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Magnetic Nanoparticles in Nanomedicine

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2.1 Introduction

Magnetic materials are in the limelight of modern nanotechnological applications. Over the last decades, a tendency of miniaturization has been observed for different types of magnetic materials, which can be understood from the point of view of their size-dependent properties. The advancements in the field of nanotechnology have shown that Magnetic Nanoparticles (MNPs) display completely different properties as compared to those of bulk materials. By reducing their size to values of the order of their single-domain dimension (~20 nm) or even lower, the MNPs, which at room temperature can exhibit a ferro- or ferri-magnetic behavior, become superparamagnetic (SP). In other words, the reduction of their size can be used for modulating their physical properties by diminishing the magnetic interaction manifesting between them. This finding represented a very good starting point, in terms of the applicability of MNPs in nanomedicine.

On the other hand, nanomedicine is a research topic that has seen a tremendous development in recent years. Basically, nanomedicine can be defined as the use of nanomaterials/nanostructures in medical applications. Several nanoformulations have been tested so far for such applications. Among them, the inorganic nanoparticles and, more precisely, the MNPs proved to possess numerous benefits over conventional medicines, making them valuable candidates in various fields of biomedical applications (Martins et al. 2020). As a direct consequence of their high versatility, the MNPs were proposed for numerous applications. However, a complete and comprehensive classification of these applications is not a very easy task. Over the years, three major types of MNPs applications in biomedicine have emerged: diagnosis, therapy, and targeting. By either functionalizing their surface with biomolecular components or by creating hybrid nanoformulations, in combination with polymers, fluoro-phores, liposomes, plasmonic, or silica shells, the MNPs gain multiplexing capabilities. Among numerous research groups that have performed extensive research in this area (Salgueiriño-Maceira et al. 2006; Arruebo et al. 2007; Colombo et al. 2012),

Magnetic Nanoparticles in Human Health and Medicine: Current Medical Applications and Alternative Therapy of Cancer, First Edition. Costica Caizer and Mahendra Rai.

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