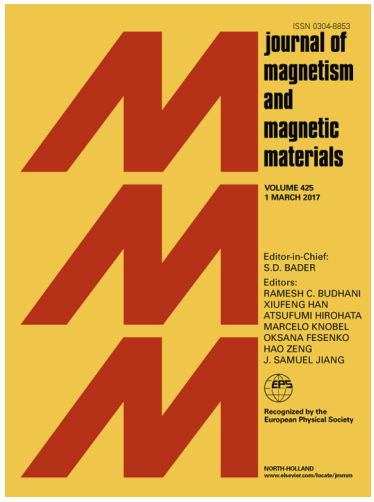

Multiplex biosensing with highly sensitive magnetic nanoparticle quantification method

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Multiplex biosensing with highly sensitive magnetic nanoparticle quantification method

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Keywords: non-linear magnetization; multiplex immunoassay; simultaneous detection; biomagnetic chips; micropillar arrays; microfluidic sensor chips.

Abstract

Unique properties of magnetic nanoparticles (MNP) have provided many breakthrough solutions for life science. The immense potential of MNP as labels in advanced immunoassays stems from the fact that they, unlike optical labels, can be easily detected inside 3D opaque porous biosensing structures or in dyed mediums, manipulated by an external magnetic field, exhibit high stability and negligible background signal in biological samples, etc. In this research, the magnetic nanolabels and an original technique of their quantification by non-linear magnetization have permitted development of novel methods of multiplex biosensing. Several types of highly sensitive multi-channel readers that offer an extremely wide linear dynamic range are developed to count MNP in different recognition zones for quantitative concentration measurements of various analytes. Four approaches to multiplex biosensing based on MNP have been demonstrated in one-run tests based on several 3D porous structures; flat and micropillar microfluidic sensor chips; multi-line lateral flow strips and modular architecture of the strips, which is the first 3D multiplexing method that goes beyond the traditional planar techniques. Detection of cardio- and cancer markers, small molecules and oligonucleotides were used in the experiments. The analytical characteristics of the developed multiplex methods are not inferior to those of the modern laboratory techniques. The developed multiplex biosensing platforms are promising for medical and veterinary diagnostics, food inspection, environmental and security monitoring, etc.

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