Beaufort Undergraduate Internship Programme 2010

PROJECT NO. 3

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Co-supervisors: Prof. Brett Paull and Dr. Dermot Brabazon

Project Title: Development of a high sensitivity on-chip detection cell for environmental analysis

Duration of Project **From:** 7 June 2010 **To:** 10 September 2010

Project Description:

Accurate determination of environmental pollutants present in aquatic systems and drinking water is essential for assessing the water quality and safeguard public health.
However, most of these species are present at very low concentrations and, therefore, very sensitive detection techniques must be employed for analysis of this samples. The aim of this project is to develop a high sensitivity detection system for rapid separation and determination of target species in environmental samples using a micro-fluidic chip. The advantages of microchip platforms include very fast analysis times (typically seconds or minutes), the use of extremely low sample volumes (a few μLs), minimal reagent consumption and waste generation, low cost (essential if disposable devices are needed), and ease of mass-production and integration in portable systems. Additionally, micro-fluidic devices offer the possibility of integration of multiple analytical steps (preconcentration, sample cleanup, mixing, etc) within the same chip.

This project will explore the possibility of using a micro-fluidic channel coated with a thin layer of gold as a highly sensitive detection cell. A commercial light source coupled to an optical fibre or, alternatively, a high power light emitting diode (LED), will be used as the light source. Absorbance and/or fluorescence measurements will be carried out using a commercial spectrophotometer coupled to an optical fibre. The gold layer (highly reflective surface) is expected to act as an optical waveguide for the highly efficient propagation of light from the illumination point to the detection point. Higher efficiency in the light propagation will presumably lead to a significant enhancement of the measured signal and a consequent improvement in the detection sensitivity. Furthermore, the possibility of functionalising the gold layer with selective groups via thiol chemistry will be also explored in order to allow customization of the micro-fluidic device for analysis of different targets.

The undergraduate intern will be involved in the design, setup and testing of the micro-fluidic based optical detection system. This will allow him/her to became familiar with micro-fluidics, optical detection and several micro-fabrication techniques. Furthermore, he/she will be involved in the functionalisation of gold-coated micro-fluidic channels with different selective groups. The resulting functionalised micro-channels will be then evaluated for the separation of test samples.

Key Words:
Environmental analysis, micro-fluidic chip, gold coating, optical detection, optical waveguide, channel functionalisation.

Background Expertise Required:
General knowledge of analytical chemistry.