Nanomotors: Artificial active matter for nanomedicine

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Engineering nanomotors which convert chemistry into motion is of fundamental relevance and interesting for specific applications. Self-propelled micro- and nano-motors are opening many avenues in fields such as nanomedicine, robotics, biosensing, microfluidics, and environmental field [for reviews see 1-3]. Due to the versatility of fabrication techniques available nowadays, we can synthesize nano- and micromotors of different shapes and materials almost on demand, from nanoparticles, microcapsules to nano- and microtubes.

The combination of biological components and artificial ones emerges into what we call hybrid machines/bots. Alike bacteria or small swimmers found in nature, artificial nanobots convert bio-available fuels to generate propulsion force to swim at the nanoscale. One of the dreams in nanotechnology is to engineer small vehicles which can eventually be applied in vivo for medical purposes. Major advances have been demonstrated towards that end, however, questions like -how to swim at the nanoscale, how to achieve motion control and how to image these nanobots- need to be properly addressed.

Here, I will present our recent developments in the field of nanomotors that can autonomously swim and perform complex tasks in vitro. Our hybrid “bots” combine the best from the two worlds: biology (enzymes) and (nano)technology (nano- micro-particles) providing swimming capabilities, remote control, multifunctionality and actuation.[4]
I will present some of the fundamental aspects that we have studied for enzyme nanomotors such as the role of asymmetry, catalysis and enzyme quantity [5]. Moreover, I will show some proof-of-concept applications such as the efficient transport and the enhanced release of drugs into cancer cells [6] and spheroids [7], sensing [8].
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References

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Figures

Figure 1. Micro-and nanomotors, from fundamentals to applciations