PHOTO-REVERSIBLE ELASTOMERIC MATERIALS AS SHAPE MEMORY POLYMERS AND REVERSIBLE ADHESIVES

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Carboxylated nitrile butadiene rubber (XNBR) was functionalized using 2-(anthracene-9-yl)oxirane [1] and exploited as a thermo- and photoresponsive shape memory polymer. In a first step, a physically crosslinked thermo-responsive approach was pursued. The anthracene-functionalized XNBR was initially crosslinked via dimerization of the anthracene side groups by illumination with UV-light ($\lambda > 300$ nm). The elastomeric network was then heated above T_g and after a macroscopic deformation, the temporary shape was fixed upon cooling. Subsequent reheating enabled a release of the stored strain energy and the shape recovery of the elastomer system occurred regaining the permanent shape. In a second study, a photochemically triggered shape change was chosen. The modified and thus reversible elastomer system was deformed macroscopically and this temporary shape was maintained by covalent bonds formed upon dimerization of the photoactive anthracene moieties via a concerted [4+4] photocycloaddition upon exposure to UV-light ($\lambda > 300$ nm). The shape recovery process was then performed under deep UV exposure with $\lambda < 300$ nm inducing the photocleavage of the anthracene dimers.

Along with the application as a shape memory polymer, anthracene-modified rubber was shown to exhibit reversible and wavelength dependent adhesive properties. A spatially controlled, photo-mediated [4+4] cycloaddition reaction of the introduced anthracene moieties in thin XNBR films resulted in the loss of adhesion strength towards an elastomeric surface within the illuminated areas. This process as well as its reversibility, either thermally or photochemically induced, was characterized by peel strength tests [2].

[1] Manhart, J.; Ayalur-Karunakaran, S.; Radl, S.; Oesterreicher, A.; Moser, A.; Ganser, C.; Teichert, C.; Pinter, G.; Kern, W.; Griesser, T. *et al.* Design and application of photo-reversible elastomer networks by using the [4πs+4πs] cycloaddition reaction of pendant anthracene groups. *Polymer,* DOI: 10.1016/j.polymer.2016.08.106.

[2] Harper, T.; Slegeris, R.; Pramudya, I.; Chung, H. Single-Phase Photo-Cross-Linkable Bioinspired Adhesive for Precise Control of Adhesion Strength. *ACS applied materials & interfaces* **2017**, *9*, 1830–1839, DOI: 10.1021/acsami.6b14599.