Novel Pressure-Responsive Shape Memory Polymers

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Abstract

Shape memory polymers (SMPs) are stimuli-responsive materials that can change their shape upon application of an external stimulus (e.g., heat and light). They have been extensively exploited for a wide spectrum of technological applications ranging from smart biomedical devices to aerospace morphing structures. Most of the currently available SMPs are thermoresponsive and they suffer from slow response speed and heat-demanding programming and recovery steps. Although pressure is an easily adjustable process variable like temperature, pressure-responsive SMPs are largely unexplored. By integrating scientific principles drawn from two disparate fields that do not typically intersect – the fast-growing photonic crystal and SMP technologies, we have recently developed a new type of SMP that enables unusual "cold" programming and instantaneous shape recovery triggered by applying an external pressure or exposing to an organic vapor (e.g., acetone) at ambient conditions. This unique integration has not only led to the discovery of the new pressure- and vapor-responsive SMPs, it also provides a simple and sensitive optical technique for investigating the intriguing shape memory effects at nanoscale. Simultaneously, these novel stimuli-responsive SMPs empower smart and reconfigurable nanooptical devices, such as rewritable photonic crystal circuits and tunable antireflection coatings. Systematic mechanical and thermomechanical experiments have also been conducted to elucidate the basic shape memory mechanisms of this new type of SMP.

Dr. Jiang is currently an associate professor in the Department of Chemical Engineering at the University of Florida. He joined the department as an assistant professor in August, 2006. He obtained his Ph.D. in materials chemistry at Rice University and was a postdoctoral fellow in the Department of Chemical Engineering at Princeton University. He worked at Corning and GE for a few years before he started his academic career. His current research interests include broadband antireflection coatings, smart windows for energy-efficient buildings, material self-assembly, plasmonic nanooptical devices and biosensors, scalable nanomanufacturing, and biomimetic materials. Dr. Jiang has published more than 80 peer-reviewed papers with over 5500 citations in prominent journals, such as *Science*, *Nature Photonics*, *Physical Review Letters*, *Journal of the American Chemical Society*, and *Angewandte Chemie International Edition*. His group's work has been featured in *Nature*, *Laser Focus World*, *Popular Mechanics*, and many other public media.