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Use of Giant Magneto Resistance Sensors to Detect Micron to Submicron Biologic Objects

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Abstract : Early diagnosis or detection of harmful substances at low level is a growing field of high interest. The ideal test should be cheap, easy to use, quick, reliable, specific, and with very low detection limit. Combining the high specificity of antibodies-functionalized magnetic beads used to immune-capture biologic objects and the high sensitivity of a GMR-based sensors, it is possible to even detect these biologic objects one by one, such as a cancerous cell, a bacteria or a disease biomarker. The simplicity of the detection process makes its use possible even for untrained staff. Giant Magneto Resistance (GMR) is a recently discovered effect consisting in the electrical resistance modification of some conductive layers when exposed to a magnetic field. This effect allows the detection of very low variations of magnetic field (typically a few tens of nanoTesla). Magnetic nanobeads coated with antibodies targeting the analytes are mixed with a biological sample (blood, saliva) and incubated for 45 min. Then the mixture is injected in a very simple microfluidic chip and circulates above a GMR sensor that detects changes in the surrounding magnetic field. Magnetic particles do not create a field sufficient to be detected. Therefore, only the biological objects surrounded by several antibodies-functionalized magnetic beads (that have been captured by the complementary antigens) are detected when they move above the sensor. Proof of concept has been carried out on NS1 mouse cancerous cells diluted in PBS which have been bonded to magnetic 200nm particles. Signals were detected in cells-containing samples while none were recorded for negative controls. Binary response was hence assessed for this first biological model. The precise quantification of the analytes and its detection in highly diluted solution is the step now in progress.

Keywords : early diagnosis, giant magnetoresistance, lab-on-a-chip, submicron particle
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