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Active nematics of flat and spherical surfaces

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The laws of equilibrium statistical mechanics impose severe constraints on the properties of conventional materials assembled from inanimate building blocks. Consequently, such materials cannot exhibit spontaneous motion or perform macroscopic work; i.e., a fluid in a beaker remains quiescent unless driven by external forces. Inspired by biological phenomena such as ciliary beating or *Drosophila* cytoplasmic streaming our aim is to develop a new category of materials assembled from animate, energy-consuming building blocks. Starting from a few well-characterized biochemical components we assemble and study far-from-equilibrium analogs of conventional liquid crystals. Released from the constraints of equilibrium, this internally driven polymeric material exhibits a host of highly-sought after properties including appearance of steady-state streaming flows that are accompanied by the spontaneous unbinding and annihilations of motile defects as well as appearance and subsequent self-healing of fracture lines. Active liquid crystals can serve as a platform for developing novel material applications, testing fundamental theoretical models of far-from-equilibrium active matter and potentially shedding light on self-organization in living cells.