Measurements of exposure and emission of arc discharge produced multi-walled carbon nanotubes in a small scale facility

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16. Exposure assessment of silver nanoparticles- Modelling of an exposure scenario for consumer products

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Nanomaterials have a great capacity to improve industrial and consumer products or create new applications. Researchers evaluating toxicity and human exposure potential of engineered nanomaterials (ENM) are challenged by rapid development of novel materials.

In the context of the project nanoGEM the internal and external exposure as well as the toxicity and biokinetic of selected, industrial relevant nanoobjects are investigated for a risk assessment.

Our goal was to estimate available data of exposure of different ENMs in consumer products based on relevant regulating background.
Inhalation is assumed as a critical uptake route and may be the key exposure route to human body. Therefore sprays are considered to be critical to human health because ENMs can attain to the pulmonary region of the respiratory tract due to their small size.

The results of exposure of silver nanoparticles during a spray process are presented here. We reviewed published in-vivo and in-vitro data of silver nanoparticles to identify input levels for estimating silver mass retained in the human lung using ConsExpo and SprayExpo model. The results of the two different exposure programs were compared to get information about the potential application of using these models for estimating human exposure of ENMs in consumer products.

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The industrial use of carbon nanotubes (CNTs) is rapidly growing as well as the potential for worker exposure. This study aimed to perform measurements at a small scale facility producing multi-walled carbon nanotubes (MWCNT) by arc discharge. Several steps in the production, such as harvesting, sieving, dispersion and purification of harvested material, involves handling of MWCNTs in powder form during which the workers are potentially exposed. Both personal exposure measurements and fixed emission measurements of respirable dust to determine mass concentration, particle number concentration and elemental carbon (EC) were performed. Full-shift filter sampling in the workers breathing zone was performed during two consecutive workdays. By using cyclones (BGI4L, BGI) respirable dust fractions were collected on MCE-filters (37 mm diameter; 0.45 µm pores) for gravimetric analysis, on polycarbonate filters (37 mm diameter; 0.4 µm pores) for SEM analysis and on quartz filters (37 mm diameter) for thermal-optical analysis. Direct-reading instruments measuring respirable mass concentration (Sidepak, TSI) and particle number concentration (Nanotracer, Philips Electronics) in the workers breathing zone were used. For each production step emission sampling was conducted a few cm from the emission source. Preliminary data shows mass concentrations of respirable dust up to 93 µg/m^3 in breathing zone and 6818 µg/m^3 at emission source. Particle number concentrations up to 0.57 CNT-containing particles/cm^3 in breathing zone and 11.08 CNT-containing particles/cm^3 at emission source were also measured. Thus, the results demonstrate workplace exposure to MWCNTs.