FT-IR spectroscopy of algal cells

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The estimates of nutrient fluxes are a major challenge in aquatic ecology. A quantitative flux estimate of carbon, nitrogen, phosphorus or other elements are the basics to manage rivers or lakes according to national water regulations, but also to assess the impact of the oceans on global warming. Since the growth rates and the fate of the newly formed phytoplankton algae are different from taxon to taxon or in some cases even species-specific, the challenge is to measure growth rates, physiological activity and the element ratios in algal cells in a taxonomically resolved manner. For this purpose we have developed a single cell analysing system composed of a flow cytometer in the core and several other measuring devices in the periphery. This includes UV-VIS spectroscopy, chlorophyll a in-vivo fluorometry, *in situ* hybridisation and FT-IR microscopy. The advantage of this system is the extreme flexibility to concentrate either on quantitative taxonomic resolution or to focus on physiological activities or biochemical composition of the biomass.

We used FT-IR microscopy not only to assess carbon to silicon, carbon to nitrogen, but also to detect changes in the major cell components as lipids, proteins and carbohydrates under nutrient limiting conditions. This attempt was used to identify nutrient limitation in cells taken from true nature. Finally, we have tried to extend the FT-IR spectroscopy to measure secondary metabolites in plant cells. For quantitative estimates on secondary metabolites the FT-IR microscopy is less powerful in comparison to microtiter-plate coupled IR-spectrometer. This configuration allows on the one hand high quantitative accuracy of minimal amounts of cell materials and on the other hand it has the potential to be used for high through-put analysis. Future attempts will be made to couple this set-up with single cell techniques by quantitative cell sorting.