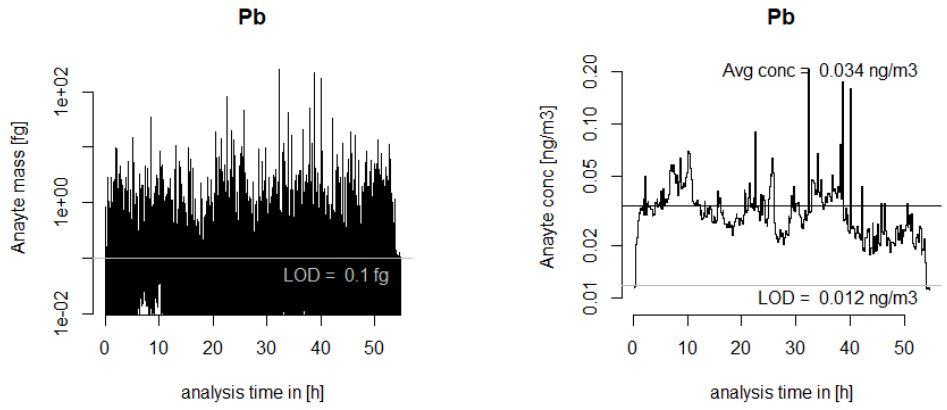
Quantitative Measurement of Dynamic Changes of Trace Element Content in Ambient Aerosol by MICAP-TOFMS

Martin Tanner, Alexander Gundlach-Graham, Carsten Stoermer

TOFWERK AG, Schorenstrasse 39, 3645 Thun, Switzerland
m.tanner@tofwerk.com

Knowledge of metal content in aerosol is crucial for source apportionment and estimation of potential health risks [1]. However, quantification of metal aerosols is analytically challenging because low detection limits for a wide range of analytes are required. Currently, there are two main technologies applied: ICP-MS [1] and XRF [2]. Both ICP-MS and XRF are typically used to analyze aerosol that is collected on filters, and so can only provide metal-aerosol content with a time resolution from 30 minutes to 24 hours. Nonetheless, shorter accumulation times (or even real-time analysis) would be preferable to allow for monitoring dynamic processes of variable metal concentrations in outdoor or indoor environments.



Pb content in industrial indoor air. Signal measured in 1 s intervals over 50 h (left). The same signal averaged to 10 min intervals and considering the actual volume flow (right).

We present an approach to directly measure aerosol metal content at the single-particle level and in real time using a Microwave-Sustained, Inductively Coupled, Atmospheric-pressure Plasma (MICAP) coupled with a Time-of-Flight Mass Spectrometer (TOFMS) [3]. Microdroplet calibration standards were used to calibrate signal intensities to analyte mass [4]. The setup offers simultaneous detection of femtogram amounts of most metallic elements in individual particles, which translates to ng m^{-3} detection limits. Results from measured indoor and outdoor air will be discussed.

[1] Daellenbach, K. R., Uzu, G., Jiang, J., Cassagnes, L. E., Leni, Z., Vlachou, A., Stefenelli G., Canonaco F., Weber S., Segers A., Kuenen J. J. P., Schaap M., Favez O., Albinet A., Aksoyoglu S., Dommen J., Baltensperger U., Geiser M., El Haddad I., Jaffrezo J.-L. & Prévôt, A. S., *Nature*, **2020**, 587(7834), 414-419.

[2] Furger, M., Minguillón, M. C., Yadav, V., Slowik, J. G., Hüglin, C., Fröhlich, R., Petterson, K., Baltensperger, U., and Prévôt, A. S. H., *Atmos. Meas. Tech.*, **2027**, 10, 2061–2076

[3] Schild, M., Gundlach-Graham, A., Menon, A., Jevtic, J., Pikelja, V., Tanner, M., Hattendorf, B. & Günther, D., *Analytical chemistry*, **2018**, 90(22), 13443-13450.

[4] Hendriks, L., Ramkorun-Schmidt, B., Gundlach-Graham, A., Koch, J., Grass, R. N., Jakubowski, N., & Günther, D., *Journal of Analytical Atomic Spectrometry*, **2019**, 34(4), 716-728.