Sensitive Characterization of Aquatic Nano-Particles (Colloids) by means of Laser-induced Breakdown Detection

Dr. Tobias Bundschuh[#], Dipl.-Chem. Tobias Wagner, Prof. Dr. Rainer Köster
Forschungszentrum Karlsruhe GmbH
Institute of Technical Chemistry, Water Technology and Geotechnology
Karlsruhe, Germany

Colloids (sizes 1 nm - 1 µm) are present in all aquatic systems. They are chemically surface active and they therefore readily absorb e.g. heavy metal ions. The generation of colloids may increase the sum of mobile heavy metals in water over what expected by their thermodynamic solubility. In addition, disease-causing microbial impurities (algae, bacteria, viruses, …) themselves can be called colloids and nano-particles as such are often unwanted particular contaminants reducing the product quality in many modern production processes (e.g. semiconductor industry). The possible environmentally relevant impact of colloids in natural aquatic systems as well as the relevance of nano-particles in technical processes needs therefore to be investigated and new analytical methods like Laser-induced Breakdown Detection (LIBD) are developed. The LIBD bases on the plasma generation on single particles by an intense, pulsed laser beam and the detection of the produced shock waves or plasma light emissions. The method detects colloids in the lower part of the nanometer size range with colloidal concentrations in the ppt (ng/L) range.

The application of the LIBD for the determination of aquatic colloids present in groundwater as well as in surface water will be demonstrated. The LIBD is a unique method to monitor on-line the colloid content after the purification steps for the production of drinking water. It could be proved that after precipitation and filtration not only suspended matter but also colloids are effectively removed from surface water.

The LIBD is up to 1,000,000 times more sensitive in comparison to Laser Light Scattering (LLS). Therefore the direct, on-line coupling of our Sedimentation Field-Flow Fractionation (SdFFF) with the mobile constructed LIBD is the future goal. Such SdFFF–LIBD instruments, or preferably all FFF–LIBD instrumentation will act as high resolution elution methods for separating and sizing a wide range of environmental and industrial samples.

[#]P.O. Box 3640, 76021 Karlsruhe, Germany
Phone: +49 7247 82 2648, Fax: +49 7247 82 6639, E-Mail: tobias.bundschuh@itc-wgt.fzk.de, Web: http://www.fzk.de/itc-wgt/4/english/mitarbeiter/bundschuh.htm