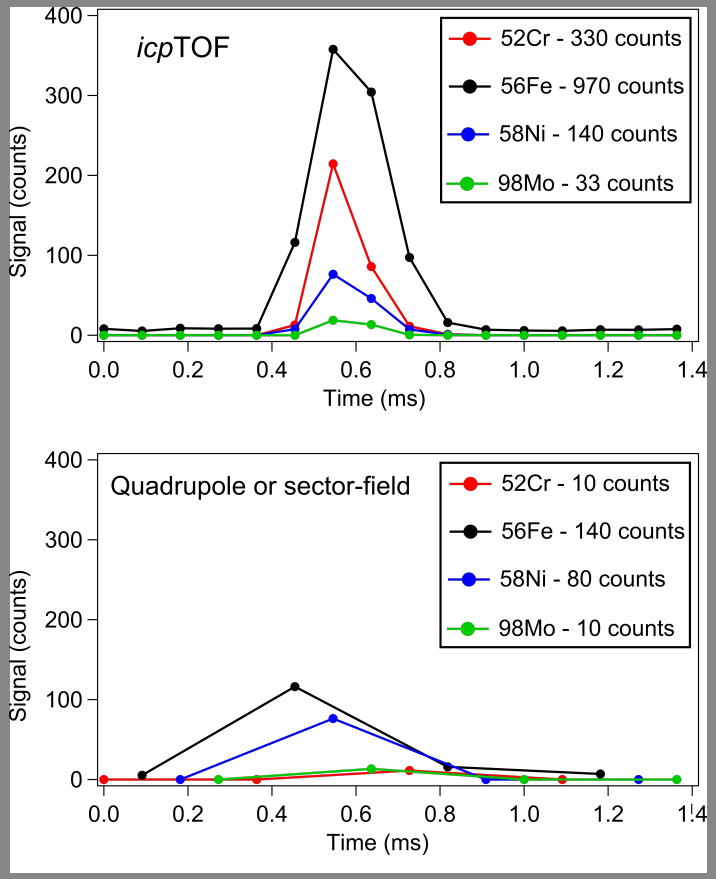
Inductively coupled plasma-mass spectrometry (ICP-MS) operated in single particle (sp) mode can be used as a rapid particle screening tool at low and environmentally relevant concentrations (ng/kg-µg/kg). Sp-ICP-MS performed with quadrupoles and sector-field instruments provides quantitative information about the mass, size and number concentration of particles composed of a single metal or metal oxide.

An increasing number of multi-element nanoparticles (alloy, core-shell structures) are being manufactured nowadays. Multi-element particle detection is necessary to trace manufactured nanoparticles in the high background of natural particles. However, this cannot be realized by sequential MS such as quadrupole and sector-field.

The *icp*TOF provides simultaneous detection of all isotopes and records a unique mass spectrum every 30 µs, making it an ideal tool for multielement detection and quantitation of nanoparticles in unknown or poorly characterized samples. Moreover, it uniquely combines high mass resolution with collision- and reaction-cell technology (Q-cell), enabling more efficient resolution of analytes from interferences (e.g. 56Fe).

The *icp*TOF quantitatively detects multiple isotopes in single nanoparticles at high temporal resolution and without loss in sensitivity and offers multiple approaches for interference removal.

*icp*TOF



Nanosteel nanoparticles composed of Fe, Cr, Ni, Mo were diluted with milliQ water and measured with the *icp*TOF using H2 in the Q-cell at 3 ml/min to remove ArO interference on 56Fe.
Top: Transient signal of a single steel particle detected with 90 µs temporal resolution (3 single TOF extractions were averaged). The total counts detected per particle are given.
Bottom: Simulated transient signal of the same particle recorded with sequentially measuring quadrupole or sector-field. The data were simulated from the TOF signal using 90 µs dwelling time on each isotope, with no analyzer settling time. Sensitivity is decreased by up to 33-fold due to sequential detection of the four isotopes. Element mass ratios deviate from ratios determined with TOF by 76-270%.

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