STORM characterization of enzyme powered micro- and nanomotors

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Self-propelled enzyme micro- and nanomotors are promising in the biomedical field as a drug delivery platform. This kind of self-propelled motors make use of enzymes to transform the environmental chemical energy into active motion. Despite the recent advances in the field, a deeper understanding of fundamental aspects is required for an efficient implementation in biomedicine. For example, in order to achieve active motion, an asymmetry on the distribution of the particles has traditionally been claimed. Herein, we study the quantity and distribution of urease molecules around the surface of our different motors, including mesoporous silica nanomotors, polystyrene and core-shell polystyrene silica micromotors, in order to understand key parameters such as the enzyme coverage, the number of enzymes needed to power motors, or the impact of an asymmetric enzyme distribution to the motion. Moreover, given the applicability of nanomotors in the nanomedicine field, we also provide a study of the interactions between the nanomotors and biological fluids. The motion of the motors was measured with optical tracking software and the distribution of single molecules (urease and other physiologically relevant molecules) around them was observed and quantified using Stochastic Optical Reconstruction Microscopy (STORM). Interestingly, we observed an asymmetric distribution of enzymes around the motors surface regardless of particle composition and size, suggesting the stochastic asymmetric distribution is enough to break force symmetry and produce motion. These results provide deeper knowledge on the fundamental aspects underling enzyme-powered motors and might help to establish more efficient designs for better applicability in the near future.

References

[1] Patiño T, Feiner-Gracia N, Arqué X, et al. *J Am Chem Soc*, 25 (2018) 7896-7903.
[2] Ma X, Hortelão AC, Patiño T, Sánchez S. *ACS Nano*, 10 (2016) 9111-9122.

Figures

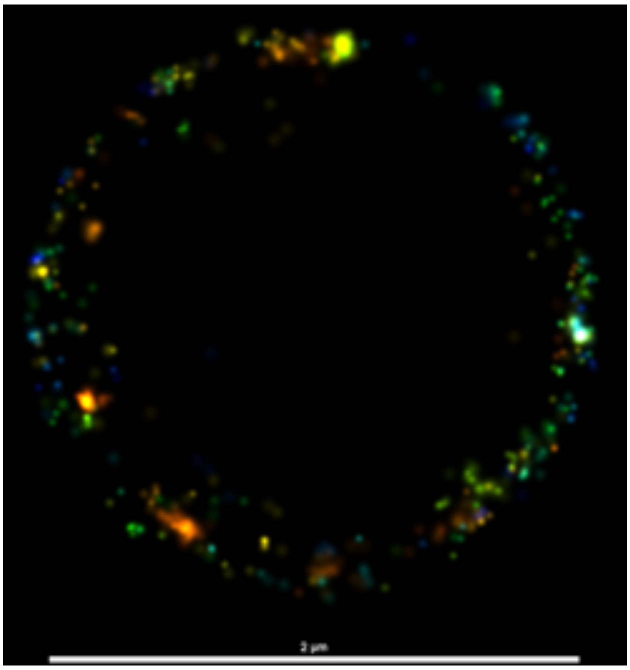

Figure 1. Urease molecules conjugated to the surface of a micromotor viewed with STORM. Scalebar is 2 µm.