Use of elemental composition to quantify engineered nanoparticles in environmental samples

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The increasing manufacture and implementation of engineered nanomaterials (ENMs) will continue to lead to the release of these materials into the environment. Reliably assessing the environmental exposure risk of ENMs will depend highly on the ability to quantify and characterize these materials in environmental samples. However, performing these measurements is obstructed by the complexity of environmental sample matrices, physiochemical processes altering the state of the ENM, and the high background of naturally-occurring nanoparticles (NNPs), which may be similar in size, shape and composition of their engineered analogues. Current nanometrologies can be implemented to overcome some of these obstacles, but the ubiquity of NNPs presents a unique challenge requiring the exploitation of properties that discriminate engineered and natural nanomaterials. To this end, new techniques employing elemental analysis by ICP-MS are being developed that take advantage of the unique nature of ENMs to discern them from naturally occurring analogues. Specifically, by exploiting the narrow size distributions and elemental uniformity of ENPs, as compared to NNPs, their presence might be quanitfiable. Using the capabilities of field flow fractionation-ICP-MS for high resolution size and elemental analysis, narrow regions of a broad size distribution of NNPs can be probed for the presence of elements characteristic of the more-narrowly distibuted ENPs. Focusing on particle-by-particle analysis using single particle ICP-MS (spICP-MS), with multielement detection, may allow for ENP quantification using the realtively higher purity of the ENPs to distinquish from the more elementally complex ENPs. While only at the proof-of-concept stage currently, further development of these ICP-MS-based approaches may lead to a robust means of quantifying ENPs in complex environmetnal samples.