HOW DOES A MARANGONI DROPLET RESPOND WHEN ITS INTERFACE STARTS REACTING?

SEMINAR

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Abstract

Living systems often exhibit dynamic behaviours driven by interfacial chemical reactions that generate Marangoni stresses, leading to droplet motion and self-propulsion through surfactant activity. Building on this paradigm, we investigate the migration of a surfactant-laden droplet in a thermally driven Poiseuille flow, where a first-order interfacial reaction continuously modifies the surfactant concentration and thereby the local surface tension. The droplet hydrodynamics are governed by the Stokes equations. Under the small Péclet number limit, we solve the hydrodynamics using the solenoidal decomposition method and regular perturbation. This framework allows us to capture the coupled effects of interfacial chemistry, viscous flow, and imposed temperature gradients on droplet self-propulsion and cross-stream migration. Our results demonstrate how reaction kinetics and thermal forcing can be tuned to achieve controlled droplet transport, with potential applications in targeted biomedical delivery and microfluidic manipulation.

Everyone is invited to attend