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Shapely polymers get the green light

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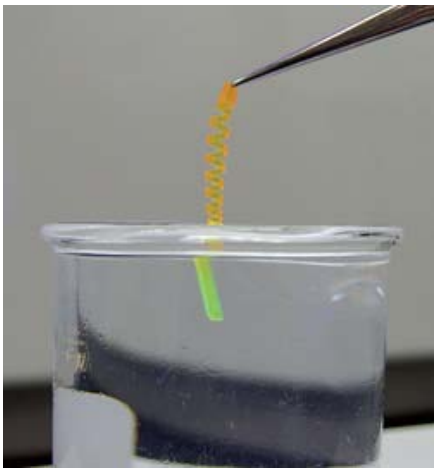
Shape-memory materials spontaneously change shape when exposed to an external stimulus, such as heat. Materials chemists have now made a shape-memory polymer that reversibly changes colour as it changes shape, enabling repeated transitions to be easily monitored even when the shape change is small.



The polymer is an orange spiral when cool, and changes to a green rod when dipped in hot oil

Shape-memory materials have been much studied since the discovery of their unusual properties in the 1960s. Recent work has included the incorporation of dyes into the polymers, allowing accurate monitoring of the transition. These systems used to rely on the dye undergoing a permanent chemical change, meaning that they only worked once. Patrick Mather, Christoph Weder and colleagues at the Case Western Reserve University, Cleveland, US, have now adapted this approach to make a shape-memory polymer that reversibly changes colour when it reaches its transition temperature, allowing it to be used for repeated transitions.

As a demonstration, Mather and Weder took a known shape-memory polymer, crosslinked poly (cyclooctene), and treated it with solutions of a phenylene-vinylene dye. They heated the rod-shaped polymer to 75 °C, twisted it into a spiral, and cooled it to 5 °C to set the shape. The polymer spiral, which at this point was fluorescing orange, was then dipped into silicone oil at 80 °C, causing it to revert to its original shape and turn green.

The dye's colour change is caused by a reversible aggregation-deaggregation of the dye molecules that occurs at the transition temperature. This reversibility, said Mather, is 'a requirement for any application requiring multiple cycling, whether the cycle time is a day, as in architectural applications, or minutes, as for medical applications'.

Andreas Lendlein, of the Institute of Polymer Research, Teltow, Germany, said that this approach is 'an important strategy to optimise materials towards the needs of specific applications'. Future work might involve developing dyes able to visualise multiple transitions in the same polymer, said Weder.

David Barden

Link to journal article

Shape memory polymers with built-in threshold temperature sensors
Jill Kunzelman, Taekwoong Chung, Patrick T. Mather and Christoph Weder, *J. Mater. Chem.*, 2008, **18**, 1082
DOI: 10.1039/b718445j

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