Miniature electrical nanoparticle detector for simultaneous measurement of particle number, average size and lung-deposited surface area

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We have recently introduced the concept of aerosol measurements by induced currents, where pulsed unipolar charging leads to a varying space charge in an open Faraday cage, thereby inducing a compensating current to the Faraday cage. (Fierz et al, 2014). This technique allows a contactless / non-collective measurement of aerosol charge, and, since only a signal amplitude is measured, the measurement is insensitive to the electrometer offset. We also built a miniature instrument based on this principle, which measures the charge transfer to an aerosol in unipolar charging, the naneos partector. This instrument is very similar to standard diffusion chargers (like the TSI NSAM).

Here, we present an extension of the original partector, the partector 2 (Figure 1):

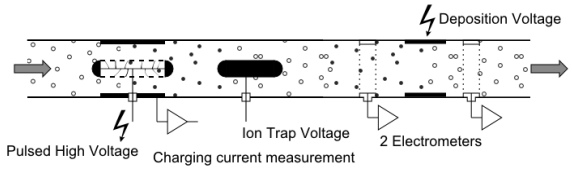

Figure 1. A scheme of the new instrument

Like its predecessor, the partector 2 is based on pulsed unipolar charging, followed by contactless electrical detection of the charges by induced currents in Faraday cages.

The partector 2 contains two Faraday cages for detection, which are separated by an electrostatic precipitator. As in the standard partector, the first Faraday cage electrometer measures an amplitude proportional to the total charge acquired by the aerosol, which is approximately proportional to the lung-deposited surface area of the nanoparticles (LDSA) (Wilson, 2007). In the electrostatic precipitator, small particles are preferentially removed, and thus the electrometer amplitude in the second Faraday cage is reduced. The ratio of the two signal amplitudes on the two Faraday cages is a measure for the average particle diameter of the aerosol, as can be seen in Figure 2. Once the average particle diameter is known, the particle number can be inferred from the signal amplitude on the first cage, as in other simple electrical detectors (Matter Aerosol DiSCmini, Philips Nanotracer).

The first devices have now been built and, despite having added several components (a second detection stage and electrometer, an electrostatic precipitator and a second high voltage module), the partector 2 is hardly bigger than the original partector: at 142x88x32mm it is still very small, and thanks to a plastic housing, it is also light at 420g. The battery lifetime has been increased to 24h.

We will show date on the performance of the instrument for lab-generated and ambient aerosol, and data on the long-term performance of the instrument.

As with the standard partector, the detection principle is insensitive to electrometer drifts. Due to the non-collective principle, long service intervals can be achieved.

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Wilson W.E. et al. (2007) *J. Air & Waste Manage. Assoc.* **57**:211-220.