SCANNING MICRODIFFRACTION APPLIED TO POLYMERIC MATERIALS

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Microdiffraction continues to be an important tool for characterising polymeric materials. It provides information which is inaccessible to many other experimental techniques, spanning a range of critical length scales. A technological drive over recent years has led to the development of ever smaller X-ray beams at microfocus SR facilities. These allow smaller morphological heterogeneities to be resolved in scanning studies, and permit reduced sample volumes to be probed. To put such developments in perspective, 3 µm spot sizes were considered the norm only a few years ago. Today, sub-µm beams are available as a matter of routine at microfocus beamlines such as ID13. These small beams, coupled with higher flux densities and advances in detector technology allow larger scans to be performed, and at higher spatial resolutions. Meanwhile, complementary advances in automatic data treatment have ensured that even large data sets can be assessed and analysed on a single PC. For example, data sets containing tens-of-thousands of individual diffraction patterns are now considered routine.

Some recent examples of scanning microdiffraction applied to polymeric materials include studies of fiber morphology, spherulitic microstructure and lamina composite geometries. For single fibers, on-axis diffraction allows quantitative information to be obtained on radial anisotropy. This enables many hitherto unconfirmed models to be assessed whilst providing a greater understanding of structural development during manufacture. Meanwhile, high-resolution scans of spherulites demonstrate how microdiffraction can provide a new insight into even the most well-characterised polymer systems. Finally, for studying lamina composites, microdiffraction's phase selectivity provides unique access to the embedded fibers. This information is inaccessible to many other techniques and can reveal how real composite systems perform during deformation.

Each of these recent examples demonstrates how microdiffraction provides quite different information to that which is available using other experimental methods. Such studies reveal the value of microdiffraction for polymer research, and show the current state-of-the-art.