Silicone dielectric elastomer fiber actuator

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Dielectric elastomer fiber actuators can present linear actuation in response to external stimuli, which makes them promising in creating artificial muscles, advanced robotic, and prosthetic limbs. In this work, we developed a wet spinning approach to create polydimethylsiloxane (PDMS) hollow fibers by employing a photocurable thiol-ene reaction. The morphology and dimension of PDMS hollow fiber are adjusted by modifying the flow rate of the PDMS layer and internal removable solvent during the spinning process. The optimized PDMS hollow fiber, with a uniform dimension of approximately 80 µm wall thickness and 460 µm external diameter, demonstrates seven times higher tensile strain and five times greater tensile strength compared to those of the planar film. A PDMS fiber actuator with a transparency of approximately 90 % in a visible light spectrum is created by injecting ionic liquid as the core electrode and dip-coating ionogel to form the electrical outer sheath. The PDMS fiber actuator exhibits a large linear strain of around 10 %, and repeatable and stable linear actuation strain over 1000 cyclic actuations. The PDMS fiber actuator is employed in various weight-lifting systems constructed by using Lego models. The lifting weight and displacement are adjusted using appropriate fiber lengths and bundles. Additionally, the PDMS fiber actuator presents exceptional actuation strain (10 %) and fast response times (0.1 s) when actuating in an ionic liquid electrolyte. Furthermore, the PDMS fiber actuator can also serve as a microfluidic pump, displaying remarkable pumping capabilities.

Key words: dielectric elastomer, fiber, linear actuator, weight-lifting, microfluidic pump

References

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