Use flexible Tube Micro Plasma (FμTP) for Lipidomics

Reporting

Project Information

BIOplasma

Grant agreement ID: 840743

Project website

DOI
10.3030/840743

Project terminated on 31 October 2020

EC signature date
9 April 2019

Start date
1 May 2019

End date
30 April 2021

Funded under
EXCELLENT SCIENCE - Marie Skłodowska-Curie Actions

Total cost
€ 162 806,40

EU contribution
€ 162 806,40

Coordinated by
LEIBNIZ-INSTITUT FUR ANALYTISCHE WISSENSCHAFTEN-ISAS-EV
Germany

Periodic Reporting for period 1 - BIOplasma (Use flexible Tube Micro Plasma (FμTP) for Lipidomics)

Reporting period: 2019-05-01 to 2021-04-30

Summary of the context and overall objectives of the project

Cancer is the leading cause of death in economically developed countries and the second leading cause of death in developing countries. In 2015, over 8.8 million people died of cancer worldwide and the numbers are expected to rise above 13 million in 2030. As a consequence, the development of non-invasive, fast and robust methods to detect different types of cancer in an early stage are timely.

BIOplasma addresses the essential need for analytical tools that permit the diagnosis of biological tissues. A novel analytical strategy based on the Liquid Chromatography/Mass Spectrometry (LC-MS) and Gas Chromatography/ Mass Spectrometry (GC-MS) using flexible Tube Micro Plasma (FμTP) as ionization source for the identification and quantification of several biomarkers in body fluids is proposed.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

During BIOplasma implantation, a new CA-FμTP was presented as a further development of the CA-DBDI ion source for mass spectrometry. Understanding and controlling the gas flows were found to be crucial parameters for reproducible long-time measurements. Following previous publications, oxygen was found to be an important part of the ionization atmosphere for high-sensitivity measurements. The optimal nitrogen/oxygen mixture was measured using ketones as a model analyte for volatile organic compound candidate biomarkers relevant for oral squamous cell cancer. Using these optimized conditions for detection of candidate biomarkers resulted in instrumental limit of detection the range of 0.7–10 ppb for all analytes, whereas LODs in saliva ranged from 0.08 to 1.1 ppb, taking into account a preconcentration factor of 10. Comparing the LODs of the presented work with LODs of other methods in the literature, depending on the analyte, an improvement of 2.5 times was found. It was demonstrated that the use of ambient air for detection of the analytes led to a significant decrease of the signal, resulting in a worse sensitivity of the system. Therefore, the CA-FμTP ionization source is a very promising tool for both sensitive analysis of VOCs and to study the mechanisms of plasma-based ionization techniques.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

n this project, a new soft ionization device for mass spectrometry is presented using the flexible microtube plasma under controlled atmospheric conditions. The controlled atmosphere flexible microtube plasma consists of the plasma source itself connected to a gas chromatograph and a mass spectrometer using a borosilicate glass crosspiece. Controlled atmosphere, for example, nitrogen and/or an oxygen mixture, is introduced to the system to create a clean ionization environment. Reproducibility issues are discussed, and solutions are presented manipulating the gas flow in the crosspiece. A proof of concept is shown using a ketone mixture introduced to the mass spectrometer to optimize atmospheric conditions. Furthermore, application of the presented device for the sensitive and non fragmenting ionization of volatile organic biomarkers relevant for cancer is carried out. Sample treatment for human saliva is described, and relevant candidate biomarkers are measured in the saliva matrix, showing a very good ionization efficiency and neglectable matrix effects with limits of detection below 80 ppt. Last but not least, this project will allow to obtain a powerful tool for cancer diagnosis, which would have a huge impact on society. Early cancer detection presents a critical factor associated to patient survival. According to the European Union, the devastating tragedy

cancer is at individual level, we must keep in mind that the combination of an ageing population and the rising costs of cancer treatments is stretching health care budgets of even the richest countries. Promoting health and prevention are cost-effective public health measures to identify new cancer cases in the early stages of development and to reduce both the risk of cancer and – this goes hand-in-hand - the burden on national health budgets. The European Commission has recently kicked-off the State of Health in the EU cycle to support the EU Member States in making their health systems more effective, accessible and resilient – so that prevention starts playing a major role and people have optimal healthcare options. BIOplasma offers an interesting tool to reach this objective.

Last update: 26 February 2021

Permalink: https://cordis.europa.eu/project/id/840743/reporting