# Aerosol Dynamics of NP in Workplace Exposure

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Recent research has indicated that the toxicity of inhaled ultrafine particles may be associated with the size of particles deposited (Oberdörster, 2000). For the estimation of health effects it is therefore important to obtain knowledge about the evolution of particle size from the point of release to the (human) receptor under conditions relevant for workplace exposure. Parameters of relevance include the time interval between release and reception and the characteristics of the background aerosol.
State-of-the-art nanoparticle (NP) generation and aerosol monitoring equipment was used to demonstrate that the properties of the generated NP aerosols change dramatically between the source and the point of reception in a simulated environment. An aerosol chamber was designed with the dimensions 1·1·2 m and a volume of 2 m³. On the floor a speed-adjustable fan was placed, allowing a variation of the flow pattern from still air to a fully turbulent flow. At several points distributed over the walls sampling probes allowed the release of particles and the extraction of small sample flows from the chamber. After characterization of the NP source changes in the aerosol characteristics in terms of size distribution, concentration and chemical composition were investigated as functions of time and distance from point of release and interaction with pre-existing ambient aerosol particles.
Platinum NP with a mean diameter of 9 nm and a geometric standard deviation of 1.3 were generated using a Hot-Wire Generator (HWG). These particles were fed to the chamber for several hours and the particle size distributions (PSD) were measured. Then, the particle feed was shut off while detecting the PSDs for several more hours. Experiments were done at varied fan speed. Without a background aerosol the changes in the size distribution could be explained by coagulation kinetics over a long period of time.
To demonstrate the interactions of exposed NP with ambient air particles, the silica particles (Monospheres, Merck KGaA) were released to the chamber with a constant concentration of about $1\text{-}2\cdot10^4$ $cm^{-3}$, which is a typical indoor particle concentration. Then Pt particles were released and the size distribution evolution was measured with SMPS and an optical particle counter (Grimm, Model 1.109). It was shown that the Pt particles very rapidly coagulate with the coarse particles and could not be detected with the particle counters anymore. Measurements were also done with a multistage cascade impactor (18 nm – 20 µm) to demonstrate that the Pt particles were still dispersed in air adhering to the silica particles. The Pt NP were then distinguished chemically from the ambient aerosol by ICP-OES. The experiments demonstrated, that the NP, although invisible in the size distribution, remained airborne attached to larger background aerosol particles. This work is part of the project "Nanotransport" supported by the European Commission under grant FP6-2004-TI4.

Oberdörster, G. (2000). *Phil. Trans. R. Soc. London Ser. A,* 358(1775), 2719-2740.