

Research Highlights

Nature Chemistry

Published online: 30 May 2008 | doi:10.1038/nchem.18

Subject Categories: [Polymer chemistry](#) | [Nanotechnology](#)

Molecular machines: Move on up

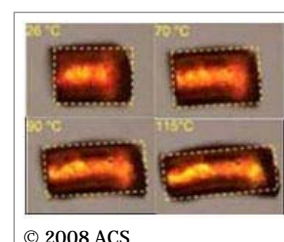
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The untwisting of a dendron-coated helical polymer during a phase transition drives macroscale motion — enough to move 250 times its weight

Creating large-scale motion from molecular-scale effects is a crucial goal in nanotechnology. Although scientists have created many different nanomachines, these are yet to rival biomolecular machines that can translate their work into a macroscopic output. Approaches to magnify the length-scales on which nanomachines are effective include self-assembled monolayers acting in concert and rotating molecular motors. Now, Virgil Percec and colleagues from the University of Pennsylvania have exploited¹ the phase transition of a helical polymer to move a coin uphill.

The polymer in question — a helical polyphenylacetylene with dendritic side chains attached to it — self-organizes into hexagonal columnar forms. On heating, the tightly twisted chain relaxes and extends as it changes into a different phase. It is this extension that drives the motion, or mechanical actuation. The polymer was extruded into fibres containing oriented bundles of the helices and a single fibre was able to move an object 250 times its own mass 1 mm up a slope.

The extension is fully reversible, because it is caused by a phase transition: the temperature is simply lowered, and the system returns to its original state. The distinguishing feature between this and other dynamic helical polymers is that the 'coat' of dendrons prevents the helix from collapsing. This forces any conformational changes to occur in the direction of the long axis of the polymer, hence the large extension. The choice of dendrons was therefore crucial, especially because at lower temperatures the architecture of the coat dominates the self-assembly process.



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REFERENCE

1. Percec, V., Rudick, J. G., Peterca, M. & Heiney, P. A. Nanomechanical function from self-organizable dendronized helical polyphenylacetylenes. *J. Am. Chem. Soc.* doi: 10.1021/ja801863e (2008). | [Article](#) |