Ioanna Giouroudi et al., J Nanomed Nanotechnol 2014, 5:5
http://dx.doi.org/10.4172/2157-7439.S1.018

OMICS Group Conferences
Accelerating Scientific Discovery

4th International Conference on
Nanotek & Expo

December 01-03, 2014 DoubleTree by Hilton Hotel San Francisco Airport, USA

On-chip separation and detection of magnetically labeled pathogens

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This paper presents the investigations towards a compact, fully automated biosensing device for pathogen monitoring (e.g. bacteria or viruses) based on selective labeling of the pathogens with functionalized magnetic nanoparticles (MNPs). On chip separation is established by combining microfluidics with integrated current carrying microstructures. Following magnetic separation the magnetic moment of the magnetically labeled pathogens, and thus their presence in the sample fluid, is sensed by an embedded, highly sensitive giant magnetoimpedance (GMI) microwire sensor (CoFeSiBNb alloy, diameter and length of 40 µm and 10 mm, respectively). The innovative aspect of the proposed separation method is that the induced velocity on MNPs in suspension, while imposed to a magnetic field gradient is inversely proportional to their volume. The volumetric increase of the MNPs is caused by the binding of pathogens to their functionalized surface. The new formed compounds are called loaded MNPs (LMNPs). By setting up an actuation time adequate for the size of the MNPs, the LMNPs will fall back, thus separating them. The separation microfluidic channel and the detection chamber are fabricated using a dry photoresist thin film (Ordyl SY355) and standard photolithography. The current carrying microstructures are fabricated using photolithography and gold evaporation. The GMI microwire sensor is inserted in a trench, perpendicularly to the microchamber, fabricated by standard photolithography and plasma etching. Gold electrodes are fabricated by pulse current electrodeposition in order to electrically connect each end of the GMI microwire. A volume of 180 nl MNPs with a concentration of 18 mmol (Fe)/l was detected.

Biography

Ioanna Giouroudi received the Doctorate Degree (Dr. techn.) in Electrical Engineering from the Vienna University of Technology, Austria in 2006. She is currently employed as University Assistant (towards habilitation) by the Institute of Sensor & Actuator Systems, Vienna University of Technology, Austria. She has developed a research line focusing on biomedical applications of magnetic micro- and nanoparticles. Her research interests include: microfluidics, magnetism, biomedical applications of magnetic materials and sensors as well as micro- and nanotechnology. Parallel to her research activity, she is teaching several undergraduate (BSc) and graduate (MSc) courses and is supervising MSc and PhD students.

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