Detection of Herbicides in Water and their Interactions with Chlorella Kessleri

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Abstract

Herbicides have always played an important role concerning the supply of mankind with drinking water. Standard methods such as HPLC are time-consuming and rather expensive and therefore not suitable for in-situ monitoring of waters. In-situ spectroscopy methods have been established as a common tool in environmental monitoring. Laser-induced fluorescence spectroscopy can be used for the detection of organic herbicides. This method provides fast results without any large scale sample preparations. For the determination of a herbicide the absorption spectrum, the excitation spectrum and the time resolved fluorescence spectrum are needed. Furthermore, it is possible to usephytoplankton as a biological indicator, i.e. the herbicides are detected by their effects on phytoplankton fluorescence, in this case Chlorella Kessleri.

For the time-resolved fluorescence measurements presented here, a pulsed Nd:YAG pumped and frequency doubled dye-laser was used for excitation. The substances were excited in the range from 270 nm to 330 nm. The fluorescence signal was recorded in the range from 350 nm to 650 nm by a spectrograph and an ICCD-camera. The fluorescence lifetimes could be recorded within the nanosecond time scale. A solid-state arrangement of the fluorescence cell was realized. Due to its high laser intensities, this setup made it possible to detect herbicides even in low concentrations.

Computer-simulations were applied to analyse the spectra and the fluorescence lifetimes of the herbicides.

The experiments show, that it was possible to detect herbicides in water via their fluorescence signals. For example the herbicides amizol (fluorescence decay time 1.1 ns), ethidimuron (1.7 ns) and methabenzthiazuron (1 ns) have been detected in drinking water for the first time using time resolved LIF. By using the biological indicator and the absorption spectra it was possible to distinguish between amizol and methabenzthiazuron.

The results show that it is possible to detect herbicides selectively by means of time resolved LIF in water. Based on these results a mobile device with different spectroscopic techniques (LIF and reflectance measurements) was constructed for routine measurements of drinking water quality at the institute. In order to get more detailed information of the investigated substances the device contains additional sensors, i.e. sensors for the temperature, for the pH-value and the oxygen value of the probe.