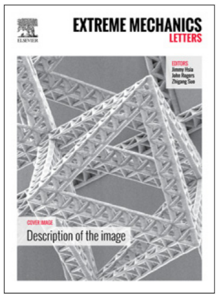

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Optimizing parameters to achieve giant deformation of an incompressible dielectric elastomeric plate

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Abstract: Snap-through instability can be readily utilized to acquire giant deformation of dielectric elastomeric structures. This study focuses on exploring such utilization by taking account of effects of intrinsic material properties, in addition to the extrinsic means (e.g. pre-deformation) that has been reported. Based on the recently proposed nonlinear formulations of electroelasticity and the so-called Hessian approach, we analyze theoretically the snap-through instability of an incompressible dielectric Gent elastomer plate sandwiched between two compliant electrodes subject to the combined action of electrical voltage and prestress. The snap-through instability occurs because of sudden decrease in the thickness and abrupt increase in the true electric field of the plate, and ceases at a state close to the limiting chain extensibility of the elastomer. By comparing the critical values for onset and stop of snap-through instability and electric breakdown of the elastomer, we study the possibility of using snap-through instability and maximal allowable actuation stretch to achieve large deformation. Three kinds of phase diagram are constructed to reveal the underlying mechanism of how material properties and prestress influence the snap-through instability. The results indicate that material properties and prestress may be tuned properly so as to achieve giant deformation of the plate.