

Iron Oxide-PNA Nanoparticles for miRNA targeting

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Abstract

The dysregulation of microRNAs (miRNAs) has been implicated in a variety of pathologies, such as inflammatory and autoimmune diseases, neurological disorders, as well as several types of cancer. Anti-miRNA platforms highly effective in in-vitro cell assays have been reported, but translation to the clinic is hampered by poor in-vivo stability of nucleic acids and ineffective uptake of nucleic acids by target cells.

This study aims to overcome these obstacles by designing, producing and testing in-vivo new miRNA targeting materials constituted by Peptide Nucleic Acids (PNAs, synthetic mimics of natural DNA and RNA) [1]. Indeed, PNAs conjugate the effectiveness of the natural nucleic acids targeting with chemical/thermal stability and resistance to enzymatic biodegradation.

In order to follow the fate of PNA and improve its solubility and permeability to cells, PNA has been linked to superparamagnetic iron oxide nanoparticles (SPIONs), affording new nanocomposites which will be exploited both as contrast agents for magnetic resonance imaging (MRI) and as sources of local overheating through the application of an alternating magnetic field (Magnetic Fluid Hyperthermia, MHF).

SPIONs have been prepared by a slightly modified thermal decomposition method [2] in order to optimize in particular the hyperthermia effectiveness [3]. Then, the oleate layer has been exchanged with dimercaptosuccinic acid (DMSA) which is a bifunctional small molecule, able to efficiently substitute the oleate capping agent [4]. This way both COOH and SH groups can be exploited to link PNA to the NP surface.

In this work the synthesis of the magnetic NPs, their characterization and their functionalization with PNA are presented.

References

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- [2] P. Calcagnile, D. Fragouli, I. S. Bayer, G. C. Anyfantis, L. Martiradonna, P. D. Cozzoli, R. Cingolani, A. Athanassiou, *ACS Nano*, **6** (2012) 5413.
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- [4] A. Ruiz, P. C. Morais, R. Bentes de Azevedo, Z. G. M. Lacava, A. Villanueva, M. del Puerto Morales, *J Nanopart. Res.*, **16** (2014) 2589.

Figures

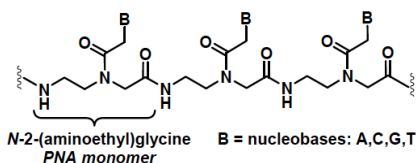


Figure 1. A peptide nucleic acid repeating fragment

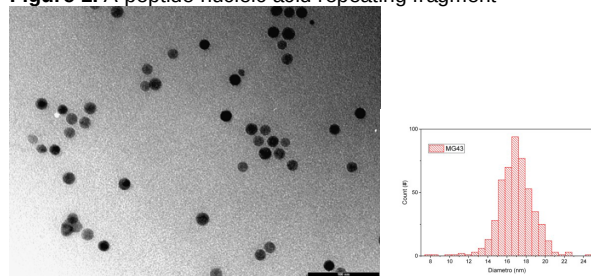


Figure 2. TEM image of the synthesized magnetite nanoparticles and their size distribution.