Proceedings of the ASME 2010 Conference on Smart Materials, Adaptive Structures and Intelligent Systems
SMASIS2010
September 28 - October 1, 2010, Philadelphia, Pennsylvania, USA

SMASIS2010-3709

SHAPE MEMORY POLYMERS: A POTENTIAL MATERIAL FOR FUTURE'S CHANGING SHAPE

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ABSTRACT

Shape memory polymers (SMPs) undergo significant macroscopic deformation upon the application of an external stimulus. As a novel and promising kind of smart materials, they have been widely researched since the 1980s. SMPs present many potential technical advantages that surpass those of shape memory alloys and shape memory ceramics such as good shape recoverability, low density, ease in processing and in tailoring of properties (e.g., transition temperature, stiffness, bio-degradability, and ease of functionally grading), programmability and controllability of recovery behavior, and most importantly, low cost. This paper aims to provide a comprehensive review of SMPs, encompassing a fundamental understanding of the shape memory of SMPs. The synthesis of SMPs is presented firstly. In order to realize the actuation of SMPs for a special application, the investigation of actuations in multi ways are performed, namely electroactive SMPs, light-responsive SMPs, magnetism-induced SMPs, and chemo-responsive SMPs. These novel actuation approaches play a critical role in the development of multifunctional materials that not only exhibit the shape memory effect but also perform particular functions. Based on the unique properties of such materials, primary applications are also listed, and the potential directions and applications of SMPs are proposed to be developed in future research.