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Osmotic robotics: Reversible shape change driven by local osmolarity gradients[1] TAO ZHANG, DUANDUAN WAN, J. M. SCHWARZ, MARK J. BOWICK, Syracuse University — Nature provides us with many examples of biomaterials that can change their shape in response to external stimuli and/or in response to varying internal stresses embedded within the structure of the biomaterial. Inspired by such biomaterials as well as recent experiments, we consider a three-dimensional network of aqueous droplets joined by single lipid bilayers to form a cohesive, tissue-like material. The droplets in these droplet networks can be programmed with different osmolarities. These osmolarity gradients generate internal stresses via local flows and the network then folds into designed structures. Using molecular dynamics simulations, we study the formation of shapes ranging from rings to spirals to tetrahedra and determine the optimal range of parameters for such structures. We also add an osmotic interaction with a dynamic environment, i.e. external stimuli, to realize a reversible folding-unfolding process. This finding contributes towards the development of osmotic robotics in bio-inspired materials.

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