Scilight

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Motile soft microrobots shapeshift, move in response to temperature changes

Study reveals novel propulsion mechanism based on swelling, deswelling in confined thermoresponsive microgels

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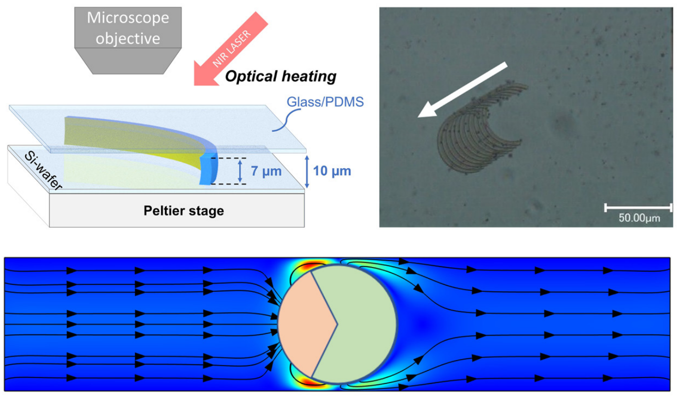

Self-propulsion allows microorganisms to explore their environments. Studies beginning in the 1950s enabled discoveries of many physical mechanisms used by motile cells — in particular algae, bacteria, and spermatozoa — to propel through viscous fluids.

Today, the field of biomimetic design mimics these mechanisms to create artificial microswimmers that can change their morphology to control their swimming motility. Motile soft microrobots have great potential in medical applications, especially in targeted drug delivery and minimally invasive surgery.

Tanasijević et al. investigated the behavior of a new type of artificial microswimmers, observing the dynamics of micro-sized, asymmetrically-coated thermoresponsive hydrogel ribbons confined between two planar surfaces under periodic heating and cooling. With temperature changes, they found that the volume, and thus shape, of the slender microgel changes, leading to repeated cycles of bending, elastic relaxation, and ultimately, to net locomotion.

Tanasijević and his colleagues first explored the propulsive features of the microswimmers, finding external actuation results in a slightly non-reciprocal shape change. Using standard modeling of the hydrodynamic forces and flows, they showed the non-reciprocity in shape change was not sufficient to account for the overall swimming motion.

“Unlike the physics of propulsion used by biological flagella and cilia, the motion of these microswimmers is driven by a novel propulsion mechanism that originates from local flows induced by the swelling and deswelling of the gel,” said Tanasijević.

“Our findings uncover a proof of concept for the design of microswimmers that successfully navigate through strong confinement, opening the door for future work on optimizing and exploiting this novel propulsion mechanism,” he said.

Source: “Jet-driven viscous locomotion of confined thermoresponsive microgels,” by Ivan Tanasijevic, Oliver Jung, Lyndon Koens, Ahmed Mourran, and Eric Lauga, *Applied Physics Letters* (2022). The article can be accessed at https://doi.org/10.1063/5.0076244.