Functionalized Silica Nanoplatform as Bimodal Contrast Agent for ^{1}H MRI and Optical Imaging

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Purpose

The inherent low sensitivity of magnetic resonance imaging (MRI) can be overcome by the use of paramagnetic contrast agents (CAs), typically gadolinium complexes. It is known that the effect of a Gd^{3+} chelate on the longitudinal relaxation rate of water molecules depends on molecular weight of the system. In order to improve the relaxation process, we decided to perform a non-covalent confinement of small gadolinium Gd^{3+} based CAs in a semi-permeable nanosystem. Thanks to their exceptional properties (i.e. biocompatibility, chemical stability, low toxicity) silica nanoparticles (SiO_2 NPs) have been chosen as a matrix.

Materials and Methods

SiO_2 NPs were obtained by reverse micro-emulsion procedure in the presence of a hydrosoluble paramagnetic CA (Gd-HP-DO3A). Bimodality was reached by introducing ZW800-1, a near-infrared emitting molecule, during the micro-emulsion. Then, the particle surface was modified by silanol-PEG chains to ensure aqueous stability. Functional groups were introduced by mean of a photochemical treatment in the presence of a diazirine system. The as-obtained platforms were characterized by dynamic light scattering (DLS), nuclear magnetic resonance (NMR) spectroscopy, relaxometry measurements, UV-Vis and IR spectroscopies, transmission electron microscopy (TEM).

Results and Conclusions

A stable fluorescent paramagnetic nanoplatform (figure 1) was successfully prepared and completely characterized. Narrow size distribution SiO_2 NPs were obtained (D_H: 80 nm). Relaxometric measurements of the as-synthetized nanoplatform have proven its efficiency to decrease $T_{1,2}$ of water protons molecules. The fluorescent properties were kept after encapsulation of the ZW800-1. In a near future, a biological vector (peptide targeting inflammation) will be grafted on the surface of our bimodal platform and its efficiency will be evaluated *in vitro* and *in vivo.*

Financial interest statement:
No author has a direct or indirect financial interest in the products under investigation or subject matter discussed in the manuscript.

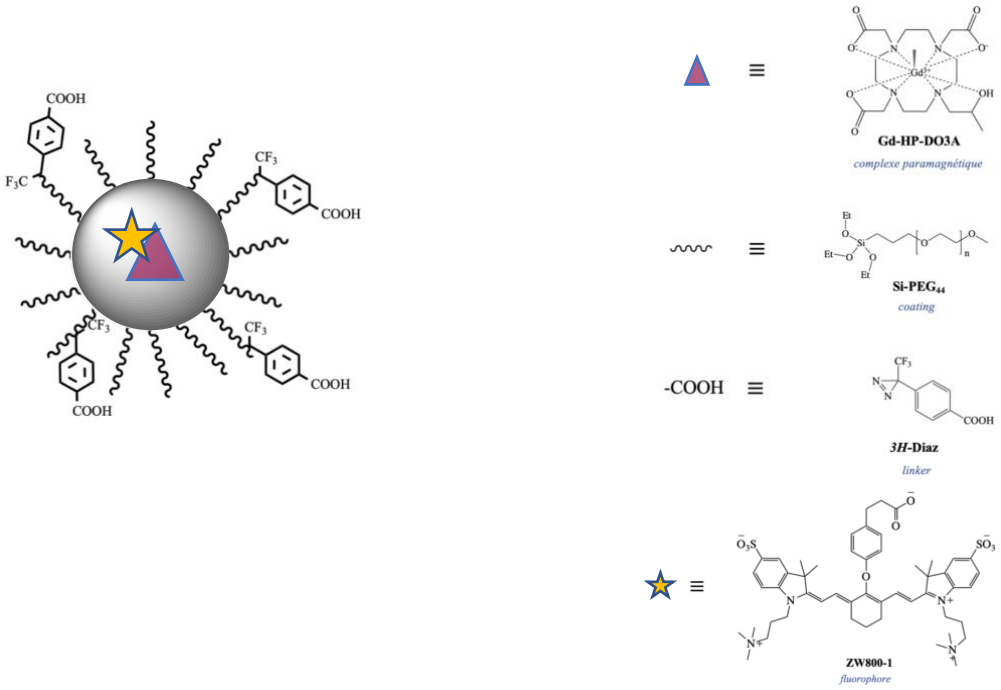

Figure 1: Schematic silica nanoplatform