TXRF analysis of silver nanoparticles in fabrics

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Silver nanoparticles are commonly used for an increasing amount of a variety of products due to their antibacterial effects. These effects are caused by silver ions on the particle surface and therefore increased with increasing surface area. However, toxic effects on animals have been reported [1, 2] and harmful effects on human health are possible. Silver nanoparticles are also environmentally accumulated [3]. One pathway of mobilization of Ag is in form of airborne particles. Since harmful effects are always depending on concentrations and particle size a detailed knowledge about the amounts and size of silver nanoparticles originating from fabrics is crucial. Therefore, aerosols from fabrics coated with Ag nanoparticles were collected from a test control unit where fabrics are tested for galling resistance. A low pressure Berner impactor was used for size segregated aerosol collection, which is capable of collecting particles down to 15 nm in diameter on Si-wafer carriers.

Total X-ray reflection analysis (TXRF) is a time and cost efficient analysis capable to nondestructively analyze minute amounts of sample material. Specimen preparation in environmental TXRF usually includes preparation of a liquid sample on a carrier, which is then dried to give a small residue. Small deposits of aerosols can be analyzed likewise, if the Si-wafer with the aerosol is placed in an adapted sample holder.

TXRF measurements are usually carried out in air, so an argon Kα peak at 2.957 keV that is interfering with the silver L-lines around 2.984 keV will always occur and therefore be hampering the analysis of minute amounts. In order to eliminate the argon peak it is obvious to work in a nitrogen atmosphere. To achieve that, we build a box for our TXRF instrument (Picofox, Bruker) that can be connected to a nitrogen gas container and opposing to that to a vacuum pump. The pump is required to apply a nitrogen flow for cooling. With the argon peak eliminated, a quantitative analysis of the silver nanoparticles will be possible. For comparison single particles were also analyzed using electron micro probe analysis.

