

2D–SAXS during the straining of multiblock copolymers from PBT and PTHF

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The material. Multiblock copolymers with blocks from poly(butylene terephthalate) (PBT) and poly(tetrahydrofuran) (PTHF) belong to the class of thermoplastic elastomers. The PBT blocks are called hard segments. The PTHF blocks are the so–called soft segments. At ambient temperature the material undergoes phase separation forming hard domains from PBT and soft domains, which are rich of PTHF. Various commercial grades are available, which differ in block length and hard–to –soft ratio. The material is no typical elastomer, since it shows considerable remnant elongation indicating irreversible structural changes during straining. A second peculiarity is its strain hardening resulting in extreme tensile strength. The material is widely used in automobiles, tubes and as isolating layer of electrical wires.

Sample preparation. From different grades of commercial material (Arnitel, DSM) isotropic films are prepared in a heat press. The thickness of the films is 0.4 mm. From these films samples of 50 mm length and 12 mm width are cut.

The experiment. Strain and relaxation experiments are carried out in the synchrotron beam at HASYLAB in Hamburg, beamline A2. A typical maximum elongation $\epsilon = (\ell - \ell_0)/\ell_0 \approx 3$ can be reached before the sample slips out of the clamps. During straining small–angle X–ray scattering patterns are recorded on image plates placed 1.8 m behind the sample. After exposing for 1 min the maximum recorded scattering intensity amounts to 60,000 counts. The geometry of the chosen semitransparent beam stop ensures low scattering background at the expense of a relatively large central blind area. Data analysis is carried out using published computer programs[1], which are freely available [2].

Results. During straining the samples exhibit a wealth of different SAXS fibre patterns, which can be assigned to different structures as a function of increasing elongation (Figure 1). No single Arnitel grade shows all the four basic SAXS patterns during elongation. The quantitative analysis of these patterns is in progress. Problems occur for some of the sample series, where the low–intensity outer part of the scattering patterns was not recorded to a sufficient extent. For these materials the sample–detector distance has to be reduced in future measurements. Some related work has already been published [1, 3, 4].

References

Figure 1: Typical SAXS patterns from various PEE samples under strain. Elongation increases from top to bottom.