FINGER MODEL MADE OF TORSIONAL ARTIFICIAL MUSCLES

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It was recently shown that drawn polymer monofilament such as nylon fishing line have the ability to act as linear actuators when twisted and configured helically if exposed to temperature changes, this type of linear actuator is known as twisted coiled polymer actuators (TCPAs). The same monofilaments can be torsional actuators if twisted but not coiled helically under the name of straight twisted polymer actuators (STPAs). Both, TCPAs and STPAs are also known as artificial muscles. The actuation phenomenon in TCPAs and STPAs is thought to be a result of an untwisting that occurs about the fiber's axis due to an asymmetric thermal expansion. Before being twisted, the precursor fibers are comprised of polymer chains that are aligned axially. During fabrication of a STPAs (the one used in this design project), the polymer chains reorient as the precursor fiber is twisted about the central axis of the monofilament. At the end of the fabrication process, the STPA is annealed in order to relieve internal stresses and to keep the fiber in the twisted configuration. The mechanism of untwisting actuation is generally thought to be a result of radially expansion and axially contraction. After being twisted,these radial and axial expansion relationships remain relatively unchanged, but the polymer chain direction is no longer axially aligned. Thus, upon heating the twisted fibers of the STPA untwist and torsional actuation occurs. This actuation phenomenon has been used in torsional actuators (STPAs), however; The exactly same actuation mechanism produce linear actuation in TCPAs. Compared to other torsional actuators STPAs are low cost, lightweight, and can actuate reasonably high torques per unit volume[3]. STPAs have not been extensively used in applications; however, there is the potential for use in different engineering applications. For example, small, lightweight, and strong actuators are needed in microrobotics, where the actuators are required to be on the scale of small bodyparts like facial muscles [Reference]. STPAs could also be used as electro active polymers have in microfluidics field. In this application, control and manipulation of fluids are required on the scale of sub-milimeters, which STPAs could supply if carefully designed.

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