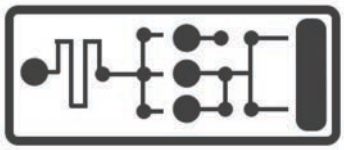
Point-of-Care microfluidic chip



MSc thesis theme

Introduction

"Point-of-Care" (POC) testing is a method to carry out a medical diagnosis outside a central diagnostic lab – for example at the family doctor's office, in an ambulance, or even at home. This can have great advantages, but it will only be feasible if a POC test can be done fast (within minutes), with small samples (e.g. a finger prick of blood), is easy to use, is still sufficiently sensitive, and is not too expensive. At TU/e, a new method has been invented to sensitively detect antibodies in small samples of blood which is promising as a POC test, by detecting a color change that is triggered by a biochemical reaction, simply by using a smartphone (Fig. 1).[1] This "LUMABS" assay has now been shown in a lab environment, however to develop this further towards a product, a chip must be developed that allows for this method to be done in an autonomous, fast, and east-to-use manner.

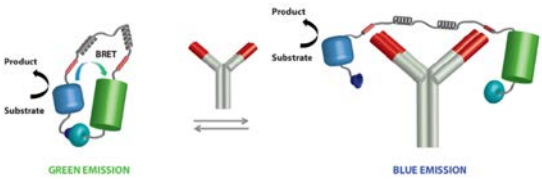


Figure 1: A detection method suitable for POC, developed at TU/e: The biochemical reaction of a luminescent sensor molecule (LUMABS), in combination with a substrate molecule, with proteins that may be present in the blood sample, lead to a color change.[1]

In the Microsystems Research Section, we are developing such a microfluidic chip, combined with a handheld readout system. The chip must have a number of functions: (1) sample intake; (2) plasma extraction from the blood sample e.g. by a special filter; (3) the plasma is led to micro-reaction chambers, where the sample is mixed with reagents and the biochemical reactions take place; (3) the sample is lead to a detection chamber at which the possible color change can be detected using an optical reader. All these operations should work automatically. The reagents needed for the assay need to be pre-stored in the chip.

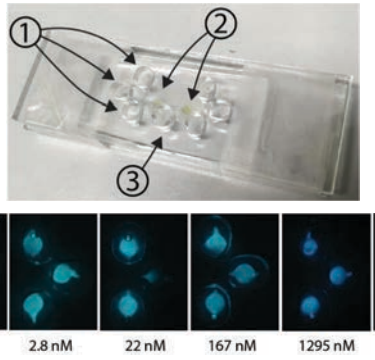


Figure 2: Top: First microfluidic chip developed in [2], to automatically run the LUMABS sensor with detection chambers (1), reaction chambers (2), and an inlet (3). Bottom: image of luminescence result of a LUMABS assay in the chip, showing color change.

Project topics

In our lab, we have made basic prototypes for the POC chip showing some of the functions required. Fig. 2 shows a chip with automatic sample intake and filling, in which the LUMABS assay was successfully demonstrated. Fig. 3 shows an improved chip including a blood cell separation filter. However, much work still needs to be done to develop the full microfluidic chip that can perform all functions reliably.

MSc thesis projects can focus on microfluidics design, sample intake, microfabrication approaches, possible integration of mixing, design for optical detection, or assay testing. In this research, we collaborate with the inventors of the LUMABS assay in TU/e-BME.

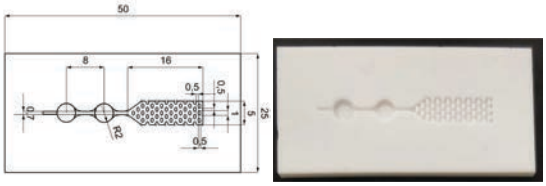


Figure 3: Improved microfluidic chip developed in [3], which also includes a filter that separates blood cells from the sample of a few drops of blood, before the sample is further transported and analysed.

References
[1] R. Arts et al. (2016), Analytical Chemistry 88, 4525.
[2] Harm Visscher (2018) MSc thesis TU/e.
[2] Emma Moonen (2019) MSc thesis TU/e.

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