# Development of a PDMS microfluidic – paper analytical hybrid microdevice for blood processing

Degree programme: Master of Science in Engineering | Specialisation: Medical Engineering
Thesis advisor: Prof. Dr. Cédric Bessire
Expert: Prof. Dr.Olivier Guenat

## By checking infection levels physicians want to know the white blood cell count as well as the human C-reactive protein concentration in the blood. These different markers react differently on the type of infection and in time after the infection. A microfluidic platform that can provide both diagnostic markers has been developed.

### Motivation

Human C-reactive protein (CRP) is an acute phase inflammation biomarker. The concentration of this biomarker is used for spontaneous diagnosis of infection. At low levels of concentration (1-5 µg/ml), knowledge of cardiovascular risk can be assessed, and at greater levels of concentration (>10µg/ml), information about infections and type of infections (usually bacterial >20 µg/ml or viral <20 µg/ml) can be assessed. CRP protein is a very important biomarker in Point-of-care testing (POCT) devices. These are medical devices that can be used for diagnosis at the site of care and in short time spans. This thesis aims to show the utility of microfluidics for processing whole blood and its components for diagnostic purposes.

### Objective

The project itself deals with developing microfluidic platforms for blood processing, with the ultimate aim of developing functioning POCT platforms for whole blood diagnosis. The microfluidic platform can perform white blood cell (WBC) count. The objective of the thesis is to facilitate measuring CRP concentration on the platform as well. The thesis therefore can be broken down into two integral parts – developing a biosensor for CRP measurement, and mechanically integrating this biosensor component to the microfluidic system.

### Methodology

A commercially used, clinically approved CRP nitrocellulose based analytical device was used as the basis to develop this biosensor. The concentration of CRP protein in a sample is correlated to the colour intensity of the colour band that shows up on the paper strip. The key for the integration of this biosensor into the microfluidic platform is a blood cell separation membrane. A silicone microfluidic chip that takes up whole blood for enabling a WBC count was fabricated. The chip accommodates the paper analytical device for the optical CRP detection. The resultant device is a unique hybrid silicone – paper microfluidic device (see figure 1).

### Results

A correlation between CRP protein concentration in a sample and colour intensity of bands was observed. This analysis was performed after images of the colour bands were taken under a microscope (see figure 2).

Kevin Nicholas
kevin160894@hotmail.com

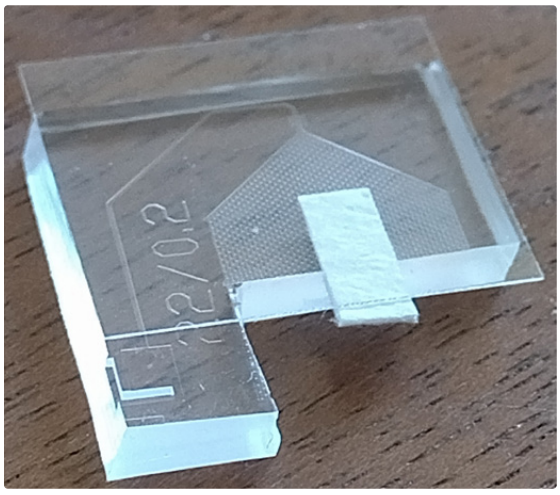

figure 1: shows the mechanically integrated paper and PDMS microfluidic system

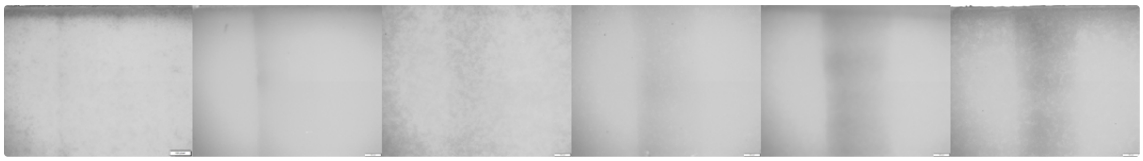

figure 2: left to right 2µg/mL to 16 µg/mL; colour intensity increasing