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Cinnamic Acid Derivatised Poly(Ethylene Glycol) as a Bioinspired UV-Adaptable Material

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The field of bioinspired materials is steadily growing and the project we are working on was inspired by the sea cucumber; a sea creature which has the ability to protect itself from enemies by going from a soft to a hard phase within seconds. From a rheological perspective this can be interpreted as an increase in the value for the elastic modulus on a very short timescale. Our approach is to use cinnamic acid (CA) derivatised polymers, which are well known for their ability to crosslink under UV-irradiation (Figure 1) and for their versatility, e. g. in preparation of UV-active "shape memory" polymers from poly(ethylene glycol) (PEG). [1]

We synthesised a CA-derivatised 4-armed PEG star (Mn=2000 g/mol) (PEG-CA star) and two CA-derivatised linear PEGs (Mn=1000 and 4000 g/mol, respectively). We investigated samples of the PEGs by rheology and thereby we found that the most significant difference in rheological properties after irradiation with UV-light were found when the PEG-CA star was used exclusively. We observed a pronounced time dependence of the reaction and this was further investigated. We found, that with the equipment at hand a stable value for the *G'*-value was obtained after app. 70 hours of irradiation (Figure 1), hence definetely not a fast response. On the other hand the slow response allowed us to investigate the structural development.

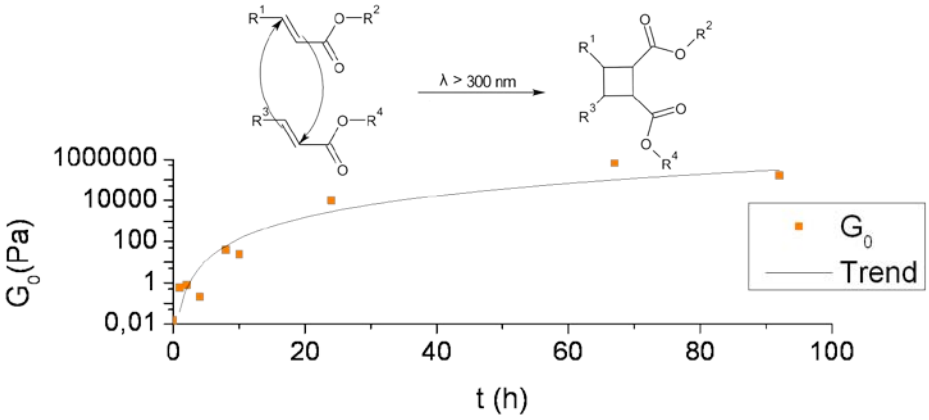

Figure 1: On top is the cyclobutane formation of CA-derivatives. Below is the value of the elastic modulus, G_0, as a function of time for the PEG-CA star.

References

[1]. A. Lendlein et al., Nature, 434, 879–882 (2005)