Novel Applications of Photothermal Techniques in Environmental Analysis, Medical Diagnostics and in Characterization of Related Materials

Mladen Franko,

Laboratory for Environmental and Life Sciences, University of Nova Gorica, Nova Gorica, Slovenia

The objective of this presentation is to present some selectedapplications of thermal lens spectrometry (TLS) and beam deflection spectrometry (BDS) in environmental and biomedical research and in nondestructive characterisation of related materials.

In the first part novel approaches to speciation of iron in environmental samples by exploiting the advantages of photothermal techniques such as TLS and BDS will be discussed. This includes determination of iron redox species by coupling of TLS to flow injection analysis (FIA) and TLS microscopy to microfluidic systems (μFIA-TLM) which was recently shown to provide limits of detection at ng/mL level in sub μL samples. TLS was also applied for detection in liquid chromatography for determination of fluorescing pyoverdines as well as nonfluorescing Fe(III)-pyoverdine complexes in a single chromatographic run. Application of BDS was related to analysis of passive samplers based ondiffusive gradients in thin-film (DGT) technique, which is increasingly used for monitoring of environmentalpollution due to its robustness, versatility, precision andcapacity of pre-concentrating bioavailable trace-level metal pollutants.

In the field of medical diagnostics and structural characterization of related materials most interesting recent achievements include applications of HPLC-TLS for detection of free bilirubin, an important endogenous antioxidant in vascular endothelial cells. μFIA-TLM and magnetic nanoparticles were exploited for high sample throughput and sensytive determination of HPV - human papilloma virus antibodies and NGAL - a biomarker of acute kidney injury.

BDS was used for non-destructive characterization and determination of thermal properties and porosity of silicon/zirconium hybrid anticorrosion layers for medical implants, as well as to investigate the influence of cerium on these properties. In another study, the thickness of subsurface layers in chitosan aerogel-coatings for protection of steel implants, and the concentration of pharmaceuticals in thin layers was determined on the basis of thermal conductivity and diffusivity of materials measuredby BDS.