

Trace element analysis of airborne particulate matter with TXRF and SR-TXRF-XANES

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Airborne particulate matter is a topic of growing interest. Particles with aerodynamic diameters less than 10 μm (PM_{10}) and especially the fine fraction below 2.5 μm ($\text{PM}_{2.5}$) are of particular importance, as they can enter the human respiratory system and cause acute and chronic respiratory or cardiovascular diseases [1]. The mass distribution of airborne particles in dependence of their diameters is well-known [2], but also the abundance and temporal variation of trace elements in air (mass concentrations down to the pg/m^3 range) are crucial. These elements originate from various natural (abrasion, erosion) and anthropogenic sources (combustion, road traffic), which complicate the discrimination between harmless and toxic emissions. Some new methods of investigation are therefore needed and X-ray fluorescence spectroscopy has ascertained its huge potential in this matter, thanks to the possibility to determine simultaneously, in a time-resolved manner, the mass concentrations of critical elements which can be considered as markers of a potential toxic source.

A method for the quantitative analysis of airborne particles directly collected on sample substrates (30 mm quartz reflectors and 1" Si wafers) suited for total-reflection X-ray fluorescence analysis (TXRF) will be presented. Samplings were performed using a three-stage DekatiTM PM10 impactor ($>10 \mu\text{m}$, 2.5 to 10 μm and 1 to 2.5 μm) and a four-stage Sioutas Personal Cascade Impactor ($>2.5 \mu\text{m}$, 1 to 2.5 μm , 0.5 to 1 μm and 0.25 to 0.5 μm) at indoor and outdoor sites at the Atominstitut (Vienna, Austria). Quantitative results of two outdoor test sampling campaigns (July 2016 and January 2017) will be presented and discussed. Low detection limits were assessed via TXRF and range from several 10 to several 100 pg/m^3 depending on the element and particle size fraction.

Furthermore, chemical speciation of the elements Cr, Cu and Zn using X-ray absorption near-edge structure (XANES) analysis was carried out at the BAMline @ BESSY-II, Berlin, and at the XRF beamline at ELETTRA – Sincrotrone Trieste, Italy. Results from these measurements will be presented and discussed in detail.

[1] C.I. Davidson, R.F. Phalen, P.A. Solomon, *Aerosol Sci. Technol.*, 39(8), **2005**, 737-749.

[2] J.H. Seinfeld, S.N. Pandis, *Atmospheric Chemistry and Physics*, 2nd ed., Wiley, **2006**.