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Wide-Angle Light Scattering for droplet and particle analysis in a Spray Flame Synthesis process

B. Münsterjohann, S. Aßmann, F. J. T. Huber, S. Will

Lehrstuhl für Technische Thermodynamik (LTT), Erlangen Graduate School in Advanced Optical Technologies (SAOT) and Cluster of Excellence Engineering of Advanced Materials (EAM), Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)
bettina.muensterjohann@fau.de

In the last two decades, Spray Flame Synthesis (SFS) has become a highly promising technique for the production of functional nanomaterials due to its good scalability, robustness and controllability [1]. However, large-scale industrial production is not yet economically viable, as precursor solutions are often expensive and the complex process has not been completely characterized and understood. The flame can be divided into different overlapping zones where droplet formation, evaporation, combustion, nanoparticle formation and finally particle growth, agglomeration and sintering take place. In order to produce nanoparticles with well-defined properties and functionality, a precise characterization of the morphological parameters depending on the synthesis boundary conditions in these different flame zones is required.

In this context, Wide-Angle Light-Scattering (WALS) has turned out as a powerful measurement technique [2]. It is based on elastic light scattering (@ 532 nm) from a point-shaped measurement volume and the scattered light is imaged onto a CCD-camera-chip using an ellipsoidal mirror. The recorded scattering pattern covers scattering data from an angular range of 10°-170° with a very high resolution of typically 1° or better, high data density and good signal-to-noise ratio. For this reason, size and shape parameters of fractal aggregates or the diameter of spherical particles can be determined *in situ* and time-resolved under different SFS process conditions. Besides, WALS can also be applied for the analysis of droplets.

In order to contribute to a better understanding of the effect chain in an SFS process, a standardized “SpraySyn” burner is employed and the influence of changing process settings, such as volume flows, on particle properties in different flame regions is shown. Furthermore, scattering data of pure ethanol and ethanol + TTIP for TiO_2 production is compared for different boundary conditions.

References

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