Microbeam Diffraction of Hierarchical Nanocomposites

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Advanced composite materials with optimized mechanical properties are often hierarchically structured from the atomic/molecular level up to macroscopic length scales. Typical examples are biological tissues such as bone or wood, but also many complex technical composites, which often benefit from the imitation of natural materials by biomimetic principles or by biotemplating. Structural investigations of such materials require new experimental techniques with a position resolution covering several length scales. Beside electron microscopy, small- and wide-angle X-ray scattering (SAXS/WAXS) are well suited to study structural features in the nanometer regime. The high brilliance of third generation synchrotron radiation sources together with novel X-ray optics can be used to extend the position resolution to the micrometer regime by using microbeam scanning techniques in combination with SAXS/WAXS.

The present contribution reviews some recent experimental studies from different complex materials with scanning microbeam SAXS/WAXS. Results from the imaging of nanostructural parameters such as shape, size and orientation of nanoscale inhomogeneities in bone and other hierarchical biocomposites are presented. Moreover, a unique combination of *in-situ* bending deformation with X-ray nanobeam scanning is demonstrated for single carbon fibres.

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