Electromagnetic and microfluidic lab-on-chip using magnetic nanoparticles for immunological pathogens detection

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Abstract

The rapid detection and quantification of a biological agent has become essential to anticipate a possible public health threat (epidemic or pandemic), environmental or other contextual threats. In this area, one of the main objectives is to facilitate this detection with a portable, rapid, cost-effective, sensitive and reliable Lab-on-Chip (LoC) system. To achieve this goal, it is therefore necessary to design and build microsystems composed of innovative sensors. The biological analysis based on high sensitivity magnetic measurements is a new type of immunological diagnosis using magnetic nanoparticles (MNP) as markers instead of the enzymes, radioisotopes or fluorochromes conventionally used. This new method of analysis involves the coupling of antibodies or antigen proteins to MNP. The detection of MNP of various sizes and also different magnetic properties has been achieved through multiphysics simulations and measurements using the frequency mixing technique and a planar micro-sensor that measures the induced magnetic field variation. The microfluidic channels integrated in this system make it possible to use very small quantities of reagents (microliters), thus reducing by several orders of magnitude the volume of samples to be used. The time required for bioanalysis will also be considerably reduced which can be very significant in the case of epidemics or pandemics, water, food and environmental security.

Keywords: pathogen sensing, microfluic channels, magnetic nanoparticles, frequency mixing technique, LoC

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