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Swimming near an interface in a viscoelastic fluid SHAHRZAD YAZDI, Department of Chemical Engineering, The Pennsylvania State University, AREZOO ARDEKANI, School of Mechanical Engineering, Purdue University, ALI BORHAN, Department of Chemical Engineering, The Pennsylvania State University
— Given the versatility of their natural habitats, microorganisms often encounter the presence of confining boundaries while moving in polymeric solutions. Some examples include swimming of spermatozoa in the mammalian reproductive tract or bacteria in extracellular polymeric matrices during biofilm formation. It has been shown that both confinement and fluid elasticity can have significant impacts on the locomotion of microswimmers. However, the combined effect of these environmental conditions has not been fully understood yet. In this work, we present a fully resolved solution of a low-Reynolds-number microorganism swimming near an interface in a viscoelastic fluid. The kinematics of locomotion for a squirmer in a viscoelastic fluid is compared to its Newtonian counterpart using a perturbation analysis. The results suggest that extracellular polymers dramatically alter the swimming hydrodynamics, and in general increase the residence time of the microswimmer near a no-slip boundary that can consequently facilitate its adhesion rate. The emergence of a limit cycle can also enhance cell-cell communication in the form of quorum sensing and consequently biofilm formation.

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