Shape Memory Composites Based on Electrospun Poly(vinyl alcohol) Fibers and a Thermoplastic Polyether Block Amide Elastomer

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Abstract

Shape memory polymers, which have the ability to return from a deformed state to their original shape through application of pre-defined stimulus (such as exposure to heat, chemicals, electrical current, and others) in a highly selective and reversible manner are generating great interest. Many design principles have been proposed and demonstrated to be useful to create such materials. One attractive approach is the exploitation of shape-memory composites that consist of two components in a co-continuous architecture. They typically include an elastic polymeric phase and a filler that is responsible for fixing the temporary shape, either due to a phase transition or the formation / break-up of a mechanically reinforcing network induced by the stimulus. One intriguing feature of shape-memory composites is that they display emergent properties, i.e., a characteristic behavior that is not found in either of the components alone. From an application point of view, the possibility to create novel materials with new properties from readily available components without the new chemistry is particularly attractive.

In this study, we report the fabrication of new thermally responsive shape-memory composites employing two widely used commercially available polymers and fabricated by a simple melt compaction process (**Figure)**. Electrospun fibers mats of poly(vinyl alcohol) (PVA) were used as the switching element and thermoplastic polyether block amide elastomer (PEBA) were used as the rubbery matrix. Upon introduction of 10-20% w/w PVA fibers, the room-temperature storage modulus (E′) of composites increased by a factor of 4-5 in comparison to the neat PEBA, and they reveal a stepwise reduction of E′ around the glass transition temperature of PVA. This transition was further utilized to demonstrate in both qualitative and quantitative manner, the emergent shape memory characteristics of the obtained composites.

References

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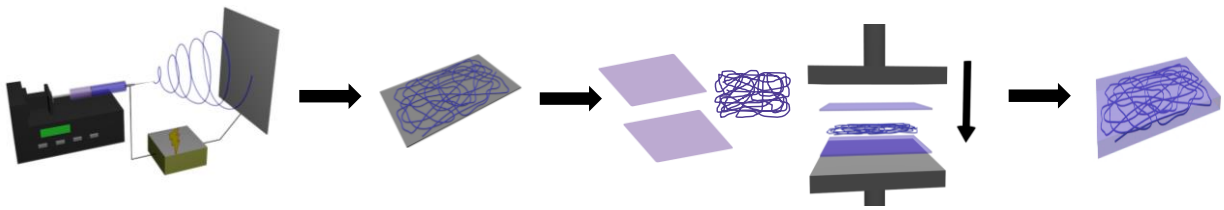
Figures



Schematic representation of the fabrication process of PVA fibers and PEBA/PVA composites.