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Viscosity destabilizes the propulsion dynamics of active droplets.

BABAK VAJDI HOKMABAD, RANABIR DEY, Max Planck Institute for Dynamics and Self-Organization, Gttingen, Germany, MAZIYAR JALAAL, Physics of Fluids Group, Max Planck Center for Complex Fluid Dynamics, Enschede, The Netherlands, KYLE BALDWIN, Max Planck Institute for Dynamics and Self-Organization, Gttingen, Germany, DETLEF LOHSE, Physics of Fluids Group, Max Planck Center for Complex Fluid Dynamics, Enschede, The Netherlands, CORINNA MAASS, Max Planck Institute for Dynamics and Self-Organization, Gttingen, Germany — Biological micro-organisms have developed sophisticated swimming behaviors such as run-and-tumble or switch-and-flick. These complex functions depend on their complicated biophysical machinery. In efforts to develop artificial micro-swimmers, the aim is to build a minimal system based on the principles of out-of-equilibrium physics that is able to mimic such complex behaviors. In this work, we show that an active droplet, undergoing micellar solubilization, experiences unsteady self-propulsion in response to an increase in the viscosity of the swimming medium. The origins of this seemingly counterintuitive behavior is explained using theory in conjunction with a novel experimental technique to simultaneously visualize the hydrodynamic and chemical fields around the droplet. By varying the viscosity we can tune the propulsion dynamics and observe behaviors reminiscent of natural micro-swimmers.

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