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Structure-property relationships in reversible supramolecular polymer adhesives

Diana Kay Hohl

The stimuli-responsive nature of supramolecular polymers (SMPs) makes them promising candidates as reversible adhesives with debonding-on-demand capabilities. The temporal disassembly into the monomeric species upon external stimulation has a drastic effect on the macroscopic properties, that is, a reduction of the mechanical strength and the formation of a low-viscosity melt. These features are beneficial for effective surface wetting during the bonding process, and for rapid and easy debonding induced through cohesive failure. However, the adhesive strength of most reported SMP adhesives remains in the range of hot-melt adhesives. In order to improve the bonding performance of SMP-based adhesives, an improvement of their mechanical properties, and therefore the cohesive strength of adhesive bonds is necessary.

To address this issue, SMPs based on linear or branched low-molecular-weight (macro)monomers were designed in order to create materials with low melt viscosities and improved mechanical strength. It was demonstrate that the binding motif, structural design, and processing conditions affect the assembly, morphology, and therefore the (thermo-)mechanical and adhesive properties of the materials. Controlling these parameters proved an effective tool to tune the properties of the SMPs. Importantly, the materials were exploited as reversible adhesives that could be bonded and debonded using heat or light as stimulus.

The findings contribute to a better understanding of the structure-property relationships in SMPs, and give useful insights for further developments that aim at the design of materials with improved mechanical performance and adhesive properties.

Jury:

Prof. Dr. Christoph Weder (thesis supervisor)

Prof. Dr. A. Dieter Schlüter (external co-examiner)

Dr. Stephen Schrettl (internal co-examiner)

Prof. Dr. Michael Mayer (president of the jury)