CBI ERLANGEN

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Breaking the symmetry: Designing colloidal motors and swimming at oil-water interfaces

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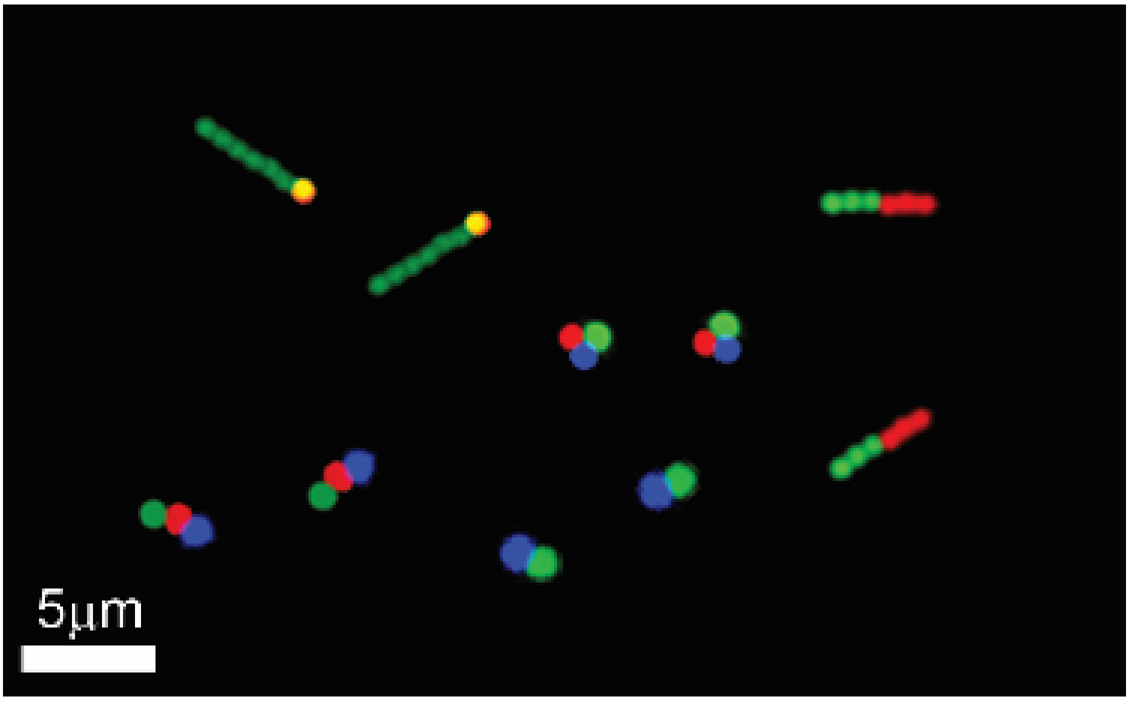

Breaking symmetry is at the very core of achieving propulsion at the microscale, where viscous forces dominate. Nature has perfected a range of different strategies to reach this goal for swimming microorganisms, which scientists have taken inspiration from to produce artificial micro-swimmers. A common way to achieve propulsion at the colloidal scale is to produce artificial particles that have asymmetric shapes and surface properties. I will first start by describing recent work in our group where we take well-known microswimmers that are propelled by self-generated asymmetrical chemical gradients (Janus swimmers) and we confine their motion at an oil-water interface. Two-dimensional confinement and interactions with the fluid interface strongly affect the propulsion speed and the directionality of the particle trajectories. Furthermore, we study how the swimmers interact with complex environments constituted by self-assembled arrays of passive obstacles. Moving further on from these simple swimmers, we developed a new fabrication strategy to create microswimmers with full control on their geometrical and compositional asymmetry. The method is based on the sequential deposition of microspheres on topographical templates, where we independently define the swimmers' shape by defining the shape of template, and we program their composition by fixing the deposition sequence. I will show how we can use this fabrication strategy to design and obtain particles that translate, rotate, switch between these two modes of motion and even perform drag-and-drop tasks in crowded environments, propelled by uniform AC electric fields. These results show how the design of microswimmers can enable the development of active components for the realization of autonomous miniaturized machines working in complex environments.

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