Structure evolution mechanisms in oriented polymers studied by time-resolved X-ray scattering

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Detailed insight in the nanostructure of polymers and its evolution can be gathered, if oriented materials are studied by means of time-resolved, two-dimensional X-ray scattering [1]. Examples demonstrate possibilities and limits of the method. They comprise both quiescent crystallization studies of samples with fiber orientation, and studies of microstructure evolution during straining. It is shown that the structure formation processes are varying as a function of the polymer, of processing parameters, and of elapsed time (in isothermal crystallization experiments). Changes in sizes, size distributions and arrangement of the domains (e.g. crystalline lamellae, hard domains) can be determined. Some results: (1) Quiescent crystallization frequently starts with random placement of thick and extended lamellae and ends in arranged placement of imperfect crystallites. (2) High orientation of lamellae is not always coupled to high orientation of its crystallites. (3) Structure studies in the vicinity of the melting point require special care and further technical progress because of extra heat load imposed by the X-ray beam itself. (4) A poly(ether ester) studied during straining shows the mechanism of how the hard domains are disrupted.

We demonstrate the demand for simultaneous recording of full 2D SAXS and WAXS patterns. Quantitative data evaluation is based on digital image processing. Routines written in *pv-wave* [2, 3] are freely available. A method for model-free visualization of nanostructure from SAXS patterns has been developed by one of us [4, 5]. It has been applied in several studies [6–17] that led to the aforementioned results.

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