

Bistable moving and resting drops in an active thin-film model

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We present a simple model, derived from basic thermodynamic principles, for active polar free-surface droplets to identify a mechanism of motility in the context of cell crawling. Namely, active stresses drive drop motion through spatial variations of polarization strength. This robustly induces parity-symmetry breaking and motility even for liquid ridges (2D drops) and adds to splay- and bend-driven pumping in 3D geometries. Intriguingly, then, stable polar moving and axisymmetric resting states are bistable, reminiscent of the interconversion of moving and resting keratocytes by external stimuli. The identified additional motility mode originates from a competition between the elastic bulk energy and the polarity control exerted by the drop surface. As it already breaks parity-symmetry for passive drops, the resulting back-forth asymmetry enables active stresses to effectively pump liquid and drop motion ensues.

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