Traking nanomotors for in vivo applications using nuclear imaging techniques

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Micro/nanomotors, which are micro/nanoscale devices capable to induce self-propulsion in fluid environments, have recently gained attention for different biomedical applications [1,2]. Initial works reported in the literature described micro/nanomotors able to swim in non-biocompatible matrixes such as aqueous hydrogen peroxide. Moving towards *in vivo* applications, enzyme catalysis has emerged as a biocompatible and powerful alternative to produce self-propulsion. However, tracking these micro- and nano-devices *in vivo* and at the whole body level still remains a challenge. Here, we describe the application of radiollabelling followed by Positron Emission Tomography (PET) imaging to achieve the time-resolved tracking of urease-functionalized nanomotors as potential drug delivery agents for bladder cancer.

Fully mesoporous silica nanoparticles (MSNP) with a mean diameter of 480 nm were fabricated and modified with amine groups using previously reported methods [3]. The MSNP were then functionalized with urease and heterobifunctional H_2N-PEG-SH via glutaraldehyde crosslinking, to obtain pegylated urease-powered nanomotors. The available thiol groups were then used for anchoring 20 nm gold nanoparticles. The efficient radio-fluorination of the nanomotors was achieved by the reaction (pH = 8, room temperature, 35 min) between the amine groups of the urease and 6-[^{18}F]fluoronicotinyl-2,3,5,6-tetrafluorophenyl ester ([^{18}F]FPy-TFP), which was prepared following a previously reported procedure [4].

PET Imaging studies in a labyrinth-type phantom (Fig. 1a) clearly showed the self-propelling capacity of the nanomotors in the presence of urea (Fig. 1c) while no significant movement was observed in pure water (Fig. 1b). In vivo biodistribution studies in rodents after intravenous administration showed accumulation of the nanomotors in lungs and liver, majoritarily. Our results clearly demonstrate the suitability of our approach for the *in vivo* tracking of nanomotors.

References

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Figures

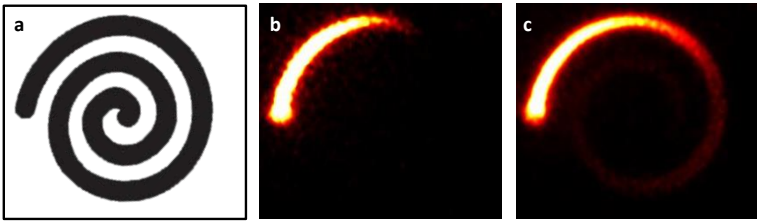

Figure 1: (a) Schematic top view of the laberynth-type phantom; (b) Image obtained at t=60 min after seeding of nanomotors in water; (c) Image obtained at t=60 min after seeding of nanomotors in 300 mM aqueous urea solution.