Nanostructure deformation behaviour in poly(ethylene terephthalate) / polyethylene drawn blends observed by SAXS

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Synopsis. By co–extrusion of two polymers and subsequent cold drawing polymer reinforced polymer fibres can be produced. On the microscopic scale the material is a blend from two fibrillar components with considerable orientation. On the nanometre scale each component exhibits a semicrystalline layer structure with peculiar orientation. This two–component structure is studied during elongation of the material. Data shall be evaluated using a quantitative method developed previously[1, 2]. The resulting SAXS patterns show an oriented structure with many reflections and increasing void scattering during the elongational process.

Experimental. A blend comprising equal weight parts of PET and PE was melt blended and shaped in the form of bristles with a diameter of $1\,\mathrm{mm}$ by extrusion[3]. Subsequently, the bristles were drawn to undergo neck formation up to about 4 times of their original length. The drawn fibres were annealed with fixed ends at $120\,^{\circ}\mathrm{C}$ for 6 h in vacuum. The resulting fibres were strained in the synchrotron beam of beamline A2. 2D scattering images were recorded on image plates and converted into GEL files. The exposure time was up to 5 min. An area of 900×900 pixels, each with a size of $176\,\mu\mathrm{m} \times 176\,\mu\mathrm{m}$ was read out and used for data evaluation.

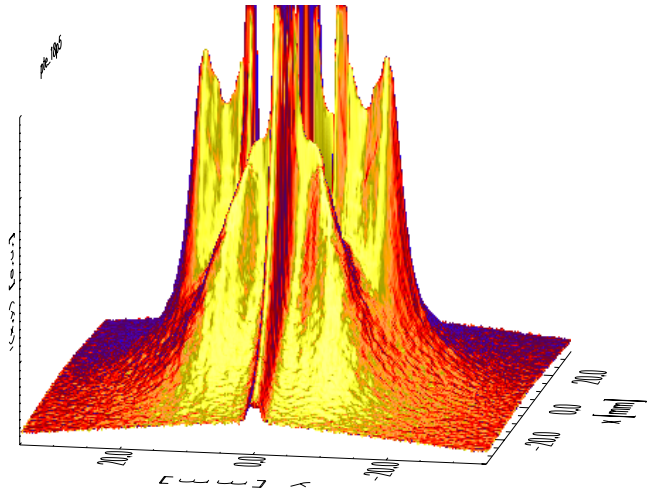

Figure 1: The SAXS pattern of the PET/PE blend sample at an elongation $\epsilon = 0.185$

Data evaluation. GEL files were processed using computer programs for *pv–wave*[4], which are published elsewhere[5].

Results. Figure 1 shows the SAXS pattern at an elongation of 18 %. Well–expressed six–point SAXS patterns are observed in the whole deformation range ($0 < \epsilon < 0.185$) irrespective of the presence or absence of external stress. Up to now a quantitative analysis of the patterns has not been performed. But even a qualitative comparison with similarly prepared blends[6, 7] from other polymers shows that a broad variety of nanoscale structures can be observed when the polymers in the blend are exchanged.

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