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Toxicity of metal nanoparticles and determination of dose in the Air-Liquid interface

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Nanoparticle exposure by inhalation is of special toxicological interest since the lung represent our largest contact area towards our environment. There is an ongoing discussion whether conventional toxicological methods are sufficient to evaluate the risk of inhalable nanoparticles. Since the use of nanoparticles in occupational settings and consumer products is increasing the need for relevant toxicological data is great. This has led to the emergence of Air-Liquid Interface toxicology. Here aerosol nanoparticles are administered from air and deposited upon cellular cultures providing an environment that resembles that of the lung.

NPs were generated and characterized in the aerosol phase with regards to mass, size and morphology. The NPs were deposited unto cellular cultures using a commercialised deposition chamber, Nano Aerosol Chamber In Vitro Toxicity (NACIVT) Savi et al (2008). Multiple methods were used to determine the deposition efficiency and delivered dose in the NACIVT system. Among these nanoparticles were deposited on silicon wafers in the NACIVT and analysed by SEM, Figure 1.

![Figure 1. SEM deposition-efficiency analysis of AgNPs deposited on a silicon wafer in the NACIVT system.](image1)

The toxic response of of silver, gold, palladium, copper and nickel NPs were tested. The NPs were generated using a novel spark discharge generator. To calculate the dose with respect to number, mass and surface area, the particles were characterised online using a Scanning Mobility Particle Sizer, a TEOM, and an Aerosol particle mass analyser coupled in series after a Differential Mobility Analyser in a set-up similar to that in Messing et al (2013). Furthermore, off-line TEM analysis were performed. The nanoparticle dose was controlled by a dilutor, keeping other parameters such as spark discharge generator-settings and exposure time constant.

Primary small airway epithelial and standard cell line A549, was used during 1 hour exposure events in the NACIVT system. Toxicological endpoints were analysed 48h post exposure and included WST-1 viability, cytokine secretion and gene expression data.

![Figure 2. Dose-response of copper nanoparticles in the Air-Liquid interface.](image2)

A Dose-response of WST-1 viability with an increasing dose of copper nanoparticles could be determined for the primary cells, Figure 2. Dose response could also be observed in A549 cell line and other endpoints including TNF-α.

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