Labelled Self-propelled nanosystems: towards improved (nano)theragnostic agents

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Abstract

Nanoparticles have been widely investigated in the biomedical field: They are small-sized, their surface composition and properties can be easily tuned, and they have the capacity to carry large amounts of cargoes. Additionally, they can be provided with imaging capabilities, enabling their non-invasive in vivo tracking. These properties position nanoparticles as promising therapeutic, diagnostic or even theragnostic agents. However, recent studies have demonstrated that only a small fraction of the nanoparticles typically reach the target site, resulting in insufficient accumulation to guarantee diagnostic or therapeutic efficacy. Moreover, distribution within the targeted tissue or organ is often heterogeneous.

Micro- and nanomotors, which are micro- and nanodevices capable to self-propel in different media, have proven to overcome a number of limitations of classical nanomedicines, by enhancing targeting properties and penetration capacity in complex structures. Still, the design of biocompatible motors capable to self-propel in biological fluids remains challenging, and their control and in vivo visualization to aid in the evaluation of motile nanomedicines and facilitate the eventual translation into the clinics remains unresolved.

In this talk, recent works related to the radiolabelling and subsequent investigation of micro- and nanomotors carried out in collaboration with Prof. Samuel Sánchez (IBEC, Barcelona) will be discussed. The discussion will include labelling strategies and pioneering in vitro PET studies to evaluate motile properties of tubular micromotors at the macroscopic level [1], as well as recent results covering the radiolabelling and in vitro/in vivo evaluation of biocompatible, enzyme-powered nanobots [2]. Finally, currently ongoing applications of the nanobots as theragnostic agents in a mouse cancer model will be presented.

References

[1] D. Vilela, U. Cossío, J. Parmar, A.M. Martínez-Villacorta, V. Gómez-Vallejo, J. Llop, S. Sánchez. ACS Nano, 12 (2018) 1220-1227.

[2] A. C. Hortelao, C. Simó, M. Guix, S. Guallar-Garrido, E. Julián, D. Vilela, L. Rejc, P. Ramos-Cabrer, U. Cossío, V. Gómez-Vallejo, T. Patiño, J. Llop, S. Sánchez., Science Robotics, 6 (2021) eabd2823.