Portable Sizer that Meets the Challenge of Nanoscale Metrics

Application Note NANOSCAN-003 (US)

Definition of Nanomaterial

On October 18, 2011, the European Commission (EC) adopted the following definition of nanomaterial[1]:

> "a natural, incidental, or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the **number size distribution**, one or more external dimensions is in the size range 1 to 100 nm"

The definition reflects the consensus that mass-based metrics are not appropriate for nanoscale particles. Moreover, it requires that both size and number concentration are quantified in order to identify particles as "nano." While previous definitions of nanomaterial included a size range of <100 nm, the inclusion of a size distribution metric represents progress based on data published over the last decade indicating that particle number may be the most applicable metric for nanomaterials[2–4].

A Portable Nanoparticle Sizer for Number-based Measurements

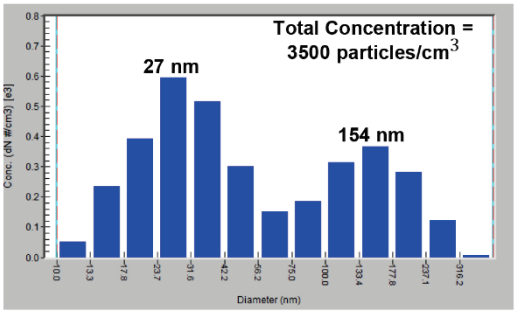
NanoScan SMPS™

The NanoScan SMPS™ is a portable, battery-operated instrument that uses Scanning Mobility Particle Sizer™ (SMPS™) Spectrometer technology to meet the challenge of nanomaterial metrics. The key to reliable number-based size distribution measurements lie in the ability of the NanoScan SMPS™ to count size-classified particles using single-particle detection.

NanoScan SMPS

Many nanoparticle measurement methods generate size distributions that must be mathematically converted into number-weighted distributions based on assumptions and are prone to error, particularly as the particle size or mass fraction decreases[5]. Methods that directly count particles often count an extremely small number of particles, resulting in unreliable measurements.

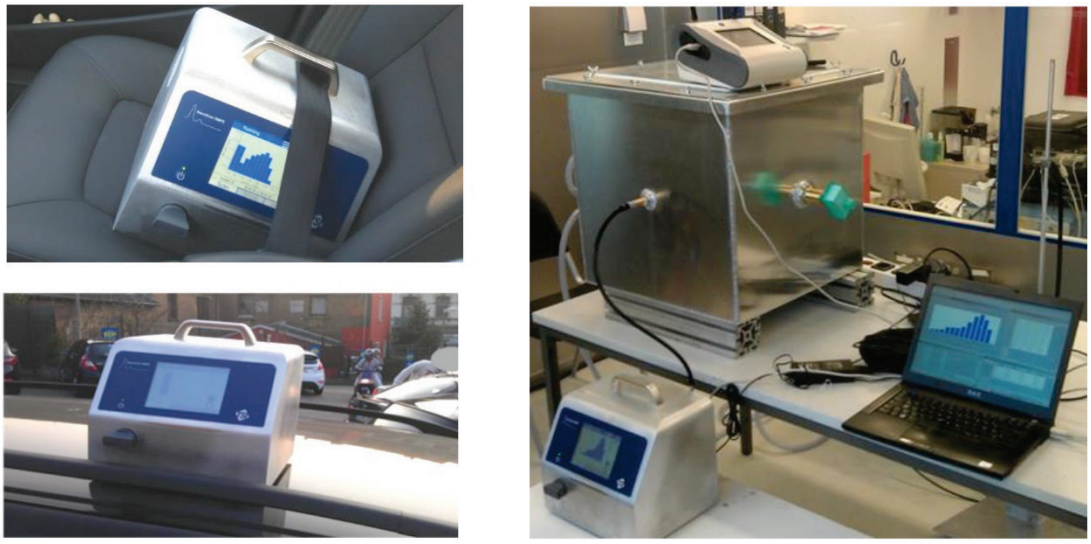
The NanoScan SMPS™ classifies particles in the size range of 10 to 420 nm using a Radial Differential Mobility Analyzer (RDMA) based on first-principles measurements of electrical mobility – an approach that does not suffer from size-dependent scaling[6]. A Condensation Particle Counter (CPC) is used for single-particle detection and monitors concentrations up to 1,000,000 particles/cm^3, providing superior counting statistics and highly reproducible measurements[7]. Thus, the NanoScan SMPS™ provides a direct—and quantitative—measurement of the number-weighted particle size distribution in real time.



NanoScan SMPS number size distribution of ambient air

Nanoparticle Exposure Monitoring

The NanoScan SMPS™ is ideally suited for nanoparticle exposure monitoring in a variety of applications, including air quality investigations, combustion/emission research, mobile studies, point source identification, health effects/inhalation toxicology, and industrial hygiene activities such as worker exposure and nanoparticle emission measurements[7–9].



Left: NanoScan SMPS used in mobile studies to investigate air quality in a vehicle cabin (top) compared to an urban street (bottom). Right: NanoScan SMPS used to sample from a chamber as part of an occupational medicine study.

NanoScan SMPS™—Data Consistent with Regulatory Trends

There is a recognized need to develop standards and protocols for nanoparticle sizing and exposure assessments, and the EC definition of nanomaterial was developed for regulatory implementation[4]. Currently, recommendations and guidelines related to nanoparticles have been reported by agencies such as NIST, NIH, NIOSH, FDA, SCENIHR, ISO, and others; these recommendations are trending toward particle size quantification and number-based concentration metrics[1,2,4,5,10,11]. The implementation of a number-based size distribution metric provides guidance as nanomaterial environmental, health, and safety (EHS) regulations move forward—and the NanoScan SMPS™ is already ahead of the trend.

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