Polymers under Multiple Constraints

Polymer- & Soft-Matter-Seminar

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at: **5.15pm**

VDP 4 1.27, Von-Danckelmann-Platz 4, 06120 Halle

"A new class of submolecular switches based on the DBCOD conformational change "

Dibenzocyclooctadiene (DBCOD) is composed of a flexible eight-membered ring fused into two rigid phenyl rings. It can be regarded as the simplest submolecular structure that can undergo controlled conformational changes. The DBCOD conformational change from "twist-boat" to "chair" leads to thermal contraction. We have incorporated this contractile unit in polyamides. In the presence of a small number of DBCODs, the value of negative thermal expansion of this DBCOD-containing polymer is about 12 times greater than that of the second best reported system. A new polymer system that offers anomalous giant thermal contraction has therefore been created. Furthermore, we have shown that the coefficient of thermal expansion of a linear polyamide can be adjusted by the number of DBCOD units incorporated into the polymer chain. This phenomenon can be exploited for the development of electronic packaging polymers with ultra low thermal expansion.

Composites in which carbon nanotubes (CNTs) are covalently linked to DBCOD-containing macromolecules exhibit unprecedented sensitivity to ambient temperature fluctuations. A bilayer system with DBCODs in the top polymer layer oriented parallel to the direction of an aligned CNT bottom layer, offers power-efficient controlled actuation, i.e., directional bending and twisting. This offers a foundation for low-energy consumption soft robotics with simplified design.

More recently, we have synthesized a series of single-molecule DBCODs with different substitutions. Based on results from the structure-property relationship investigation, substitution has been found to play an influential role in conformational preference and stability. We believe that the DBCOD conformational transition can be harnessed as a regulated and predictable switch.