

Occupational exposure to ultrafine particles – work place measurements

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Ultrafine particles have been postulated to be one of the most expanding risks for occupational health (Brun et al. 2009). In work environment the employee may expose to ultrafine particles. These originate from unintentional sources, e.g. welding fumes and combustion particles, or they may be purposely manufactured process particles, such as engineered nanoparticles (ENPs) (e.g. Maynard et al. 2005).

Work environment airborne PM originates from outdoor air and indoor sources. Indoor sources may be separated by measuring size differentiated concentrations and following work processes (Koivisto et al. 2012). Representative data is still lacking in large scale, thus measurements in work places are seen important.

Methods

We are studying the number concentration of ultrafine particles in different working environments. The measurement setup used in workplace measurements is illustrated in Fig. 1.

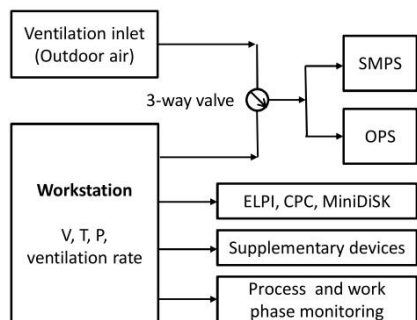


Figure 1. Measurement setup.

The exposure is defined from the work station and breathing zone. The ventilation inlet concentration defines the background. When measurements from ventilation inlet are not possible the outdoor air is measured instead where the penetration of the particles to indoors are defined with I/O measurements. For measuring number size distribution a Scanning mobility particle sizer (SMPS), Optical particle sizer (OPS), Condensation particle counter (CPC) and Electrical low pressure impactor (ELPI) are used. Personal exposure from the breathing zone is measured with MiniDiSC (Fierz et al. 2011). With this setup a particle size range of app. 3nm-10 μ m depending on application is achieved. Additionally other measurement devices are being used

to produce supplementary information on measurements. This could be e.g. measurements of gas phase contaminants or collection of EM-samples. The work process is monitored and different processes during the working period are linked to the concentrations.

Results and Discussion

In this study the occupational exposure to fine and ultrafine particles in various working environments is measured. Fig 2. shows an example of the work place measurements. The total particle concentration and particle size distribution measured during one working day in an industrial factory handling nanodiamonds (ND) is shown. Based on the results the ND concentration during the handling process does not significantly differ from the ventilation inlet concentration (i.e. background). However, the personal exposure to large ND agglomerates may be seen. The workers inhalation exposure in this case was negligible due to proper use of respiratory protective equipment.

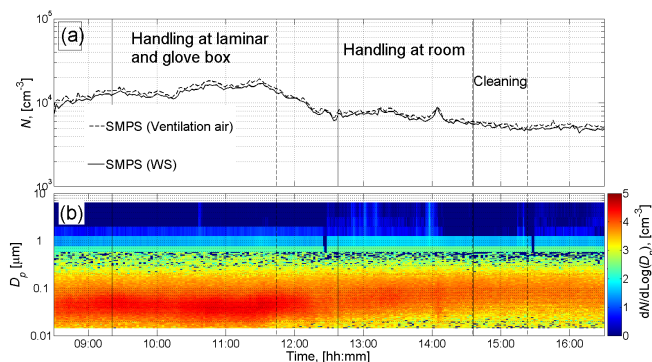


Figure 2. (a) Particle number concentration during a one day working period measured with SMPS from the work station (solid line) and ventilation inlet (dashed line). (b) Particle size distribution measured with SMPS and ELPI.

Different work phases have been indicated into the figure with vertical lines.

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