Novel photoacoustic spectroscopy methodology for biosensing of complex environmental water contamination: Baltic sea studies

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The aim of the presentation is to demonstrate the potential of novel photoacoustic (PA) spectroscopy techniques for bioassessment of Baltic sea water complex pollution i.e., chemical, plastics and biofilm-forming, photosynthetically active contamination species residing at submerged solid substrata [1]. In particular, applicable to particular contamination systems (opaque and scattering samples) unavailable for standard spectroscopic analyses. Two kinds of spectroscopic modalities were tested: a standard and diffusive reflectance (DR) together with photoacoustics depth-profiling technique. As model contaminants, three: chemical (paracetamol), biological (green algae), and microplastics samples were selected. Photosynthetic signatures such as photosynthetic energy storage, photoacoustic spectra as well as geometric and structural biogeography of microbial colonies (via confocal microscopy) were correlated to the water trophic state and organic matter transformation routes [2]. It turned out, that both PA and DR techniques provided similar results for the model microplastics-contaminated water. However, due to various efficiency of specific light-matter interactions, these two modalities demonstrated different spectral signatures. Both techniques were effectively applied to monitoring of seawater microscopic (> 0.5 μm) particles and, covering submerged solid substrata, photosynthetically-active biofilms [3]. Particularly, DR data revealed higher sensitivity to the microplastics particle presence. The PA solid state species data demonstrate, that the technique could be utilized for opaque, like sediments, sample identification. In the light of self-coincidence between the results derived by PA and DR modalities, the methodology can be useful to create a novel concept of water pollution sensing.

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