A fluorescence-based optical platform for the simultaneous detection of sepsis biomarkers

Francesco Baldini*†1, Barbara Adinolfi1, Simone Berneschi1, Romeo Bernini2, Ambra Giannetti1, Immacolata Grimaldi2, Gianluca Persichetti2, Genni Testa2, Giampiero Porro3, Sara Tombelli1, and Cosimo Trono1

1Institute of Applied Physics "Nello Carrara" (CNR-IFAC) – Via Madonna del Piano 10, 50019 Sesto Fiorentino (Firenze), Italy
2Institute for Electromagnetic Sensing of the Environment (CNR-IREA) – Via Diocleziano 328, 80124, Napoli, Italy
3Datamed srl – Via A. Grandi, 4/6 20068 Peschiera Borromeo (MI), Italy

Abstract

An optical platform was developed for the simultaneous detection of biomarkers for sepsis. It makes use of a polymethyl methacrylate chip constituted by thirteen microchannels, each of one devoted to the detection of a single biomarker. A suitable chemistry is implemented on the channel surface in order to create a sensing layer containing the capture antibody. In terms of biomarkers, the attention was focused on C-reactive protein, soluble urokinase plasminogen activator receptor, procalcitonin, and interleukin 6 among the various interleukins. Bioassays for the different chosen biomarkers have been performed in order to identify the best conditions for the immunoassays. The optical platform, ready to be used in the hospital, makes use of a diffractive optical element (DOE) able to generate 13 parallel lines (each one in correspondence of each channel of the microfluidic chip) when it is illuminated by a laser diode (LD) at a working wavelength of 635 nm. Moreover, an array of 13 coloured glass absorbing filters, faced on the sensitive part of a CCD camera, guarantees the parallel acquisition of the data. All the hardware components and the software modules were chosen and designed in order to be integrated in the final Hemospec prototype, which was implemented and used for the detection of the selected biomarker, the C-reactive protein (CRP), by an optimised immunoassay in spiked plasma samples and in real plasma samples from patients. This work was conducted within the EU FP7 Project HEMOSPEC.

Keywords: POCT, bioassay, fluorescence, sepsis

---

*Speaker
†Corresponding author: f.baldini@ifac.cnr.it