# Optically transparent shape memory polyimide- a candidate for flexible optoelectronics

Optically transparent polyimides (PI) have attracted more and more attentions due to their extensive applications in flexible optoelectronics, e. g. plastic substrate of image displays, flexible printing circuit board, optical waveguides of communication interconnects, and liquid crystal alignment layers. Shape memory polymer (SMP) is smart polymer that can fix the temporary shape and then recover to its original shape under external stimulus. The optically transparent shape memory polyimide (TSMPI) combines shape memory effects with high thermal stabilities, good mechanical properties and optical transparency. Accordingly, TSMPI will expand the application areas of PI and SMP enormously.

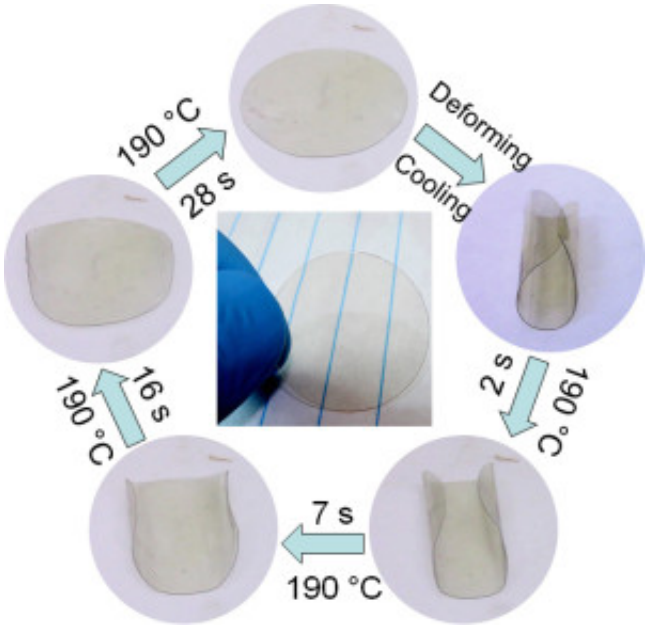


Fig. 1. Demonstration of shape memory cycles of TSMPI. The sheet was deformed into a roll on 190 ºC hot-stage and the temporary shape was fixed by cooling, and it will recover to its original shape upon heating.

The development of transparent PI has been affected by the high cost of monomers negatively, as most transparent PIs are synthesized with intricate and expensive reagents, while TSMPI is prepared with relatively cheap monomers. TSMPI is highly transparent and the 120 ?m thick film exhibits transmittance exceeding 81% in the visible range of 450-800 nm. Glass transition temperature ($T_g$) of TSMPI is 171ºC, higher than those of other transparent SMPs. TSMPI is thermally stable and its minimal decomposition temperature is 485ºC. TSMPI can be dissolved in organic solvents such as DMF, DMAc and NMP, and this solubility can be explored to produce

films at low temperature, avoiding possible damages to optoelectronic devices caused by high temperature.

The images showing shape memory process of TSMPI are shown in Figure 1, as it can be deformed into a temporary shape at high temperatures above its $T_g$ and the temporary shape is fixed by cooling. When reheated, it will recover to its original shape. The shape memory process can be repeated many times, and every time it can fix the temporary shape and then recover to the initial shape very well.

TSMPI maintained high dimensional stability and optical transparency against thermal cycles during the operating process, similar to inorganic glass. Moreover, it possesses advantages of flexibility, lightness and processability compared with fragile glass analogues. Therefore, TSMPI is expected to find applications in flexible optoelectronic devices, as well as common shape memory applications undergoing high temperature environments, such as deployable space structures, jet propulsion systems, high temperature sensors and actuators.

***Xinli Xiao***
*Department of Chemistry, Harbin Institute of Technology*

## Publication

Optically transparent high temperature shape memory polymers.
Xiao X, Qiu X, Kong D, Zhang W, Liu Y, Leng J
*Soft Matter. 2016 Mar 8*