Get a Grip: Creating Soft Robotic Grippers via Self-folding by Infrared Activation

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Robotic technologies have greatly expanded our ability to interact with our surroundings. In particular, soft robots can handle delicate objects without damaging them. However, they are made from materials that can be weak and require continuous exposure to stimuli in order to maintain functionalities. Self-folding grippers made from pre-strained polystyrene (PS) are an innovative way to remove these limitations because this commonly available and inexpensive thermoplastic maintains its shape and ability to hold cargo after the removal of stimulus (IR light). When IR light is absorbed in specific areas of PS, localized heating causes the polymer to reach its glass transition point where segments of the polymers are free to move resulting in out-of-plane folding. IR light is absorbed faster in areas marked with ink so with specific ink patterns, PS films can fold without manual manipulation and transform 2D patterns into 3D shapes. These grippers were studied and optimized based on geometry, ink placement & density, endurance, strength, and reproducibility. They were found to have better endurance and strength than other soft robotic grippers; these devices were capable of withstanding ~1 kg of weight for several months or withstanding 24,000 times their own mass for shorter time spans. Given the advantages of these PS grippers, they can be used for remote and autonomous tasks such as packaging and manipulating objects of various shapes and sizes as small as 0.5 cm. Self-folding PS is shown to be a novel technique in creating grippers and extending the applications of soft robotics.