Recent applications of the WALS-technique

Hergen Oltmann\textsuperscript{1}, Stefan Will\textsuperscript{2}

\textsuperscript{1}Technische Thermodynamik, Universität Bremen, Germany
\textsuperscript{2}Lehrstuhl für Technische Thermodynamik, Universität Erlangen-Nürnberg, Germany

email: stefan.will@ltt.uni-erlangen.de

Nanoparticles produced in combustion processes often exhibit complex fractal structures. While laser-induced incandescence (LII) is a proven technique for the determination of primary particle size no information about aggregate sizes can be obtained. To gather information about aggregate size and fractal dimension elastic light scattering (ELS) \cite{1} is an often used \textit{in situ} method.

The wide-angle light scattering (WALS) approach \cite{2} extends classical ELS-concepts by using a combination of an ellipsoidal mirror and an intensified CCD-camera. The ellipsoidal mirror redirects the light scattered within a plane onto the CCD-chip (cf. Fig. 1), which makes it possible to almost instantaneously record a complete scattering diagram over an angular range of approx. 10° to 170° with an angular resolution $\Delta \theta$ of typically 0.6°.

The basic performance of the approach was demonstrated previously by measurements on soot particles in laminar premixed flames \cite{2}. This contribution highlights various recent developments and applications of the technique. These include measurements in a turbulent diffusion flame \cite{3}, employing a pulsed laser and underlining the favourable applicability to unsteady processes. Also measurements with a particular high resolution of $\Delta \theta = 0.3°$ were performed which allow for a detailed investigation of selected angular regions. To simultaneously measure the vv- and hh-scattering components polarization foils were mounted in front of the ellipsoidal mirror. Radii of gyration obtained for soot particles in a premixed ethene flame show good agreement with former results. Furthermore investigations on silica particles produced in a diffusion flame were carried through (cf. Fig. 2) for various relative velocities between the precursor flow (nitrogen flow saturated with hexamethydisiloxane) and the methane/oxygen flow of the supporting flame. Recorded scattering diagrams indicate a change in the structure of the silica particles for the different velocities.

![Experimental setup](image1.png) ![Measurement on silica particles in a diffusion flame](image2.png)

\[ \text{Fig. 1: Experimental setup} \quad \text{Fig. 2: Measurement on silica particles in a diffusion flame} \]

\cite{1} C. M. Sorensen, Aerosol Sci. Technol. 35, 648-687 (2001)

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