Editorial corner – a personal view

New frontiers of shape memory polymers

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Frequent appearances of reviews and themed issues as well as rapidly increasing number of papers and patents regarding shape memory polymers (SMP) reflect a large room for scientific and technical investigation with ample potential applications of these materials. Permanent shape of SMP created at the primary shaping process is deformed into a temporary shape in rubbery state and fixed upon cooling into the glassy state along a prescribed programming. Upon exposure to external stimulus which typically is heat the permanent shape is recovered by the elasticity of networks.

In contrast to the conventional one-way (irreversible) SMP, two-way (reversible) SMP has recently been reported. The temporary shape under constant stress is subject to cyclic heating and cooling, which cause contraction and extension according to the temperature dependent rubbery modulus. Moreover, multiple shaping has also become possible by providing the materials with multiple transitions, which enable two or more subsequent shape changes upon heating. Hybridizations at nano-level such as nano-filler, nano-tube, and nano-layer as well as with other polymer are new frontiers to enhance the key SM properties. Chemical hybrids of polyurethane with various acrylate are simple choice for multiple transitions.

Chemical hybrid with nano-silica provided the SMP with multifunctional cross-link, reinforcing filler, and relaxation retarder which were evidenced from >99% shape fixity and recovery with negligible hysteresis over repeated cycles. Hybrid bi-layer

consisting of two SMPs having different thermal transitions, or SMP coated with gold can be used for de-bondable bonding, electro active polymer, or to reversibly alter its geometry from a tube to a layer upon change in temperature.

Most engineered area of SMP, beside packaging materials, is coatings including self-curable paint, absorption and release of moisture by coated wall, vapor permeable water resistant coatings, and smart textiles. New generation for SMP may be opened with medical devices including minimally invasive surgery, orthodontic devices, delivery vesicles, etc. Prospective works will be directed toward the performance oriented multifunctional (biodegradable, anti-bacterial, health care, swell-deswell) and multi-responsive (light, electric, magnetic field moisture, heat) multi-materials (organic-inorganic hybrids).

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