Editorial Corner

Shape Memory Polymers

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There is intense interest among scientists to develop new generation smart polymers with biomimetic applications. The famous stimuli responsive plant Mimosa pudica, also known as shy plant, is a source of fascination for all of us irrespective of age. There are also many stimuli responsive animals such as sea cucumbers (reversibly changes their dermal stiffness in the face of danger), chameleons (alters their skin colour to match the background) etc. Shape Memory Polymers (SMPs), a new class of stimuli responsive polymeric materials, have been emerged as a multi-disciplinary research topic that combines various aspects of material science, physics, chemistry, engineering and biotechnology. These smart polymers can switch from permanent shape to a temporary shape and then back to original shape by the application of an external stimulus such as heat, light, moisture, pH, electrical field or magnetic field. However, heat remains the most popular stimulus because shape memory effect in polymers is mainly attributed to thermal transitions such as glass transition or melting.

SMPs have great potential for wide range of applications from reshapeable toys to artificial muscles to morphing aircraft. Polymers such as poly(ε-caprolactone) (PCL), polylactic acid (PLA) and polyurethane (PU) are well known for their shape memory properties. Similarly, block copolymers based on polystyrene, poly (ethyleneterephthalate), polyethyleneoxide (PEO) etc. show shape memory effect. Polymer blending is a simple method to prepare dual or triple shape memory polymer blends. Poly(vinylidene fluoride)/poly(methyl methacrylate), PLA/polyvinyl acetate, PEO/PU, PCL/polyethylene glycol and epoxy/PCL are few among them. Besides blending, structural modification of polymers may also impart shape memory properties. Thus, there exist plenty of opportunities to design polymer network architecture to develop polymers with 'tunable' shape memory effect suitable for various demanding applications. Sophisticated techniques such as dynamic mechanical analysis and thermomechanical tensile/bending tests can optimize shape fixity and shape recovery of SMPs.

First SMP was developed by CDF Chimie Company (France), in 1984, under the trade name of Polynorbornene. Now, shape memory products based on PU, poly(styrene-butadiene), poly(trans-isoprene), epoxy resins etc. are available in market. The multiple-shape capability of SPMs makes them scientifically important while light weight, low cost, easy processing and versatility in design make them technologically significant. A deeper understanding of shape memory enabling mechanisms will inspire researchers to design and develop novel SMPs and there is plenty of room for research in this amazingly innovative field.

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