

Characterization of Nanoparticles in Mixtures by Capillary Electrophoresis and Taylor Dispersion Analysis Hyphenated to ICP-MS

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Summary

In this contribution, a novel methodology will be introduced for advanced characterization of the behavior of nanoparticles (NPs) in their mixtures in aqueous high-ionic strength conditions. Our approach utilizes Taylor dispersion analysis (TDA) connected to inductively coupled plasma mass spectrometry (ICP-MS) to probe metal-derived nanoparticles. The coupling of TDA and ICP-MS relies on our in-house developed interface connecting a capillary electrophoresis instrument with ICP-MS [1]. With this methodology, we are able to distinguish between magnetic Fe₃O₄-based, Au and Ag NPs. We can accurately determine their hydrodynamic size, and elemental composition in their mixtures and different pH (2.5, 4.5, 7.5, and 9.5) [2]. Moreover, the application of an electric field for a short period (e.g., 45 s) before TDA allows for the separation of ions from NPs. This approach was successfully applied, for instance, to distinguish between silver ions and Ag NPs at physiological pH. This distinction is of significant importance, especially in toxicity studies involving Ag-based products. Moreover, the setup can also be used to target protein-modified ultrasmall fluorescence NPs with core size of 1.7 nm in phosphate-based media, where traditional characterization techniques often fail. The future perspectives in the view of studies of interparticle interactions and self-assembling processes will be also mentioned.

References

- [1] A. Šebestová, D. Baron, R. Pechancová, T. Pluháček, J. Petr, Determination of oxaliplatin enantiomers at attomolar levels by capillary electrophoresis connected with inductively coupled plasma mass spectrometry, *Talanta* 205 (2019) 120151.
- [2] D. Baron, T. Pluháček, J. Petr, submitted.