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Harnessing Elastic Instability for the self-assembly of complex patterns ELISABETTA MATSUMOTO, YING ZHANG, ANNA PETER, PEI-CHUN LIN, RANDALL KAMIEN, SHU YANG[1], University of Pennsylvania —
Directed pattern formation through the self-assembly of complex polymer systems promises to be a powerful approach in the pursuit of novel, transformative technologies. Current approaches to create desired motifs at the nanoscale utilize flow, shear, fields, and other externally imposed, top-down forces. Nature, on the other hand, provides us with a plethora of examples of intrinsic, bottom-up effects: from the phyllotactic growth of plants to animal stripes to fingerprints, instabilities, packing constraints, and simple geometries can drive the formation of delicate, detailed, and beautiful patterns. By harnessing the elastic instability in flexible poly(dimethylsiloxane) (PDMS) membranes with a square lattice of circular pores exposed to a solvent, we distort the pores into a pattern featuring long-range orientational order. Within linear elasticity theory, we find the groundstate configuration of a lattice of interacting deformation elements, or "dislocation dipoles" to be in complete agreement with the observed pattern. Our theory allows us a means to design the patterns formed by such elastic frustration.

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