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Buckling of Dielectric Elastomeric Plates for Electrically Active Microfludic Pumps DOUGLAS HOLMES, BEHROUZ TAVAKOL, Virginia Tech, MICHAEL BOZLAR, GUILLAUME FROEHLICHER, HOWARD STONE, ILHAN AKSAY, Princeton University — Fluid flow can be directed and controlled by a variety of mechanisms within industrial and biological environments. Advances in microfluidic technology have required innovative ways to control fluid flow on a small scale, and the ability to actively control fluid flow within microfluidic devices is crucial for advancements in nanofluidics, biomedical fluidic devices, and digital microfluidics. In this work, we present a means for microfluidic control via the electrical actuation of thin, flexible valves within microfluidic channels. These structures consist of a dielectric elastomer confined between two compliant electrodes that can be actively and reversibly buckle out of plane to pump fluids from an applied voltage. The out-of-plane deformation can be quantified using two parameters: net change in surface area and the shape of deformation. Change in surface area depends on the voltage, while the deformation shape, which significantly affects the flow rate, is a function of voltage, and the pressure and volume of the chambers on each side of the thin plate. The use of solid electrodes enables a robust and reversible pumping mechanism that will have will enable advancements in rapid microfluidic diagnostics, adaptive materials, and artificial muscles.

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