

Fast electrochemical DNA detection in capillary electrophoresis microchip

PROJECT SUPERVISORS

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DESCRIPTION

Overview:

The proposed research project aims at the study and the final development of novel microfluidic devices for the rapid separation, capture and electrochemical detection of DNA sequences involved in breast and prostate cancer.

Background and State of the Art:

Individualised genetic diagnostics are emerging as critical medical tools towards the provision of personalised care, rapid disease screening and therapy follow-up in a new treatment paradigm, referred to as theranostics. DNA detection finds further application in defence and security applications as well as environmental chemistry (e.g. biometrics, biowarfare agents, pathogens and pest identification). The advances made both in the field of DNA detection techniques and micro-total analysis systems have fostered the development of new micro-devices that promise to provide rapid genetic testing at the point-of-need within minutes. However, the formation of duplexes between a targeted sample DNA and the analytical capture probe, used either free in solution or immobilised onto a solid substrate, is kinetically unfavourable. Mixing in microfluidics is problematic given the laminar flow profile of the fluids and the difficulty to generate turbulences to enhance probe-target interactions.

New concepts and approaches are therefore needed to achieve rapid hybridisation and detection and that promise to take genetic testing out of specialised laboratories and into the field.

Project Contribution and Methodology:

The successful candidate will join a team within the Nanobioengineering and Bioanalysis Group (NBG) currently developing novel microdevices for the early detection of breast and prostate cancer biomarkers.

During the project, affinity capillary gel electrophoresis will be coupled to electrochemical detectors to achieve fast detection (< 30 sec) of low concentration DNA amplicon amplified by

PCR. Novel affinity gels will be designed in order to incorporate recognition as well as signaling functionality. The group has achieved a number of milestones, particularly the microfabrication of interdigitated electrode arrays and their integration to complex fluidic networks.

This project is highly multidisciplinary in nature and require a candidate with hands-on approach. It also offers a great opportunity to gain experience in the field of micro/nano-fabrication, electrophoretic and electrokinetic control of DNA, material sciences and electrochemical techniques.

The ideal candidate:

Some previous knowledge of biosensors microfabrication, soft-materials, electrochemistry, and capillary electrophoresis microchip would be an added bonus, although not essential as the objective of the project is to provide advanced practical training in these techniques.

Common sense, **hands-on approach** to laboratory work and the willingness, enthusiasm and curiosity to learn new techniques are essential.

In addition, reasonable spoken and written English is necessary as well as the ability to work in a multicultural environment.

Finishing the project:

The person who finishes this project will learn the fundamentals of microfabrication and DNA biosensing, an important topic in the field of medical diagnostics but also relevant in other industries such as food and forensic sciences as well as environmental monitoring.

In addition, experience on a variety of experimental techniques that can be applied in future works will be gained.

References:

Articles available on request

General information about the European project in can be found at the consortium's website <http://www.miracle-fp7.eu/>

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Zangmeister, R. A. and M. J. Tarlov (2003). "UV graft polymerization of polyacrylamide hydrogel plugs in microfluidic channels." *Langmuir* 19(17): 6901-6904.