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Dynamical Actuation and Pattern Formation with Local Swelling in Microgels[1] HOWON LEE, KIN HUNG FUNG, NICHOLAS FANG, MIT — In this invited talk, we present a set of study on swelling-induced actuation and pattern formation in hydrogels of three dimensional microstructures. For example, rapid actuation of a micro hydrogel device is observed by exploiting swelling-induced snap-buckling. Utilizing its fast actuation speed, the device can even jump by itself upon wetting. It is demonstrated that elastic energy is effectively stored and quickly released from the device by incorporating elastic instability. In our experiment, the micro device could generate a snapping motion within 12 milliseconds, releasing power at a rate of 34 mW/g. We also captured the evolution circumferential buckling of tubular shaped microgels. Inhomogeneous stress develops as gel swells under mechanical constraints, which gives rise to buckling instability. A simple analytical model is developed using elastic energy to predict stability and post-buckling patterns upon swelling. Our experiment demonstrates that circumferential buckling of desired mode can be created in a prescribed manner. Our study on the mechanics of three-dimensionally microstructured gels might provide new insights for in morphogenesis in tissue engineering, and provide new gateways in many emerging fields such as soft robotics and tunable matamaterials.

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