Scanning Mobility Particle Sizer™ Spectrometer 3938

Knowledge Beyond Measure.

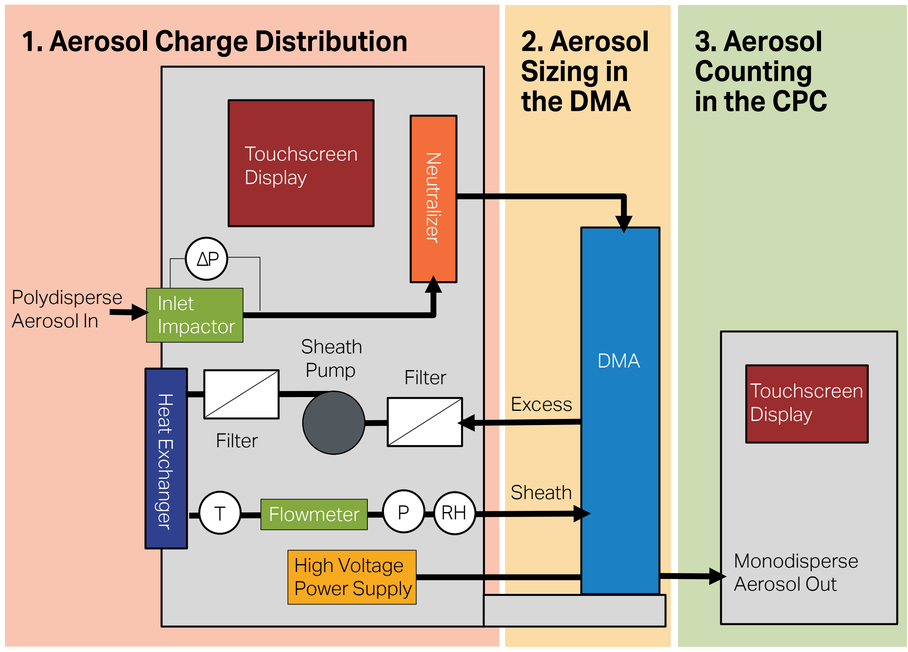
The Scanning Mobility Particle Sizer™ (SMPS™) from TSI® is considered the standard for counting and sizing nanoparticles in the gas phase from a few nanometers to 1 µm. The measurement technology performs a size selection of the particles based on their electrical mobility in accordance with ISO 15900:2009. The results (particle number concentration and particle size distribution) are independent of the refractive index of the solid or liquid aerosol and exhibit a high degree of absolute size accuracy and measurement repeatability. The sizing method is based on first principle, so no calibration is required.

SMPS™ model 3938L50

The SMPS™ spectrometer comprises an Electrostatic Classifier, a Differential Mobility Analyzer (DMA) for particle sorting, and a Condensation Particle Counter (CPC) for counting the sorted particles.

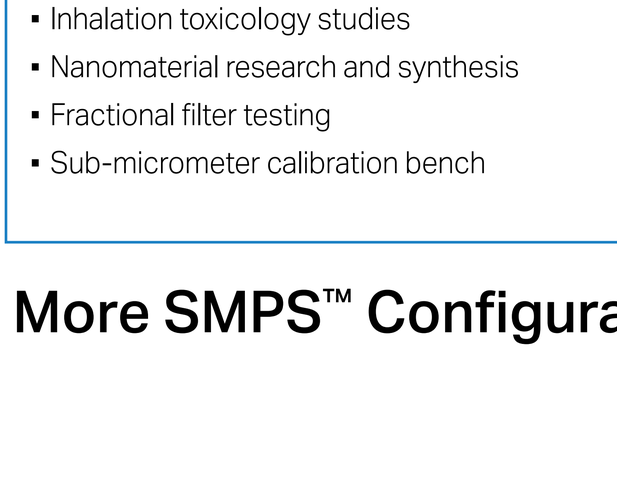
The Electrostatic Classifier uses a bipolar neutralizer to apply a standard equilibrium charge distribution to the aerosol. The DMA then selects the aerosol based on electrical mobility. The CPC counts individual particles and is used to quantify the particles in each size fraction classified in the DMA and outputs a particle number concentration.

Schematic of SMPS™



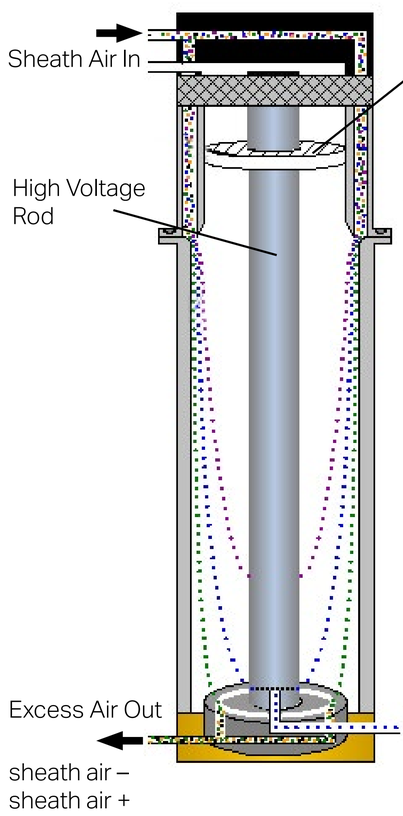
1. Aerosol Charge Distribution

In the SMPS™, the charge distribution of the polydisperse aerosol is standardized using an aerosol neutralizer (either radioactive or soft x-ray) prior to size-classification in the DMA. This bipolar charger ionizes the air inside and brings the sample aerosol into charge equilibrium when it is passed through. The known stationary charge distribution is also know as Boltzmann or Fuchs distribution.



2. Aerosol Sizing in the DMA

A charged particle can traverse a flow field that also follows the electric force acting on it, the so-called electric mobility (Zp). This ability is the key to particle sizing by the DMA in the SMPS™.



$$F_{electric} = n_p eE$$

$$F_{viscousdrag} = \frac{3\pi\mu D_p v}{C}$$

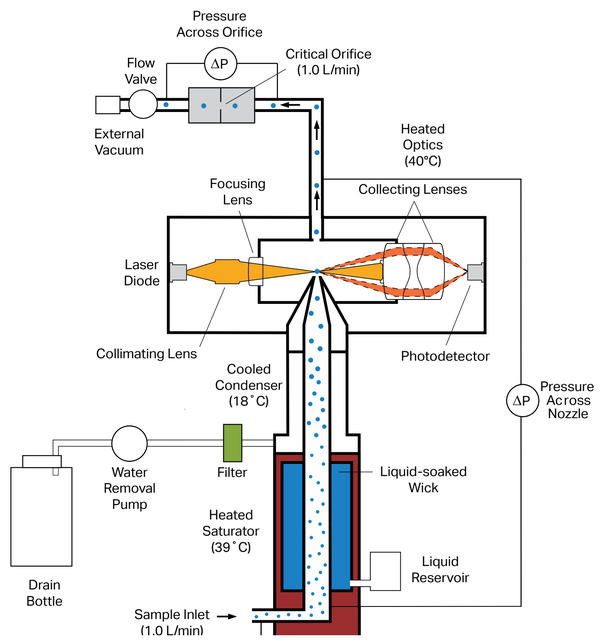
$$F_{electric} = F_{viscousdrag}$$

$$Z_p = \frac{v}{E} = \frac{n_p eC}{3\pi\mu D_n}$$

N = number of charges per particle
e = elementary unit of charge
E = electric field strength
µ = viscosity of gas
D = particle diameter
C = Cunningham slip correction
v = Velocity

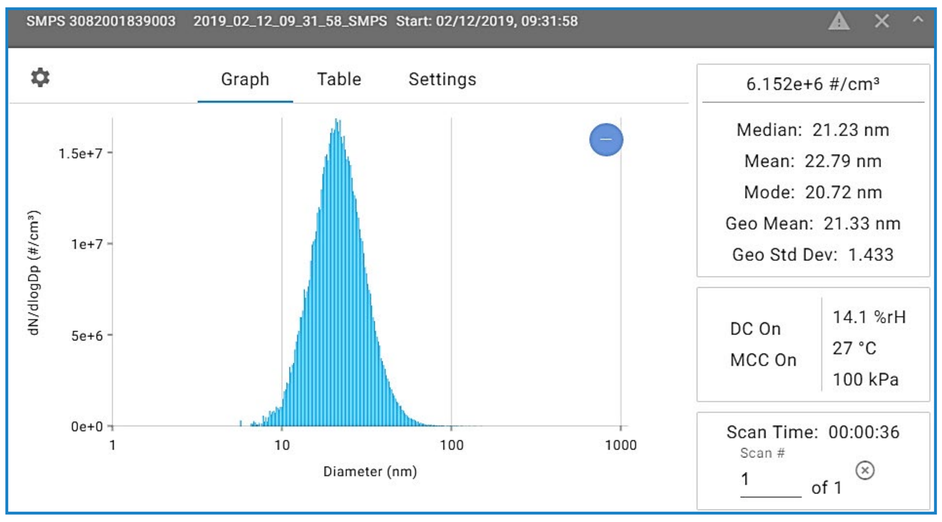
3. Aerosol Counting in the CPC

Particles are too small to be optically counted. To make them grow in size, a vapor is created inside the CPC from a working fluid (usually butanol or water) which condenses onto the particles to make them visible. The CPC then detects and counts the particles in each monodisperse size fraction from the DMA, giving a particle number concentration per size bin.



Applications

- Environmental monitoring and atmospheric research
- Nucleation and new particle formation studies
- Combustion and engine exhaust studies
- Indoor air quality measurements
- Inhalation toxicology studies
- Nanomaterial research and synthesis
- Fractional filter testing
- Sub-micrometer calibration bench



More SMPS™ Configurations:

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01/2024 RevA