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Development of a High-Throughput Method for Elemental and Isotopic Characterization of Nanoparticles via Single Particle-ICP-TOF-MS

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Single particle-inductively coupled plasma-mass spectrometry (sp-ICP-MS) has become an intriguing technique for understanding the chemical and isotopic nature of nanoparticles. These nanoparticles have an impact in the food industry, environmental implications, and may pose toxic threats to biological life forms. The ability to detect these nanoparticles has improved over recent years, however, two key areas have not been well addressed: 1) ability to detect more than one element at a time for a single particle and 2) automation to allow for large amounts of samples to be measured while maintaining good sensitivity, robustness, and high transport efficiency.

Here we present an automated high-throughput method for the analysis of nanoparticles using a dedicated sample introduction system designed for single particle and single cell type applications. To address the need for detecting multiple elements or isotopes at one time, we employed an ICP-TOF-MS that allows for every element to be detected simultaneously. Three different nanoparticles (50 nm Au, 100 nm Au, and 60 nm Ag/Au core shells) were used to evaluate method robustness over multiple runs and days, size accuracy, and isotopic ratios for Ag. These results show that this combination of automation with the ICP-TOF-MS allows for hours to days of analysis opportunities while keeping method validity.