Selection of metrics relevant for inhalation health risk study of nanoparticle aerosols

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It is expected that the greatest danger for human exposure to engineered nanoparticles in the next few years is at the workplace. However, the existing methodologies may not be appropriate for assessing the potential health risks associated with different kinds of engineered nanoparticles. In addition, nanoparticles released to air will undergo rapid physical changes, e.g. form larger agglomerates and/or bind to ambient aerosol particles. The changes in their physical properties will lead to changes in their toxicological properties. One of the key issues in health risk assessment of inhaled nanoparticles is what the relevant metrics are that should be used to monitor nanoparticles in workplace air.

Within the framework of the EU funded NANOTRANSPORT project (FP6), we have carried out a state-of-the-art study to identify parameters governing the physical, chemical and biological behavior of nanoparticle aerosols. We evaluated characterization metrics for assessment of health risks by inhaled engineered nanoparticles and selected model parameters to document physical changes, which airborne nanoparticles will undergo after release. An experimental program has been developed based on analysis of realistic model exposure scenarios in occupational settings. Experimental work has been carried out to monitor physical changes of freshly generated nanoparticles after release in an exposure chamber.

For on-line monitoring, particle size number distribution is regarded as the most important metric relevant for nanoparticle toxicology and aerosol dynamics. The surface area, a secondary metric, can be calculated from the particle size number distribution by making a few assumptions. The effects of particle shape and fractal dimension of agglomerates on aerosol dynamics is considered to be small, less than a factor of 2.

Our first experimental results show that with the chosen experimental setup and measurement techniques, the particle size changes under different release conditions can be quantitatively monitored. The quantitative documentation of agglomeration procedures of primary nanoparticles in different occupational settings is of great importance for toxicological studies and health risk assessments.