Temperature Triggered Actuation of Polymer Thin Films

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The understanding of smart structures capable of self-reconfiguration in response to an external stimulus has the potential to create nature inspired structural frameworks. The triggers like temperature, pH, light, solvent, electric field etc. have been used to convert two-dimensional (2D) material sheets in to three-dimensional structures (3D). Chitosan is one of the smart bio polymers which folds when one side of it is exposed to water. Our strategy seeks alternative stimuli to create the same accessibility in a reversible manner. Thus by altering the stimuli, solvent to temperature, it is possible to create reversible self-folding of chitosan by employing a thermo responsive hydrogel poly(N-isopropylacrylamide). We have investigated that the thermo responsive folding characteristics of chitosan/poly(N-isopropylacrylamide) bilayer results in the deformations reminiscent of bio materials. The water releasing nature of PNIPAm at 35 °c has emerged as the trigger for the self-folding of chitosan films. The bilayer film has been designed with tapered thickness along the length/breadth unveiling the chances of generating the rolling up of the films and generation of conical structures respectively. The study shows that the actuation triggered by temperature results in smooth conversion of flat film in to cone, helices, structure reminiscent of Venus fly trap etc. The work highlights the possibility of engineering the folding of thin films in to intricate shapes, which could possess potential applications in soft machines and robotics.