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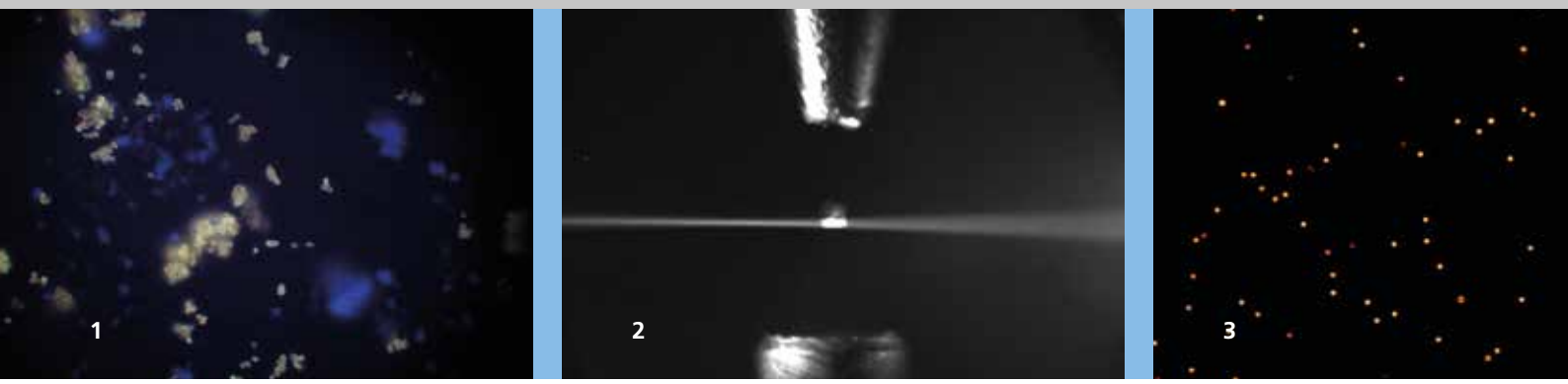
FRAUNHOFER INSTITUTE FOR PHYSICAL MEASUREMENT TECHNIQUES IPM



1 *Microscopic fluorescence image of aspergillus fumigates spores and titanium dioxide powder.*
2 *Single particle in a laser beam.*
3 *Fluorescence labeled micro-organisms.*

MEASURING AEROSOL PARTICLE DISTRIBUTIONS

FROM MICROORGANISMS TO PARTICULATE MATTER

Fraunhofer IPM can look back on a long and successful history of projects in the field of aerosol measurement technology. The spectrum of applications covers the automatic and fast detection and identification of microparticles such as pollen, bacteria and particulate matter under very different environmental conditions.

Depending on the requirements of the application several methods for the characterization of aerosol particles are available:

Laser light scattering technique

The laser light scattering technique is a very powerful and fast method to determine the aerodynamic diameter of individual airborne particles. By using high power laser sources in or close to the UV wavelength range, additional information about the composition of the particles is available by measuring the fluorescence intensity simultaneously with the scattered light intensity. Fraunhofer IPM has developed a system for the simultaneous detection of fluorescence und scattered light intensity of airborne particles in real-time. The fluorescence signal is recorded by a photomultiplier tube in combination with fast data acquisition electronics. PC based algorithms allow appropriate processing of the signals like setting thresholds, comparing scattering and fluorescence signals etc.

Advantages:

- Analysis of airborne particles between 0.5 and 30 µm
- Real-time analysis of scattered light and fluorescence signals
- Compact system due to commercially available laser diodes

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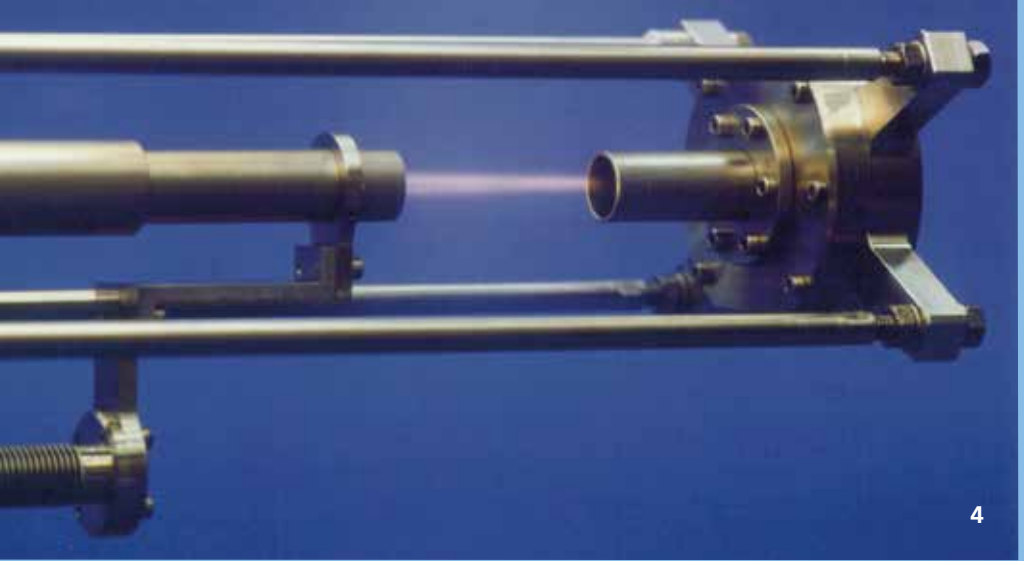

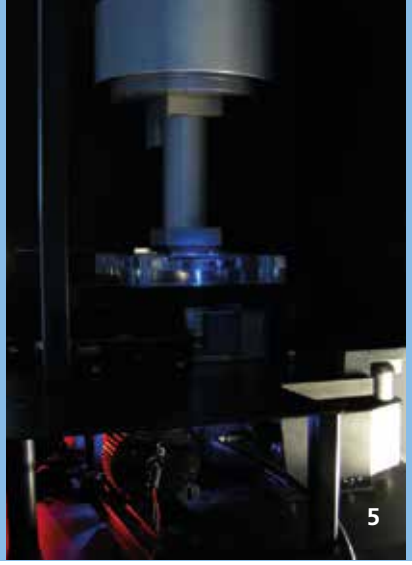

Optical imaging techniques

For applications where the shape of particles is an important property, optical image analysis is the favorite method. Fraunhofer IPM has developed an automated microscope suitable for outdoor applications. The system takes images of particles which have been deposited previously on a plate and saves them as three-dimensional image stacks. Appropriate high-power LED illumination allows the analysis of different optical properties. By using high-power UV-LEDs, for instance, pollen grains and spores, which exhibit a strong autofluorescence in this wavelength range, can be clearly distinguished from many other abiotic particles like mineral dust and abrasion from tires etc. The system forms the basis for an automatic pollen monitor, which was developed together with partners from industry and science.

Advantages:

- Individual information about the shape of particles
- Possibility of distinguishing between aggregates and single particles
- Automated microscope with data analysis

Multiwavelength extinction measurements for droplet size distribution under severe conditions

Measuring the size distribution of water droplets inside a reactor under high temperature (above 120 °C) and high pressure operating conditions is a challenging task. Fraunhofer IPM has developed a system for this application, which is based on the measurement of the spectral extinction in the wavelength range from 0.8 up to 3.5 µm with high resolution and subsequent data processing. By applying an inverse MIE-algorithm water droplet size distributions in the micrometer range, respectively volume and mass concentrations, can be determined. Scanning of the spectral extinctions within milliseconds and fast data processing allows online information about the water droplet distribution.

Advantages:

- Particle size distributions in steam generators
- Operation under high temperature and high pressure
- Robust system for harsh environments

4 *Measuring head of a stray light spectrophotometer.*

5 *Microscopic detection system with integrated air sampling unit.*