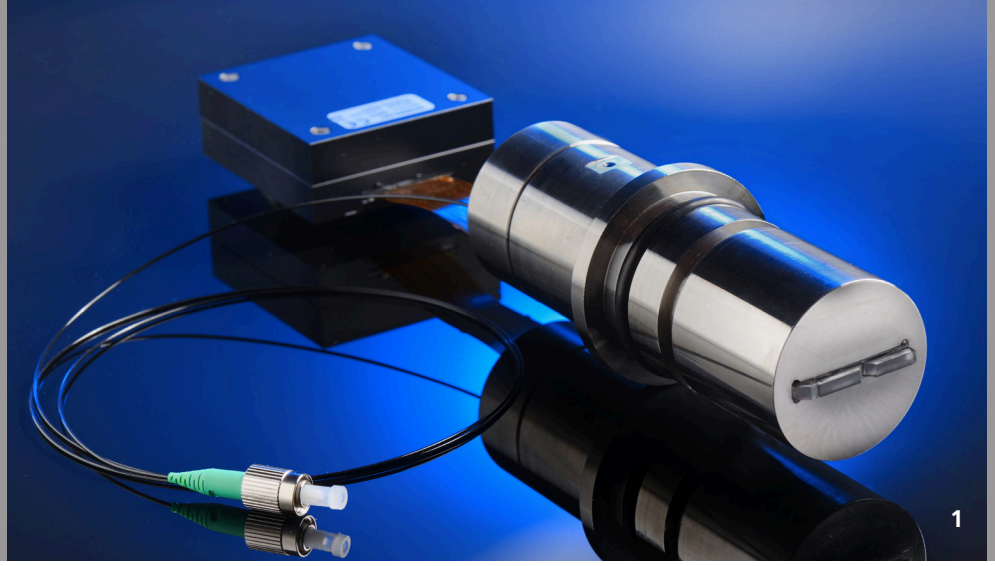
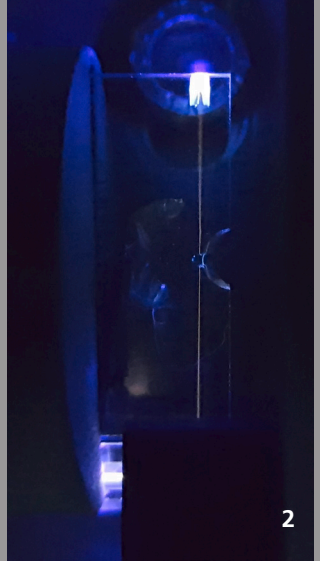


1



2

ANGLE-RESOLVED INLINE PARTICLE ANALYSIS WITH A WAVEGUIDE PROBE

Task

According to the current state of the art, no suitable inline measurement systems are available to measure particle sizes while chemical and biological processes are running. However, particle sizes and size distributions can be determined offline by angle-resolved scattered light measurements. This process, static laser-light scattering, analyzes particles between tens of nanometers and hundreds of micrometers in size with laboratory equipment. However, the method is not suitable for real-time, process-analytical immersion probes since the measuring systems are too large. In a research project with partners from industry, Fraunhofer ILT is developing a miniaturized, inline-capable immersion probe in which the angular distribution of the scattered light is measured with a diagnostic chip that has integrated waveguides.

Method

Optical waveguides are written into a glass chip with a short pulse laser. These optical waveguides are radially aligned with a sample aperture and guide the scattered light from different directions to a light-sensitive sensor chip, which quantitatively detects the scattered light signal. Since each waveguide corresponds to a known scattering angle, an angle-resolved scattering intensity can be determined from the intensity distribution of the individual waveguides. From this intensity distribution, the particle size can be calculated. Since the waveguides can be placed in a compact glass chip with an edge length of a few centimeters, the measurement method is suitable for integration in a compact immersion probe.

1 Immersion probe for angle-resolved laser scattered light measurement.

2 Glass chip with laser switched on for scattered light measurement (sample opening see center of image).

Results

Fraunhofer has developed and tested the first version of an immersion probe for angle-resolved laser light scattering. Scattered light signals from particles in solution can be detected with angular resolution, analyzed and used to determine particle sizes.

Applications

The scattered light probe can be used to measure the size of particles in the range of a few tens of nanometers to several micrometers. It can be used in applications for chemical process and bioprocess analysis. Growth processes in biofermenters, particle formation in chemical crystallizations or polymerizations as well as dispersion processes can be recorded inline during an ongoing process.

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