Bioorthogonal click chemistry and magnetic hyperthermia: a novel strategy for cell transfection

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Keywords: Click Chemistry • Magnetic Nanoparticles • Magnetic Hyperthermia • Cell Transfection

One of the most outstanding properties of magnetic nanoparticles (MNPs) is their ability of transforming magnetic energy into heat under an alternating magnetic field (AMF). This phenomenon is commonly known as magnetic hyperthermia (MH). In this work we introduce an unprecedented application of MH in the field of cell transfection or insertion of exogenous genetic material in cells. Our innovative approach is to covalently immobilize MNPs onto cell membranes *via* bioorthogonal click chemistry. With this particular subcellular localization of the MNPs, a controlled and localized heating of the cell membrane ("hotspots") could be attained, resulting in reversible changes in the permeability and fluidity of the cellular membrane.

The membrane of human breast adenocarcinoma cells (MCF7) has been successfully modified with azide reporters through metabolic glycoengineering in a dose-dependent manner. This new chemical functionality in the cell membrane makes possible the bioorthogonal "click" reaction of cyclooctyne-functionalized MNPs through the strain-promoted [3+2] azide-alkyne cycloaddition (SPAAC).[1] Hydrophobic 12 nm iron oxide MNPs were synthesized following a seed-mediated thermal decomposition methodology and transferred to water by coating with an amphiphilic polymer.[2] The MNPs were further functionalized step-wise with a strained alkyne and with polyethyleneglycol (PEG) to increase colloidal stability and biocompatibility. Results obtained using fluorescence microscopy techniques revealed that is possible to control the immobilization of the MNPs depending on the size and density of the PEG coating. We are currently investigating the MH behaviour of the immobilized MNPs and the cell transfection efficiency.

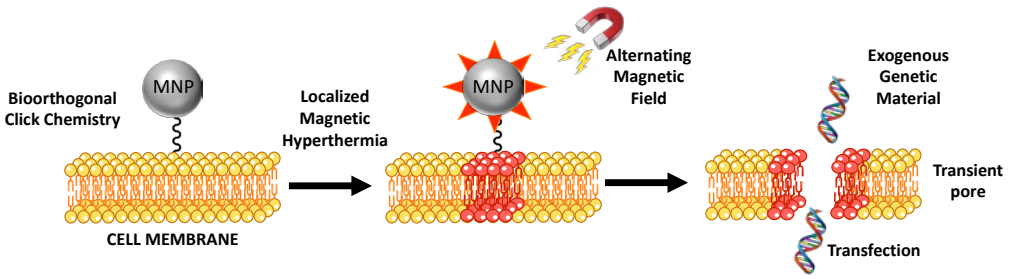

Figure 1. Scheme of the application of localized MH onto cell membranes for cell transfection.

Referencias

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