Nanometer to Micrometer Measurements with a Portable Hybrid Device For Wide Range Aerosol Size Distributions

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Measuring wide ranging particle size distributions from Nano- to micrometer generally require a combination of separate devices, such as Scanning Mobility Particle Sizers (SMPS) and Optical Particle Counters (OPC) or aerodynamic particle sizers (APS).

The company GRIMM developed a new compact and portable device that consists of an optical and electrical sensor in one device. This is world-wide unique.

It allows a wide range of particle size detection between 10 nm and 25 µm with 40 size channels with a time resolution of one complete scan of only 1 minute. Thus, very short-lived as well as highly time-varying particle sources can be examined. Figure 1 shows the MINI-WRAS device.

Figure 1. Grimm MINI-WRAS

The optical module is a newly designed particle spectrometer, which detects each individual particle and classifies its size accordingly (single particle counting).
A powerful laser diode is used as a light source. Internally, the power of the laser diode is constantly monitored and kept constant. A pin diode generates the detection signal, which turned out to be the best compromise between reliability and performance. The number of particles is determined by the number of stray light pulses per period, the particle size determines the amplitude of the scattered light. These measurements require a precisely controlled flow rate, which is determined continuously via aperture and pressure sensors.

The electrical module consists of three main components, the unipolar corona charger, a precipitation electrode and a Faraday Cup Electrometer (FCE). Once the aerosol particles (each single particle) are counted by the optical sensor and classified, they go through a short tube connected directly to the electrical sensor. Here all Nanoparticles can be reliably detected. Initially the particles are charged unipolar (positively) in the electric sensor with a positive corona charge. Then the particles go into a collecting electrode, where they are separated according to their electrical mobility. A portion of the aerosol stream passes through the collecting electrode and is recorded in the Faraday Cup Electrometer (FCE). Based on the current measured at the FCE, the volume flow, the geometry of the sensor and the charge efficiency of the particles, the size of the particles can be determined. The electrical sensor offers the possibility to determine the number of particles of a size distribution of particles similar to the optical sensor: A change of the electrode voltage in 10 steps classifies the particle size between 10 nm to approximately 200 nm in 10 classes.

The measured values of the two sensors are combined internally by a special electronics and firmware, such that the user receives measurements, which do not differ from the output of a single sensor in the nature and structure.

Extremely important to mention for this unique device is the fact, that it does not need any liquids like butanol in order to detect Nano particles, nor does it need any other consumables.

Measurement results for different applications (workplace, traffic, industry) will be presented.

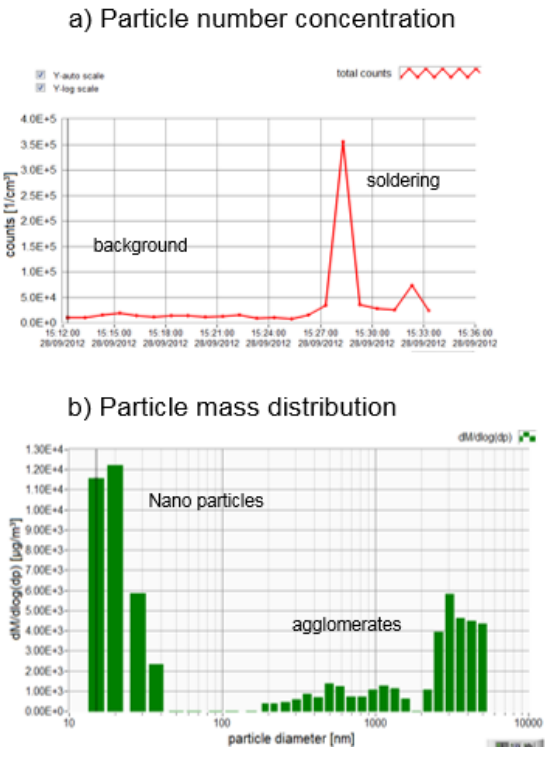

Figure 2: Measurements at workplaces with soldering a) total particle number concentration, b) particle mass distribution