TEMPERATURE- AND DEFORMATION-DEPENDENT STRUCTURAL CHARACTERIZATION OF SEMI-CRYSTALLINE POLYMERS BY X-RAY SCATTERING

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ABSTRACT

The special mechanical behaviour of semi-crystalline materials is caused by the temperature-dependent interaction between the crystalline and the amorphous phase with their specific mechanical properties. Thereby, the crystalline phase has higher strength and stiffness, it fails mainly under shear stress. The amorphous phase is tough above the glass transition with steadily decreasing strength with increasing temperature. Crazing may appear during. Under the complex load between the crystallites the amorphous phase tends to cavitation if the internal strength is too low with respect to the external load. This general behaviour was investigated and presented in the past by several different groups [1-2].

Recent investigations by synchrotron x-ray scattering enabled a highly time- and strain-resolved as well as temperature dependent investigation of structural changes during deformation. While wide angle diffraction enables a detailed characterization of the crystallites with respect to their orientation and deformation small angle scattering enables information about the size of the different phases and cavitation. Therefore the SAXS patterns were processed to estimate cord-distribution-functions according to the procedures developed by Stribeck for samples with fiber symmetry [3]. The behaviour of different semi-crystalline polymers will be presented and compared with the behaviour of pure amorphous materials. A special attention will be turned on the structural events with respect to the stress-strain-curve. Some micrographs confirm the structural units, which were discussed on the basis of the x-ray pattern.

Fig. 1: Damage of a PC sample during hot drawing, size of the detail 400 µm * 300 µm

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References

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