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Comprehensive morphological characterization of industrial nano-aerosols by optical measurement methods

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The growing importance of nano-aerosols in industrial processes leads to an increasing demand for their characterization. Laser-induced incandescence (LII) and elastic light scattering (ELS) are well established optical measurement techniques for a fast and comprehensive morphological characterization of nano-aerosols. While the size and structure of nanoparticle aggregates can be obtained from elastically scattered light [1], LII provides information about the monomer size of the aggregate and the particle concentration in the aerosol [2].

For an efficient characterization of aerosols, a mobile measurement system was developed combining wide-angle light scattering (WALS) with time-resolved LII [3]. The key element of WALS is an ellipsoidal mirror allowing for the detection of quasi-continuous light scattering data in a large angular range and with high angular resolution on a single-shot basis. Here, a continuous wave laser (532 nm) and an industrial CCD-camera are used to acquire scattering data. Effective values for aggregate size and structure can be derived from the angular distribution of scattered light. For LII, based on the detection of thermal radiation emitted by particles after laser-heating, a pulsed diode-pumped Nd:YAG-laser operating at 1064 nm is used. LII signals are recorded by gated photomultiplier tubes in defined spectral regions. Primary particle size and volume concentration can be determined from the signal decay and its magnitude, respectively.

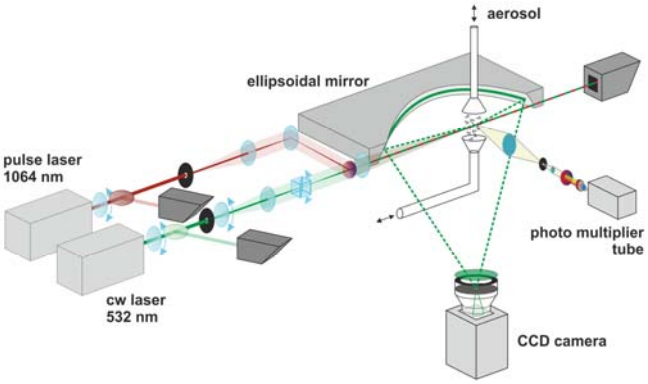

Fig. 1: Combined WALS and LII measurement setup

Combined WALS and LII measurements on nanoparticles from various processes demonstrate the applicability of the measurement system in an industrial environment. Possible applications range from carbon black production to the synthesis of metal and metal oxide particles.

References

[1] C.M. Sorensen, *Aerosol Sci. Technol.* **35**, 648-687 (2001)
[2] H.A. Michelsen, C. Schulz, G.J. Smallwood, S.Will, *Prog. Energ. Combust.*, **51**, 2-48 (2015)
[3] F.J.T Huber, M. Altenhoff, S. Will, *Rev. Sci. Instr.* **87**, 053102 (2016)