Designing Temperature-Memory Effects in Semicrystalline Polyurethane

Nikolaus Mirtschin and Thorsten Pretsch*
BAM Federal Institute for Materials Research and Testing, Division 6.5,
Polymers in Life Science and Nanotechnology, Unter den Eichen 87, 12205 Berlin, Germany
phone: +49 30 8104 3804; fax: +49 30 8104 1617;
e-mail address: thorsten.pretsch@bam.de
ESI Figures and Figure Captions

ESI Fig. 1: Programming and shape-memory properties under stress-free recovery conditions for tensile bars (DIN EN ISO 527-2:1996) made of Desmopan DP 2795A SMP. The individual programming steps included heating from 23 to 60 °C, tensile deformation in which a maximum strain of 100% was applied, cooling to −20 °C and unloading. To induce the shape-memory effect, the specimen was heated to 80 °C with a rate of 3 °C min⁻¹.

As a result of programming, 97% of the applied strain could be fixed. It can be seen that the specimen started shape recovering at about 37 °C. At the end of the recovery process, a strain of 23% was recorded.
ESI Fig. 2: WAXS diffractograms of pristine PEU recorded at 10 and 60 °C.
ESI Fig. 3: Strain and stress at yield for PEU at different deformation temperatures, depending on the applied strain rate ($\varepsilon' = 1 \% \text{ min}^{-1}$ and $3 \times 10^4 \% \text{ min}^{-1}$). The associated experimental data was taken from Fig. 2b. The size of the symbols was larger than the calculated errors.
ESI Fig. 4: Stress recorded after keeping PEU for 5 min at $T_d$, depending on the applied strain rate. The size of the symbols was larger than the calculated errors.
ESI Fig. 5: WAXS diffractograms of programmed PEU ($T_d = 10$ °C, $\varepsilon' = 1$ % min$^{-1}$ and $3 \times 10^4$ % min$^{-1}$) recorded at 10 °C.
ESI Fig. 6: Temperature dependence of strain and stress at yield for PEU ($\epsilon' = 3 \times 10^2$ \% min$^{-1}$). The associated experimental data was taken from Fig. 6b. The symbol size was larger than the calculated errors.
ESI Fig. 7: Residual stress before unloading of PEU at $T_d$, depending on temperature holding time after deformation. The size of symbols was larger than the calculated errors.
ESI Fig. 8: WAXS diffractograms of programmed PEU ($\epsilon' = 3 \times 10^2 \ % \ min^{-1}$) recorded at 10 °C. Influence of temperature holding time $t_h$ for $T_d = 10$ °C (a) and 40 °C (b).