# Measurement techniques for highly dense aerosols: Comparison of LD, PDA and SLAS

Mehrzad Roudini*†[1,2]

[1]Leibniz Institute for Solid State and Materials Research – IFW Dresden, Helmholtzstraße 20, D-01069 Dresden, Germany

[2]Institut für Mechanik und Thermodynamik / Professur Strömungsmechanik, Technische Universität Chemnitz – Technische Universität Chemnitz, 09107 Chemnitz, Germany

**Abstract**

The estimation of aerosol generator performance via the droplet size distributions of their aerosols is crucial for the development of aerosol devices. However, the measurement of aerosols with a highly dense aerosol plume and wide droplet size range is difficult. High droplet numbers, changing droplet size with time (and distance to the aerosol source) due to evaporation or coalescence and varying individual aerosol velocities are some of these complications. Therefore, In order to gain further insights into the liquid atomization mechanism, individual droplet measurement techniques have to be compared. Furthermore, the capabilities and restrictions of the various available measuring techniques must be taken into account to determine the "real" droplet size distribution.
In this study, a sophisticated surface acoustic wave (SAW)-based atomizer was used as the aerosol generator. SAW-based atomizers use the interaction of an acoustic wave on the surface of a piezoelectric substrate with a fluid placed in its propagation path to generate micrometer-sized droplets without any moving parts or nozzles. They offer several advantages including small size, adjustable droplet size distribution with narrow span and the ability to atomize highly viscous or non-volatile fluids. Chips with a SAW wavelength of 90 $\mu$m comprising 128∘YX LiNbO3 as piezoelectric substrate, Al/Ti interdigital transducers (IDTs) and polymer microchannels for well-defined fluid supply were employed. The development of the size and velocity of individual droplets ($>$ 5000 for each measurement) was precisely inspected at different locations of the generated, highly dense aerosol plume using Laser diffractometry (LD) and, for the first time, using Phase Doppler Anemometry (PDA) at different fluidic and acoustic boundary conditions. Finally, the influence of environmental condition on the aerosol size distribution in case of variable humidity was investigated using a scattered-light aerosol spectrometer (SLAS) system using the white light and 90∘ light-scattering detection with a wind tunnel (Leipzig Aerosol Cloud Interaction Simulator, LACIS-T).

Our results show that

- The SAW-produced aerosol has a constant and reproducible droplet size distribution, even when different chips are used.

*Speaker
†Corresponding author: m.roudini@ifw-dresden.de

- Significant differences in the measured droplet size distribution exist when the different measurement methods are applied.

- The specific droplet size of an aerosol at the source and the humidity of surrounding air in combination with the distance of the measurement position determine the measured droplet size distribution.
Taking into account the different working principles of the measurement techniques, we discuss the specific limits of applicability in the measurement of dense aerosols and the expectable information.

**Keywords:** Surface acoustic wave (SAW), based atomizer, Phase Doppler Anemometry (PDA), Laser diffractometry (LD), Scattered, light aerosol spectrometer (SLAS)