Marangoni propulsion on liquid surfaces: experiments and theory

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We demonstrate that non-coalescent droplets of acetone can be formed on a warm water bath. The fluid flows around and in an acetone droplet hovering on water are recorded to shed light on the mechanisms which might lead to non-coalescence. The droplets show self-propulsion in straight line trajectories in a manner which can be ascribed to a Marangoni effect. Towards explaining self-propulsion, we consider a static analysis of a circular cylinder that serves as a barrier between surfactant-laden and surfactant-free portions of a liquid–gas interface. We find that the imbalance $\Delta\gamma = \gamma_a - \gamma_b$ between the uniform surface tension γ_a of the surfactant-free portion of the interface and the uniform surface tension γ_b of the surfactant-laden portion of the interface induces a horizontal force component f^h equal to $\Delta\gamma$ in magnitude, when measured per unit length of the cylinder. In addition, we apply our analysis to amphiphilic Janus cylinders and we discuss practical implications of our findings for Marangoni propulsion and surface pressure measurements.