Total-Reflection X-Ray Fluorescence Analysis (TXRF) of Airborne Particulate Matter at Atominstitut – Overview of Recent Activities

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The Atominstitut X-ray group has been working on APM for several years using both TXRF and classical energy-dispersive XRF. In a recent paper a quantitative analysis method for TXRF of APM was presented. [1] This method uses a three-stage Dekati cascade impactor (cut-off diameters 10, 2.5 and 1 µm, backup filter for particles < 1 µm) equipped with 30 mm Vaseline coated quartz reflectors. After sampling 5 ng Y are added centrally to each sample and the Vaseline layer is removed by cold plasma ashing for 30 minutes. For each stage an individual calibration curve had to be established, as the spot patterns produced by the impactor extend over the area seen by the detector. To this end the spot patterns were simulated using droplets of multielement standard solutions applied with the Atominstitut Nanoliter Deposition Unit. [2] In January 2017 an outdoor sampling campaign was carried out during 10 days. Samplings were carried out hourly with a sampling time of 45 minutes. The size fractions collected on quartz reflectors (i.e. > 1 µm) are dominated by crustal elements such as Ca, Ti, Fe and Sr as well as Cl coming from de-icing salt. The backup filters were changed weekly and analyzed by conventional EDXRF. This size fraction is dominated by anthropogenic particles forming from combustion processes, typically containing S, K, Zn and Pb. Quantitative results of this sampling campaign will be shown and discussed.

To assess the sub-µm fraction also with TXRF, a four-stage Sioutas impactor was used (cut-off diameters 2.5, 1, 0.5 and 0.25 µm) in a sampling campaign in October 2017. Sampling was performed for 90 minutes on 1” Si wafers greased with Vaseline, with a quantitative analysis procedure similar to the one described above. Results agree very well with the January results with the anthropogenic particle fraction having its maximum in the 0.25 µm stage.

Furthermore, a comparative study was carried out by parallel sampling with the Dekati impactor as well as a Gent sampler [3], which collects particles > 2 µm and < 2 µm on filters for subsequent EDXRF analysis. For this method a calibration, verified using *NIST SRM 2783 Air particulate on filter media*, is available. Results will be presented and discussed.

[1] J. Prost, P. Wobrauschek, C.Streli, X-Ray Spectrom 46, 2017, 454-460.
[2] A. Wastl et al., Spectrochim Acta B 82, 2013, 71-75.
[3] W. Maenhaut et al., Nucl Instr and Meth B 109/110, 1996, 482-487.