A prototype of a new engineered nanoparticle monitoring device for workplaces: Device testing

J. Ruusunen[1], J. Leskinen[1], T. Torvela[1], M. Ihalainen[1,2], T. Karhunen[1], I. K. Koponen[3], V. Niemelä[4], A. Lähde[1] and J. Jokiniemi[1,5]

[1] University of Eastern Finland, Fine Particle and Aerosol Technology Laboratory, P.O.Box 1627, FI-70211, Kuopio, Finland
[2] PSI Paul Scherrer Institut, The Laboratory for Thermal-Hydraulics, CH-5232 Villigen PSI, Switzerland
[3]National Research Centre for the Working Environment, Lerso Parkallé 105, DK-2100 Copenhagen, Denmark
[4]Dekati Ltd., Osuusmyllynkatu 13, FIN-33700, Tampere, Finland
[5]VTT Technical Research Centre of Finland, P.O. Box 1000, 02044 VTT, Espoo, Finland
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Presenting author email: jarno.ruusunen@uef.fi

Occupational health risks related to workplace exposure to engineered nanoparticles (ENP) are still not well understood and there seems to be lack of instruments to measure of ENPs in the workplaces. On the market there are a few measurement devices for the ENP monitoring, such as the Nanoparticle surface area monitor (NSAM, model 3550, TSI, USA) (Asbach *et al*, 2009) and the Aerasense NanoMonitor (Philips, Netherlands). However, at workplaces there is still need for low-cost, easy to use and portable nanoparticle monitoring instruments. A prototype of a new engineered nanoparticle monitoring device (Dekati Low-Cost Surface Area Monitor LC-SAM, Dekati Ltd., Finland) based on escaping current technology has been built by Dekati Ltd in EU FP7 Nanodevice -project. In this study a prototype device was tested.

ENPs for the device testing were produced using Flame spray pyrolysis (FSP) (Karhunen *et al*, 2012) and Atmospheric pressure chemical vapour synthesis (APCVS) (Lähde *et al*, 2011). In addition, the aerosol generator (model 3076, TSI, USA) was used to produce ammonium sulfate ($(NH_4)_2SO_4$) and polystyrene latex (PSL) particles as reference materials, see Table 1.

The Scanning mobility particle sizer (SMPS, model 3080, TSI, USA), the NSAM, the Electrical low pressure impactor (ELPI and ELPI+, Dekati Ltd, Finland) and the Fast mobility particle sizer spectrometer (FMPS, model 3091, TSI, USA) were used to characterize the produced ENPs and the reference particles.

Material	GMD (nm)	c ($\cdot 10^4/cm^3$)
$(NH_4)_2SO_4$	40	6.9
PSL	74	1.0
Cu	98	5.7
LTO	193	5.1

Table 1. Materials used for testing, geometric mean diameter (GMD) and concentration (c) of the particles according to SMPS.

The produced ENPs were diluted with a porous tube diluter and an ejector diluter prior to sampling to achieve suitable sampling conditions. The Dekati LC-SAM was used in a small exposure chamber and the samples for the NSAM were taken from the same location.

The current I (fA) measured with the Dekati LC-SAM is relative to the active surface area of particles going through the device. For LTO ENPs the signal are presented in Figure 1a and the human lung-deposited surface area D ($\mu m^2/cm^3$) measured with the NSAM for LTO ENPs can be seen in Figure 1b. While the measuring principle of the Dekati LC-SAM and NSAM has some differences there was still a good agreement between the measured values.

As a conclusion, the Dekati LC-SAM has a good agreement between the measured values and the characteristic of the produced ENPs. Results indicated that tested device offer one alternative to measure workplace exposures for ENPs.

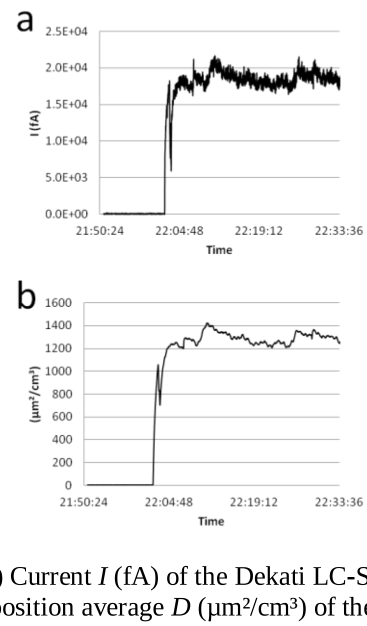

Figure 1. a) Current *I* (fA) of the Dekati LC-SAM and b) Lung deposition average *D* ($\mu m^2/cm^3$) of the NSAM.

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