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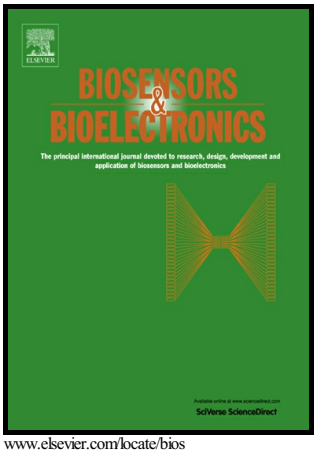

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Magnetic impedance biosensor: A review

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Abstract

Though the magnetoimpedance effect was discovered two decades ago, the biomedical applications of the magnetoimpedance sensor are still in their infancy. In this review, the authors summarized the magnetoimpedance effect in soft ferromagnetic wires, ribbons and thin films for biosensing applications. Recent progress and achievements of the magnetoimpedance-based biosensing applications including the detection of magnetic Ferrofluid, magnetic beads, magnetic nanoparticles, magnetically labeled bioanalytes and biomagnetic fields of living systems were reviewed. The modification effect of the biochemical liquids, agglomeration effect of the magnetic particles, and the effect of the stray magnetic field on magnetoimpedance were investigated in this review. Some constructive strategies were proposed for design of the high-performance magnetoimpedance biosensor, for quantitative and ultrasensitive detection of magnetically labeled biomolecules. The theoretical and experimental results suggest that the magnetoimpedance sensors are particularly suitable for highly sensitive detection of low-concentration biomolecules, and might be used for early diagnosis and screening of cancers.

Keywords: Magnetoimpedance biosensor; Detection; Magnetic nanoparticles; Label; Cancer cell; Biomolecule.

1. Introduction

Superparamagnetic particles such as magnetic beads (< 100 μm) and magnetic nanoparticles (< 100 nm) are of great interest for researchers from a wide range of the disciplines (Drozdov et al., 2016; Fuentes et al., 2005; Huang et al., 2015; Jahanbani et al., 2016; Liang et al., 2012; Palecek et al., 2007; Paul et al., 2012; Pflipsen et al., 2013; Sun et al., 2008; Uddin et al., 2016) because of their unique physical and chemical properties, including magnetic fluids, catalysis, magnetic resonance imaging, data storage, environmental remediation, biotechnology and bioengineering. magnetic particles are commonly composed of magnetic elements, such as iron, nickel, cobalt and their oxides. Superparamagnetic particles can be magnetized only if subjected to an external magnetic field, so no residual magnetization retains in the absence of magnetic field. They are also easily functionalized with different biochemical substances that can be used to capture deoxyribonucleic acid, protein, enzymes and cells. Physicochemical stability of the superparamagnetic particles enables the detection and magnetic manipulation both in vitro and in vivo, without affecting the biological interactions. Functionalized superparamagnetic particles are widely used for biomedical applications such as immunoassay (Rong et al., 2016), magnetic resonance imaging (Bi et al., 2015), telomerase activity (Zhou et al., 2008), nucleic acid isolation