Biocompatible chemical nanobots and their applications in biomedicine

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Engineering medical nanomotors/nanobots will imply the use of biocompatible materials and bio-friendly propulsion mechanisms. Our strategy comprises the use of biocatalysts such enzymes for converting biologically available fuels, such as the urea contained in the urine, into a propulsive force. Moreover, nanoparticles' chassis are generally recognized as safe (GRAS) material, FDA or EMA approved materials.
In my talk, I will present how we bioengineer hybrid nanobots combining the best from the two worlds: biology (enzymes) and (nano)technology (nano- micro-particles) providing swimming capabilities, biocompatibility, imaging, multifunctionality and actuation in vitro and in vivo. I will present some of the proof-of-concept applications of biocompatible nanobots such as the efficient transport of drugs into cancer cells and 3D spheroids (1), the imaging of swarms of nanobots in vivo in confined spaces like the bladder of living mice (2). Moreover, I will present our recent advances in the treatment of bladder cancer in mice using radionuclide-labelled nanobots (3) and STING agonist (4). Nanobots are actively crossing mucus layers present in the colon of mice (5) and in synovial fluids of joints (6).

References

[1] Hortelao et al., ACS Nano, 13 (1) (2019) 429-439.

[2] Hortelao et al., Sci. Robotics, 6 (52) (2021) eabd2823.

[3] C. Simó, M. Serra et al., Nat. Nanotech., 19 (2024) 554-564.

[4] H. Choi et al., Nat. Commun., 15 (1) (2024) 9934.

[5] M. Serra et al., ACS Nano, 18 (2024) 16701-16714.

[6] N. Ruiz-González et al., Small, 20 (11) (2024) 2309387.