Proceedings of the 29th Annual International
Conference of the IEEE EMBS
Cité Internationale, Lyon, France
August 23-26, 2007.

Fabric-based fluid handling platform with integrated analytical capability

Shirley Coyle[1], Yanzhe Wu[1,2], King-Tong Lau[1], Gordon G. Wallace[2], Dermot Diamond[1]

[1]Adaptive Sensors Group, Adaptive Information Cluster, Dublin City University, Dublin 9, Ireland
[2]ARC Centre of Excellence for Electromaterials Science, Intelligent Polymer Research Institute, University of Wollongong, Northfields Avenue, Wollongong, NSW 2522, Australia

Introduction

Bio-sensing textiles to perform on-body bio-chemical analysis are a novel concept in the field of wearable technologies. This work is part of BioTex, an EU funded project aiming to develop textile-based sensors for monitoring biological fluids (http://www/biotex-eu.com). A fabric-based fluid handling system has been developed which has promising advantages including (1) potential for sophisticated control of functions like sample application, reagent addition, inclusion of reaction manifold, separation of sample components, variety of detection modes and addition of calibrants; (2) zero power requirement for the transport of liquid; (3) compact structure, easy to fabricate.

Methods

A fabric fluidic channel is made from a moisture wicking fabric (polyamide lycra®) in combination with a superabsorbent (SAB) non-woven (Absorbtex?) placed at the end of the channel (Fig 1(a)). The SAB provides a passive pumping mechanism to control the flow of fluid through the channel and stores waste products. To control the delivery of the sample to the channel a lateral flow valve using a polypyrrole actuator has been implemented (Fig. 1(b)). The platform is configured to encompass i) a wicking channel, ii) lateral flow valves for the addition of sample, reagents and calibrant, iii)a detection unit iv) an absorbent pump. Conventional flow injection analysis may be performed using this configuration where sample is introduced to the carrier channel via the actuator valve. Mixing occurs along the channel before reaching a detection area where a detection unit can be used to generate the analytical signal. The waste is stored in the absorbent material which can be replaced with a fresh unit when exhausted. Solid state sensors can be prepared by direct immobilization of sensing material, e.g. pH indicator dye, onto the channel. Separation of mixtures may also be performed with channels of specific properties (polarity).

(a) (b)

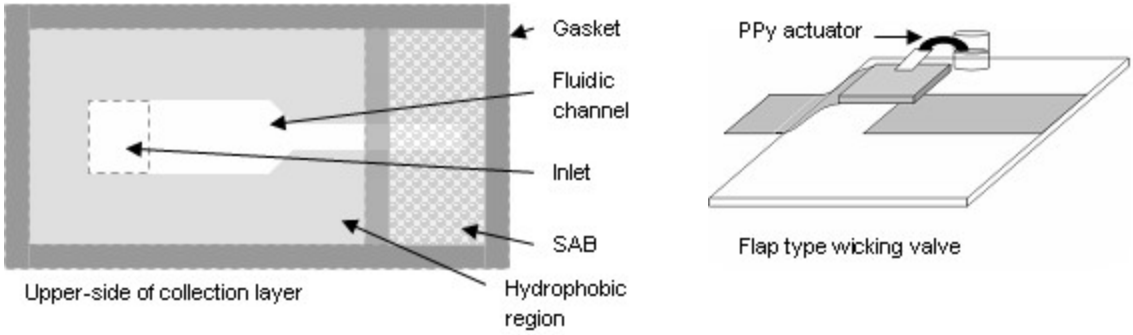

Figure 1 (a) Fabric fluidic channel for sample collection, delivery and analysis (b) Polypyrrole (PPy) lateral flow valve

Results and discussion

The separation of methyl blue and methyl orange was performed on the fluidic platform. For example, at pH 2, methyl orange was eluted before methyl blue while at the pH of 5, the reverse was observed. This concept can be applied to many applications where the relative rate of migration of sample components is affected by interactions with the channel surface and the carrier. Sensing capabilities have been demonstrated by immobilizing pH sensitive dyes onto the fabric fluidic channel. By using optical detection techniques, the pH of the sample can be estimated.

Conclusion

A fabric-based fluidic device incorporating a novel lateral valve has been successfully constructed. It has the ability to transport aqueous liquid through the material's natural infinity for water. This novel approach integrates liquid acquisition, liquid distribution, waste storage, liquid flux control and analytical functions (separation, chemical/biochemical analysis) into one package. Application area includes environmental analysis, personal health monitor, drug delivery, clinical/home diagnostic etc.