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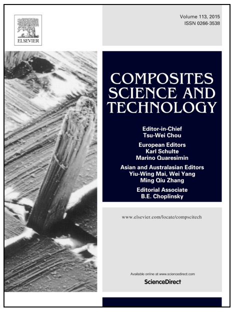

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Voltage-induced torsion of a fiber-reinforced tubular dielectric elastomer actuator

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Abstract:

A fiber-reinforced torsional dielectric elastomer (DE) actuator was conceived by embedding one family of helical fibers into a DE tube in the present work. Due to the constraint of the fibers, the application of an electrical voltage will induce torsional deformation which is coupled with the longitudinal and hoop stretches of the actuator. By employing an energy method, the voltage-induced torsion and snap-through instability of the DE tubular actuator were modeled and analyzed. Based on the formulation, the effects of the fiber stiffness and helical angle as well as externally applied mechanical loads on the voltage-induced torsional deformation were studied in detail. It was found that when snap-through instability occurs, the voltage-induced twist angle jumps from a smaller value in the unbulged state to a larger value in the budged state, and the voltage-induced twist angle can be effectively tuned by varying the fiber stiffness and helical angle. Moreover, the voltage-induced torsion of the actuator in the budged state is almost not affected by externally applied axial force or torque. The revealed results are expected to provide guide for the rational design and utilization of fiber-reinforced torsional DE actuators.

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