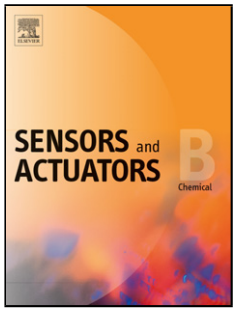

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PII: S0925-4005(18)31583-1
DOI: https://doi.org/10.1016/j.snb.2018.08.145
Reference: SNB 25293

To appear in: *Sensors and Actuators B*

Received date: 31-3-2018
Revised date: 13-8-2018
Accepted date: 27-8-2018

Please cite this article as: Aeinehvand MM, Martins Fernandes RF, Jiménez MF, Lara Díaz VJ, Madou M, Martinez-Chapa SO, Aluminium valving and magneto-balloon mixing for rapid prediction of septic shock on centrifugal microfluidic platforms, *Sensors and amp; Actuators: B. Chemical* (2018), https://doi.org/10.1016/j.snb.2018.08.145

Aluminium valving and magneto-balloon mixing for rapid prediction of septic shock on centrifugal microfluidic platforms

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Highlights

- To automate a sTREM-1 ELISA on a microfluidic disc, we developed a novel active valving mechanism (aluminium valving) by adding an aluminium and a thin flexible film layer to the common plastic materials used for disc fabrication.
- To enable rapid sepsis detection and prediction of septic shock, we employed an active microballoon-based flow reciprocation mechanism (magneto-balloon mixing) in centrifugal microfluidic platforms to accelerate the sTREM-1 immunoassay.
- Based on the aluminium valving and magneto-balloon mixing mechanisms, we developed an automated microfluidic disc for sTREM-1 analysis.

A B S T R A C T

Rapid and early diagnosis of sepsis is critical, as sepsis mortality increases by 8 % per each hour of delay in treatment. It has been recently shown that the quantification of soluble triggering receptors expressed on myeloid cells-1 (sTREM-1) can accurately predict sepsis and septic shock in infected neonates. To automate sTREM-1 ELISA on a microfluidic disc, we developed a novel active valving mechanism by adding an aluminium and a thin flexible film layer to the common plastic materials used for the disc fabrication. To enable rapid sepsis detection and prediction of septic shock, we employed an active microballoon-based flow reciprocation mechanism in centrifugal microfluidic platforms to accelerate the sTREM-1 immunoassay. The technique is called magneto-balloon mixing and provides one liquid reciprocation cycle per disc revolution and accelerates biomolecular reactions happening on the microfluidic disc, leading to the rapid detection of sTREM-1 by ELISA. The magneto-balloon enabled the reduction of the assay time for the detection of 60 pg/ml sTREM-1 (for sepsis detection) and 300 pg/ml (for septic shock prediction) from five hours to 75 minutes. Based on the aluminium valving and magneto-balloon mixing techniques, we developed an automated centrifugal microfluidic platform that enables rapid prediction of septic shock.

Keywords:

Neonatal sepsis

sTREM-1 immunoassay

Aluminum valving

Centrifugal microfluidics

Magneto-balloon mixing

Reciprocational flow