

Aktion

project 82p5 - final report

Name

Optimization of the protocol for elemental mapping of bio-samples using Laser-Induced Breakdown Spectroscopy

Duration of the project

1.7.2018 - 31.5.2019

Final report

The scope of the project was aimed at the preliminary optimization of laser ablation for the analysis of biological tissues. This issue of laser-tissue interaction has a great impact on the performance of analytical instrumentation, mainly in the sense of sensitivity and lateral resolution. This has set the basis for our research efforts. Basically, the process of optimization is in the case of soft- and plant tissues.

1. Mobility

A. 1st mobility

Time: October 2018	Location: Austria, Vienna
Travelling researchers: Dr. Pavel Porizka, Dr. Pavlina Modlitbova	
Description of research work: For the first research stay, we have delivered cross-sections of soft- and plant tissues (no ethical issues were necessary) to Vienna for their analysis with J200 LIBS system. We have also provided reference measurement using LA-ICP-MS system. During this research stay we were able to do only a feasibility study due to the long duration of measurement of each sample in the mapping mode. Obtained results were then used for further research and design of the experiment.	

B. 2nd mobility

Time: December 2018	Location: the Czech Republic, Brno
Travelling researchers: Assoc. Prof. Andreas Limbeck, DI Lukas Brunnbauer	
Description of research work: The visit in Brno served for a brief comparison of analytical performances of LIBS systems (in Brno and in Vienna). Then, based on former results, we have suggested a novel approach for optimization of the LIBS system performance when soft-tissues are of interest and then also a novel approach for quantification of analytes in the mapping of soft- and plant tissues. This approach involves sub- μ L droplets for which a sophisticated injection system is necessary. In fact, there is no generally accepted approach for analyte quantification when it comes to mapping. Our approach is complementary to the already existing ones and avoids preparation of matrix matched standards.	

C. 3rd mobility

Time: February 2019	Location: Austria, Vienna
Travelling researchers: Dr. Pavel Porizka, Dr. Pavlina Modlitbova	
<p>Description of research work: During our second stay in Vienna, we have analyzed (LIBS mapping) a set of a priori prepared standards. The sample set consisted of soft- and plant tissues with series of sub-μL droplets, the droplets had increasing analyte concentration. Analyte was in our case zinc (indicator of biological changes in soft tissues) and cadmium (toxicology of plants). Obtained spectra were then preprocessed and set into the calibration curve.</p> <p>During this stay, we have also intensively worked on the preparation of the Czech-Austrian joint grant project aimed at toxicology of microplastics. See below.</p>	

D. 4th mobility

Time: May 2019	Location: Austria, Vienna
Travelling researchers: Dr. Pavel Porizka, Dr. Pavlina Modlitbova	
<p>Description of research work: During our last stay in Vienna, we have made the last LIBS measurements that were missing or demanded more attention. We have prepared a model sample set (sub-μL droplets on soft tissues) on which the calibration curve was created. The test set consisted of samples with samples immersed in a solution with known concentration and prepared in multiple repetitions. Then, some of the test samples were analyzed using wet chemistry (ICP-OES after acid digestion). This was then used for estimation of analyte content in the test samples. Finally, we are still working on the large data sets that we have obtained during the project. Each map (analysis of a single sample) consists of tens to hundreds of thousands data points (pixel), and each data point provides information about the emitted radiation (LIBS spectra). Processing of all data is done in parallel on both, Austrian and Czech, sides and its delivery is estimated in the second half of 2019. Afterwards, we will evaluate obtained results and make a decision whether and how we can proceed with manuscript preparation.</p>	

2. Project outcomes

During the project we have focused on the further development of laser-ablation based techniques and related optimization process for the analysis of soft- and plant-tissues.

A. Basis of a novel approach to quantitative imaging

LIBS technique enables straightforward qualitative analysis of sample under investigation. However, laser ablation of matter (soft tissues in our case) is burdened with the matrix effect. This means that the signal response related to the analyte content is not linear and matrix-matched standards are necessary for system calibration. Thus, to provide quantitative imaging is not trivial and therefore it is of great interest to the LIBS community. In our project, we have designed a novel approach in creation of matrix matched standards with less work load. Cross-sections of soft- and plant tissues are spiked with sub- μL droplets of liquid

standard solution, after evaporation of the solvent the samples served as an artificially created calibration set.

B. Czech-Austrian grant proposal

As a second outcome of our fruitful cooperation, we have submitted a bilateral Czech-Austrian project proposal: An integrative approach on microplastics adverse outcomes (the registration number is 20-08013L). In this proposal, we aim to describe physicochemical properties of new emerging microparticles and determine how and to what extent microparticles contribute to an adverse outcomes in fish with focus on microbiome-gut axis and latest visualization techniques as X-ray computer tomography (CT), Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS), and LIBS technique.

3. Cooperation

The cooperation between research groups of Assoc. Prof. Andreas Limbeck (TU Vienna) and Dr. Pavel Porizka (CEITEC BUT) is just starting. The Aktion project 82p5 enabled a swift start and closer cooperation of both groups on their common projects. Without this project, despite its short duration and limited resources, our efforts would not lead to the design and experiments over a novel quantification approach and to a submission of a joint grant proposal.

4. Participants

Following researchers took their part in the 82p5 Aktion project. See Table 1 below.

Tab. 1: list of researchers participating in the **82p5** Aktion project.

CEITEC BUT	Pavel Porizka	PostDoc
	Pavlna Modlitbova	PostDoc
TU Vienna	Andreas Limbeck	Associate Professor
	Lukas Brunnbauer	Student

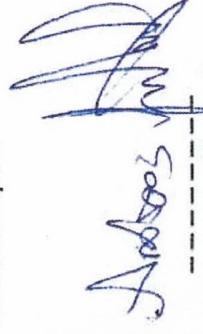
5. Budget

Budget that we have used for this short mobility project is attached to this final report.

Signatures


Pavel Porizka

Brno, Czech Republic
28.6.2019



Andreas Limbeck
Vienna, Austria
28.6.2019