Highly Sensitive Characterization of Aquatic Nano-particles by Laser-Induced Breakdown Detection

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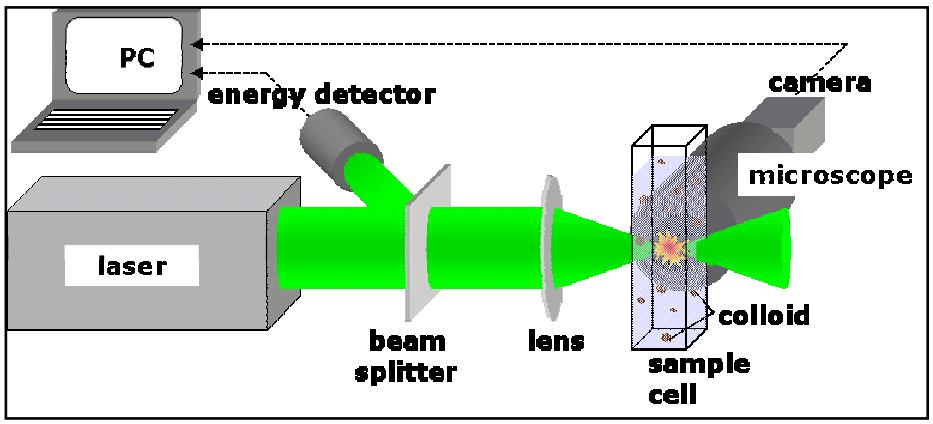

The Laser-induced breakdown detection (LIBD) is a highly sensitive method for the direct detection of nano-particles (colloids). During the detection process plasmas are generated on single particles by a focussed laser beam, the resulting plasma light emissions are detected optically [1]. The method is based on the difference in breakdown thresholds of liquid and solid matter, it is approximately one order of magnitude lower for solid material [2]. The laser pulse energy is adjusted precisely so that in the pure liquid no breakdown events occur, and only in the presence of colloids the breakdown threshold in the focal volume is exceeded. The spatial distribution of approximately 8,000 recorded plasma flashes within the focal volume reveals the mean particle diameter [3]; with a laser repetition rate of 20 Hz this typically takes app. 10 minutes. The evaluation of the number of breakdown events per number of laser shots results in a breakdown probability, together with the particle size the concentration is calculated using a specially-designed computer software [4]. Compared to conventional light scattering methods the LIBD is app. 6 orders of magnitude more sensitive for colloidal particles smaller than ca. 50 nm.

The effect of nano-particles on the migration of pollutants is of major concern in environmental research as well as drinking water purification. Due to their large surface and sorption capacity colloids may increase the total amount of pollutants in water beyond what can be expected from the thermodynamic solubility product of their respective chemical compounds [5, 6]. Also, they can provide a medium for microbial growth and thus can be an indication for the presence of disease-causing organisms, including bacteria, viruses and parasites. In cooperation with the *Zweckverband Bodensee Wasserversorgung* the LIBD has been used successfully for the quantification of aquatic nano-particles during drinking water processing [4] and its distribution via a pipeline system of 1,600 km total length.

Literature

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