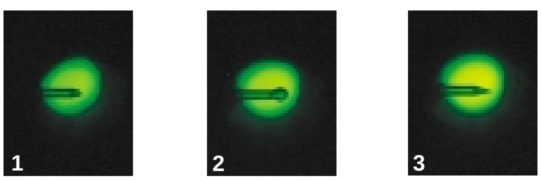
PRODUCT

INFORMATION

Model 3480
Electrospray Aerosol Generator

A method of generating 3-nanometer particles is now available from TSI. The Model 3480 Electrospray Aerosol Generator produces stable, monodisperse, submicrometer aerosol in the range from less than 3 to greater than 100 nanometers. It achieves such small diameters by moving a conductive liquid solution or suspension through a capillary and applying an electrical field to the liquid at the capillary tip. The electrical field draws the liquid from the tip into a conical jet from which ultrafine charged droplets are emitted. Air and CO_2 are merged with the droplets, and the liquid evaporates while the charge is neutralized by an ionizer. The result is a neutralized, monodisperse aerosol that is practically free of solvent residue.



A viewport in the instrument allows you to watch the capillary tip during operation. Three views of the capillary tip are shown above: (1) no liquid flow, (2) with liquid flow but no electrical field, and (3) with liquid flow and an electrical field. The latter view illustrates stable Electrospray operation.

Produces particles as small as 3 nm in diameter, in concentrations as high as 10^7 particles/cm^3

APPLICATIONS

The successful use of the electrospray method to generate monodisperse aerosol has been documented in many publications. Although the basic principles are well understood, many of the fine details explaining how different operating parameters affect the electrospray method remain to be discovered. Known applications for this instrument include:

- Instrument calibration
- Studies of nano-aerosols
- Deposition of nanoparticles onto surfaces
- Aerosol analysis in the macromolecular and submicrometer range
- Dispersion of nanometer-sized powders for research applications
- Research involving parameters that influence the electrospray process

OPERATION

The operator places a standard centrifuge vial containing a sample solution inside a cylindrical pressure vessel. The vessel accommodates a capillary and a high-voltage platinum wire, both of which are immersed in the solution. Maintaining a differential pressure moves the solution through the capillary. An electric field induces a charge on the solution at the capillary tip and acts on the induced charge to form ultrafine droplets that are mixed with clean air and CO_2. The gas flow transports the droplets to the neutralization chamber. The highly charged droplets are neutralized by a radioactive source (Polonium 210), and the liquid evaporates before the aerosol exits the instrument.

SPECIFICATIONS

These specifications include many of the critical parameters that influence the electrospray process. They include typical values TSI Incorporated has used and obtained with early Model 3480 prototypes. Many combinations of particle materials and solvents are yet to be tested. For example, methanol and acetonitrile have been found to be suitable alternative solvents for some applications. Specifications may change as different particle materials or solvents are used.

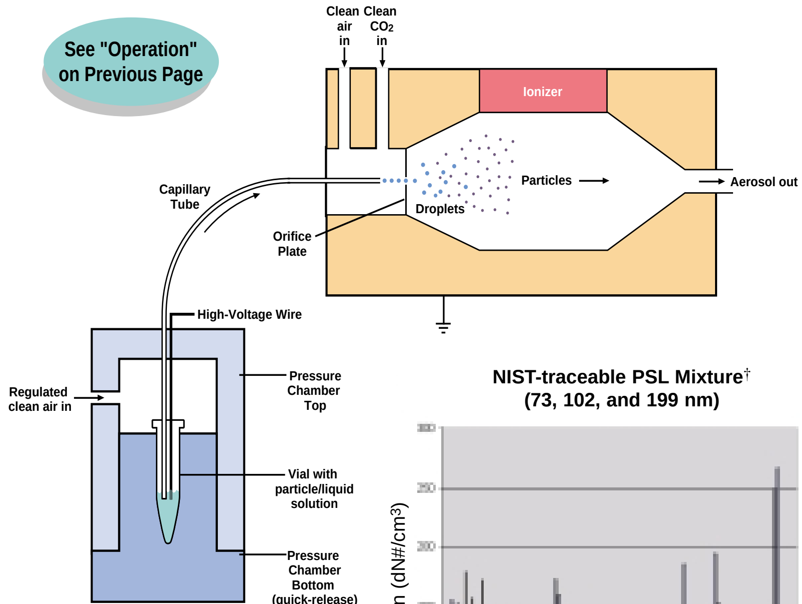
Particle type

Aerosol particles as residues from electrosprayed solutions: Water-soluble, nonvolatile solids and liquids may be used to generate residue particles with diameters from less than 3 to about 50 nm. Using this approach, every spray droplet dries to a residue particle that contributes to the final aerosol, resulting in the highest aerosol concentrations obtainable from the Model 3480. The size distribution of the final aerosol reflects that of the primary droplet distribution and is, thus, a property of the Model 3480.

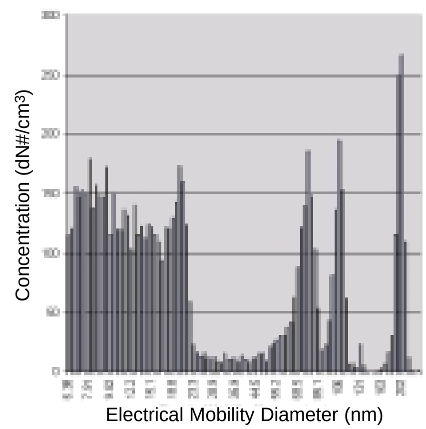
Aerosol particles from aqueous suspensions and emulsions: Aerosols of nonsoluble particles, lipid droplets, or macromolecules are obtained by spraying the corresponding dilute suspensions or emulsions. Proteins as small as 3 nm and PSL particles as large as 200 nm (that is, somewhat larger than the spray droplets) have been aerosolized successfully in this way. Dilution ensures that most droplets contain no more than a single particle. The size distribution reflects that of the suspended particles or macromolecules, and the concentration achieved is not as high as in the solution-residue method.

Particle generation rate: >10^7 particles/cm^3
Liquid conductivity: 0.2 S/m nominal
Liquid flow rate: 50 to 100 nL/min
Particle size range: <3 to >100 nm
Initial droplet diameter: 150 nm
Differential pressure: 0 to 5 psi (3.0 psi nominal)
Air flow: 0.2 to 2.5 L/min (1 L/min nominal)
CO_2 flow: 0.05 to 0.5 L/min (0.1 L/min nominal)
Charger: Po-210, 5 millicurie*
Voltage range: +0.5 to +3.5 kV (2 kV nominal, negative high-voltage module available)
Current range: 0 to 2000 nA (180 to 320 nA nominal)
Power requirements: 85 to 264 VAC, 50 to 60 Hz, 25 W maximum
Dimensions (LWH): 20.3 cm × 40.4 cm × 25.7 cm (8.0 in. × 15.9 in. × 10.1 in.)
Weight: 6.8 kg (15 lb)

See "Operation" on Previous Page



NIST-traceable PSL Mixture†
(73, 102, and 199 nm)



BIBLIOGRAPHY

Chen D, DYH Pui, and SL Kaufman, Electrospraying of Conduction Liquids for Monodisperse Aerosol Generation in the 4 nm to 1.8 µm Size Range, *J. Aerosol Science* **26**:963-977 (1995).

*Neutralizers are shipped separately. End-user name and address required.
†Emulsifier present below 25 nm.

Specifications subject to change without notice. Model 3480 is covered under U.S. Patent Numbers 5,076,097 and 5,247,842.

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