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# Characterization of a silica-aerosol in a sintering process by wide-angle light scattering and principal component analysis

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**Abstract**

In nanoparticle synthesis, a large variety of sizes and morphologies can be observed depending on the process parameters. Besides fractal-like aggregates built from primary particles and non-aggregated spherical particles also mixtures of particle fractions are obtained. For industrial process control, real-time capable algorithms for multi-variate parameter determination are required. In this work, principal component analysis is employed for inverting scattering data from elastic light scattering measurements to obtain information about the size distribution of particle fractions like fractals and spheres and the mixing ratio. Additionally in the case of fractals their fractal dimension is determined. The method is employed on simulated data and experimental data from wide-angle light scattering (WALS) measurements on a silica aerosol synthesized in a chemical vapor synthesis process with a proceeding sintering step of variable degree.

**Keywords**

nanoparticles; fractal aggregates; Mie scattering; elastic light scattering; principal component analysis; size distribution; sintering



## 1. Introduction

Nanoparticles play an increasing role in research and industrial applications. As an example carbon blacks, highly pure carbon particles, are produced in large quantities of a few million tons per year as a bulking agent in rubber industry or as black pigments (Donnet et al., 1993). Particles from silicon dioxide, called silica, are often used as anti-caking or as bulking agent (Stark et al., 2015). Many particle systems can be produced in the gas-phase like in combustion processes or in chemical vapor synthesis (CVS). Compared to liquid phase processes synthesis in the gas phase inhibits some important advantages (Kruis et al., 1998): it often requires only a few process steps resulting in highly purified products that can easily be separated from the process gas by a simple filtration step. Therefore elaborate separation, drying and cleaning steps can very often be omitted (Buesser & Pratsinis, 2012). However,

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