MAR15-2014-000820

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Performance through Deformation and Instability

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Materials capable of undergoing large deformations like elastomers and gels are ubiquitous in daily life and nature. An exciting field of engineering is emerging that uses these compliant materials to design active devices, such as actuators, adaptive optical systems and self-regulating fluidics. Compliant structures may significantly change their architecture in response to diverse stimuli. When excessive deformation is applied, they may eventually become unstable. Traditionally, mechanical instabilities have been viewed as an inconvenience, with research focusing on how to avoid them. Here, I will demonstrate that these instabilities can be exploited to design materials with novel, switchable functionalities. The abrupt changes introduced into the architecture of soft materials by instabilities will be used to change their shape in a sudden, but controlled manner. Possible and exciting applications include materials with unusual properties such negative Poisson's ratio, phononic crystals with tunable low-frequency acoustic band gaps and reversible encapsulation systems.