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Toxicity of metal NPs in the Air-Liquid interface

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Introduction

Exposure by inhalation is one route of exposure that has been pinpointed as important in risk assessments of manufactured nanoparticles (MNPs). There is an ongoing discussion whether traditional toxicological methods are sufficient to evaluate the risk of inhalable nanoparticles. Since the use of MNPs is increasing, the need for toxicological data is great. This has led to the emergence of Air-Liquid Interface toxicology. Here aerosol MNPs are administered from air and directly deposited upon cellular cultures, preferably of primary lung cells, providing an environment that more resembles that of the human respiratory tract.

Methods

This work is a holistic approach for the toxicology of metal NPs. The NPs are characterized in the aerosol phase with regards to mass, size and morphology, Figure 1. The NPs are then deposited unto cellular cultures using a commercialised deposition chamber, Nano Aerosol Chamber In Vitro Toxicity (NACIVT) Savi et al (2008).

Aerosols of gold, palladium, copper and nickel nanoparticles were generated using a novel spark discharge generator, built at the Solid State Physics at Lunds University. In order to estimate the dose with respect to number, mass and surface area, the particles were characterised airborne using a Scanning mobility particle sizer (SMPS), a TEOM, and an Aerosol particle mass analyser (APM) coupled in series after a Differential Mobility Analyser (DMA), Messing et al (2013). A dilutor was used to vary the dose, keeping other parameters such as spark discharge generator-settings and exposure time constant.

Both primary and standard cell lines, was used during 1 hour exposure events in the NACIVT chamber. Toxicological endpoints were analysed 48h post exposure and included WST-1 viability, cytokine secretion and gene expression data.

Conclusions

Aerosol generation was stable during the 1 hour exposure events in the NACIVT chamber.

![Figure 1. System setup for generation, characterization and deposition of metal NPs. Path 1) Characterization using DMA-APM. Path 2) Online characterization and deposition in NACIVT.](image)

A Dose-response of TNF-α with an increasing dose of silver and copper nanoparticles could be observed for primary epithelial cells, Figure 2. Effects could also be observed in A549 lung cancer epithelial cell lines.

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