doi:10.2533/chimia.2017.385 Chimia 71 (2017) 385

Highlights of Analytical Sciences in Switzerland

Division of Analytical Sciences

A Division of the Swiss Chemical Society

Precision Diagnostics for Mobile Health Using Capillary-driven Microfluidics

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Keywords: Immunoassays · Microfluidics · Point-of-care diagnostics · Smartphone

Microfluidic technology may revolutionize point-of-care (POC) diagnostics owing to the precision with which small volumes of samples can be analyzed outside of centralized healthcare infrastructures. However, this potential will only be fully harnessed if biochemical reactions can be implemented on microfluidics in a way that supports (i) simple use, (ii) scalability to many types of assays, and (iii) interactivity with electronic devices such as smartphones and with the 'Internet of Things'. Our research has mostly focused on implementing immunoassays on capillary-driven microfluidic chips and led to creating a library of microfluidic functional elements and integrating reagents (capture antibody and detection antibody) to such chips. The assay methodology maps the approach used for lateral flow assays wherein biochemical reactions occur sequentially as a sample progressively wets a flow path and reconstitutes reagents.

We recently devised microfluidic chips having patterned electrodes for trapping microbeads functionalized with receptors using dielectrophoresis or monitoring flow in the chips. In this later case, wetting of parallel Pd electrodes affects the capacitance across the electrodes due to the ionic double layer. The capacitance is measured by a small peripheral and transmitted to a smartphone for real-time monitoring of flow conditions in the chip with sub-nanoliter precision.

Disposable, simple-to-use microfluidic chips for immunoassays represent a powerful enabling technology in combination with chip peripherals, smartphones, and modern information technology infrastructures such as cloud computing/storage and cognitive analytics, opening the door to game-changing strategies for health technologies on a global scale.

Acknowledgements

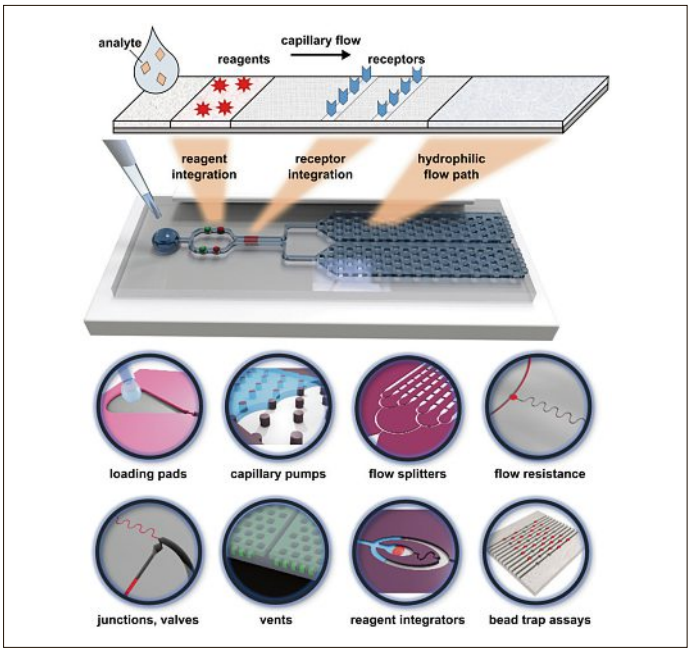
This work has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Grant Agreement No. [701690].

Received: March 28, 2017

References

L. Gervais, E. Delamarche, *Lab Chip* **2009**, *9*, 3330.

Y. Temiz, M. Lim, E. Delamarche, *Proc. SPIE 9705, Microfluidics, BioMEMS, and Medical Microsystems XIV*, **2016**, 97050Z.



Immunoassays are implemented in capillary-driven microfluidic chips by defining a hydrophilic flow path through which a sample passes, dissolves detection antibodies, and forms an antigen–antibody complex on downstream capture antibodies. The flow path is modular and can be created using various assortments of microfluidic functional elements.

A microfluidic chip having patterned electrodes can be inserted on a small, low-cost peripheral for monitoring flow and reading assay results. Such a peripheral has a Bluetooth module, a microcontroller, and can communicate with a smartphone. This technology is broadly applicable to any ligand–receptor type of assay for the generation and analysis of precise data.

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