Chromatography-on-a-chip

Proposers

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Introduction

Lab-on-chip biosensing devices have gathered much attention as they have the promise of achieving point-of-care, inexpensive, easy-to-use quantification of relevant biomarkers for human or animal health, food processing and food safety, and environmental applications. Microfluidic systems have the potential to revolutionize point-of-use biological and chemical analysis, but much of the current research has focused on microfluidic biosensors in which target molecules are captured by probe molecules via molecular recognition processes (e.g., antigen-antibody interactions). However, when there is a lack of probes for the desired targets, a need to analyze a large number of target molecules or a very complex or variable sample, another approach is needed.

Partner 1

The Thin-Film MEMS and BioMEMS group at INESC MN (www.inesc-mn.pt) has extensive experience developing and PDMS-based microfluidics for biosensing, cell-chips, and separation of bioproducts. Particular recent focus has been on integrated sample preparation modules, optical detection, and the use of nanoporous microbeads.

Partner 2

The Bioengineering Research Group at iBB (www.ibb.pt) has a vast experience in separation and purification processes for biological molecules, including chromatographic processes using bed matrix for capture and purification of molecules. Particular recent focus has been on developing chromatography at the microfluidic scale in collaboration with INESC MN.

Project outline/goal

In this project, we propose to use microfluidics technology to develop a PORTABLE MICROFLUIDIC LIQUID CHROMATOGRAPHY SYSTEM (LC-Chip) to address the need to analyze a large number of target molecules, and very complex or variable sample at the point-of-use. In this project a LC-Chip will have as main components a separation column packed with functionalized microbeads, a sample injector, and a multimode detector at the outlet. This project will significantly advance the current technology with the following developments: (i) achieving a simple, portable concept for the LC-Chip; (ii) understanding the separation performance capabilities of a microfluidic LC-Chip in terms of its stationary and mobile phases and column operating conditions; (iii) offering a proof-of-concept application that involves real-world conditions involving the detection of specific target molecules in a highly complex matrix. The device will be first characterized and modelled with a set of model solutions and then be tested in two real-world conditions: (i) the juice of wine grapes at different stages of maturation; (ii) blood serum. The microfluidic device will be benchmarked against the performance using standard LC lab-bench systems.

Student profile

Profile sought: preference, but not limited, to students with a background in Biomedical Engineering, Biological Engineering or Biotechnology with an interest in exploring complex microfluidic systems for practical applications. Experience in Micro and Nanofabrication would be helpful.