Lateral flow analysis in functional thick-film fabricated microsystems

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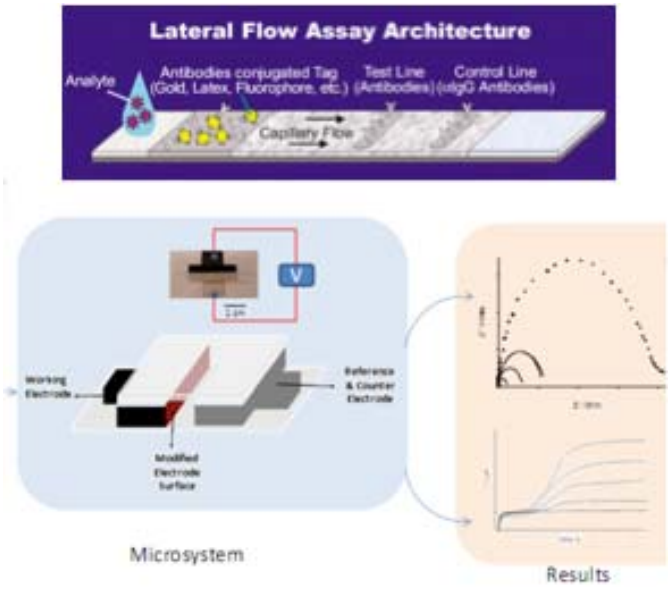
Overview: The experimental work of the MSc project involves direct hands-on experience in the fabrication, testing and characterisation of a low-cost, easy-to-fabricate microsystem produced by thick film techniques (serigraphy or screen-printing) where the graphite carbon electrodes are both structural and functional elements, capable of performing different operations(1). In the project proposed the integration of different unit operations such as flow control as well as incorporation to the functional elements of biomolecules to enhance subsequent electrochemical detections will be studied and optimised always maintaining as a requirement the lack simplicity of use of the resulting device, the possibility of mass production, its low cost, and its versatility.

Background and State of the Art: Microfluidic devices are commonly fabricated by photolithographic or injection molding techniques(2). The incorporation of functional elements such as sensors and actuators, valves and passive or active elements is cumbersome and costly with such technologies. In addition, prototyping has a long iteration cycle and it is feasible but laborious to produce hybrid devices especially incorporating sensors and active elements. For many applications the cost of these methods can be considerably high and careful study of production volumes has to be undertaken before product development. For many applications, the low resolution required for the microfluidic elements (in the order of hundred microns) does not warrant the expense of such high resolution techniques.



Our research team has proposed and alternative method for microsystem manufacturing(3): screen printing. In order for screen printing to be used as a microsystem fabrication technique all that is needed is to realise the 3-D nature of the ink deposit. Seen as a layer-by-layer 3-D element fabrication method, the flexibility of the technique lies in that almost any substrate can be used, in the possibility of printing different commercially available inks that can be

functionalized by adding different catalysts or enzymes, and in the possibility of printing different layers with various inks allowing an unlimited variety of designs and for the incorporation of active elements. These advantages as well as the low cost and fast prototyping cycle make the technique ideal as a manufacturing approach for microfluidic elements. The use of screen-printing technique in the biosensors manufacturing area has reported microfluidic devices based on the production of microchannels combined with electrodes. One of the goals achieved by our group is to set a game field where the microdevice fabrication is further simplified by making all parts both structural and funct ional.*The practical applications consists of a very versatile, fast, reliable, selective and high sensitive electrochemical detection microsystem. Monitoring and evaluation of different immobilisation techniques of biomolecules within the microsystem is a key issue to successfully produce an electrochemical serigraphy-based lateral flow analysis sensor.*

Project Contribution and Methodology: The expected contribution to the state of the art is the production of an enhanced thick-film assembled microsystem, where all the functional components are integrated. The methodology includes: 1) The production of new microsystem design where additional operations such as controlled flow or incubation steps can also be integrated. 2) Investigation on new biomolecule immobilisation method on the microsystem surface. 3) The application and validation of the above in devices that can detect allergens in milk or in clinical diagnostics.

The ideal candidate: The ideal candidate is a highly motivated, rigorously formed in quantitative and formal abilities, able of acquiring new knowledge independently, computer proficient, laboratory experienced graduate or postgraduate in chemistry, chemical engineering or materials sciences.

Finishing this project: The graduate of this project will be able to find work both in academia and industry, especially in R&D positions. Our group encourages multidiciplinary training, complements communication and leadership abilities with formal seminars and has a broad network of collaborations in the private and public sectors. A career and personal improvement plan is worked upon from the first day of incorporation.

References:

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2. Gervaisab, L., Delamarche, E.; Toward one-step point-of-care immunodiagnostics using capillary-driven microfluidics and PDMS substrates, *Lab Chip*, 2009, 9, 3330–3337
3. Bejarano, D., Lozano, P., Mata, D., Cito, S., Constanti, M., Katakis, I.; Screen printing as a holistic manufacturing method for multifunctional microsystems and microreactors *J. Microm. Microeng.,* 2009, 19(11), Article Number: 115007 DOI: 10.1088/0960-1317/19/11/115007