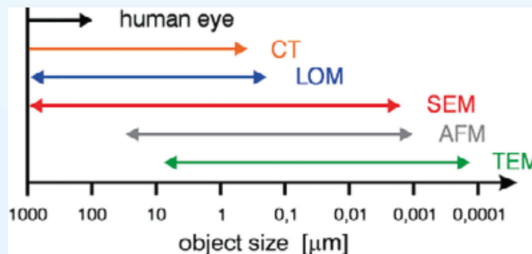
Microscopy on polymer materials

Dealing with failure analysis and quality control as well as research and development in order to optimize polymer materials containing e. g. fillers, fibers or particles microscopic methods are widely used. These methods have higher magnification and resolution than the human eye and therefore allow to analyse the smallest attributes of a material.

Applications

- Topographical considerations (surface structure)
- Analysis of surface roughness from nano- to millimeter-scale
- Investigation of inclusions and defects
- Imaging of cracks and fractures (initiation and growth)
- Imaging of phase morphology and/or inhomogeneities (material contrasts)
- Determination of dispersion of fillers and other additives
- Determination of size-distribution and alignment of fillers
- Element analysis and distribution in micro-scale
- Determination of layer thicknesses in micro-scale



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DIK

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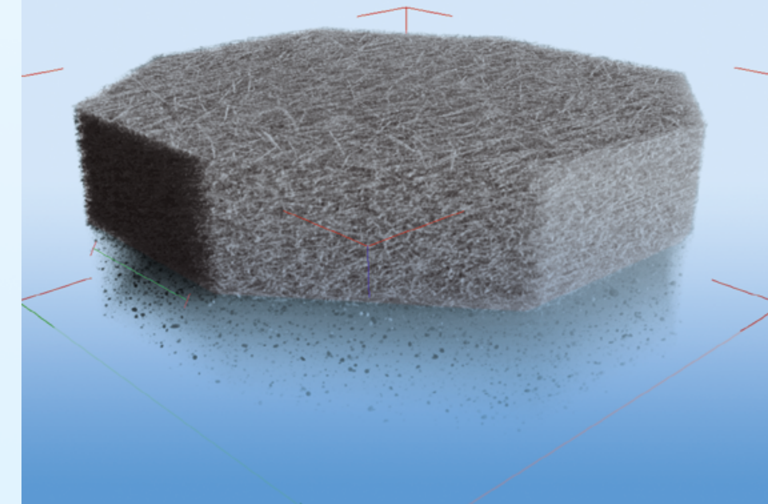
Microscopy

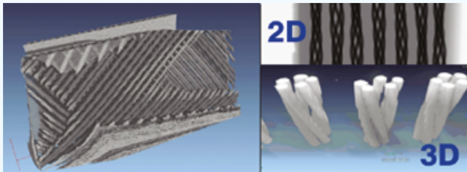


Microscopic Methods at DIK

Computed Tomography (CT)

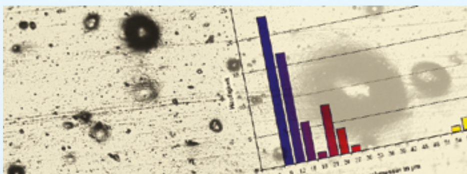
This non-destructive measurement procedure can be well applicated to polymer material characterization. Computed Tomography enables to measure a wide spectrum of parameters like crack initiation and crack growth, analysis of defects and inclusions, alignment of added particles and dispersion of additives such as carbon black or zinc oxide.

Technical specifications CT
GE Phoenix X-ray 180 kV / 15 W Nanotom



Light Optical Microscopy (LOM)

Light Optical Microscopy is widely used for analysis and quality control of polymer materials. DIK uses Light Optical Microscopy modes with reflected and transmitted light to analyse surfaces, cracks, fractures and morphological characteristics as well as the dispersion of fillers. The internally developed DIAS method enables to define the filler dispersion range in an investigated sample.



Technical specifications LOM

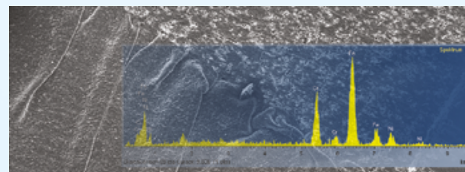
- Light Optical Microscope with phase contrast device, Zeiss Universal
- Stereo Microscope SR, Zeiss 9901
- Light Optical and incident light Microscope, Jena Jenavert
- Digital Microscope, Keyence VHX 600 with RZ20 and RZ100
- Dispersion Index Analysis System (DIAS)

Scanning Electron Microscopy (SEM)
Energy Dispersive X-ray Analysis (EDX)

Scanning Electron Microscopy is most commonly used in the polymer sector for surface analysis, representation of material contrasts, investigation of cracks and fractures and the measurement of layer thicknesses in micro-scale. To investigate topographical structures one can use the SE micrographs whereas BSE are suitable to illustrate material contrasts. The distribution of elements is investigated with EDX.

Technical specifications SEM
Zeiss EVO MA 10 (W-filament), high and low vacuum (VP 10 - 400 Pa)

Technical specifications EDX
Oxford Instruments, INCA (EDS 8100)
with element identification: ≥ 0.1 weight %

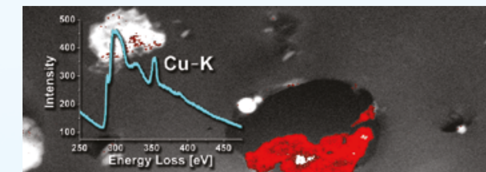


Transmission Electron Microscopy (TEM)
Ultramicrotomy / Cryo microtomy

The characterization of polymorphologies and fillers can be done by Transmission Electron Microscopy. Due to its resolution this method enables the investigation of the dispersion of fillers in the range of nanometers and subsequent allows to optimize the processing parameters of compounds. The distribution of elements is obtained by Electron Energy Loss Spectroscopy (EELS).

Technical specifications TEM
LIBRA 120 (Zeiss)

Technical specifications Ultramicrotomy
Reichert FC-4E
Leica Ultramicrotome UC6



Atomic Force Microscopy (AFM)

Atomic Force Microscopy is useful to investigate the surface roughness and material inhomogeneities as well as phase distribution and filler dispersion. This method can be combined with the white light sensor at DIK. Operation is possible in contact or non-contact mode.

Technical specifications AFM
FRT-AFM MicroProf 100
FRT-CWL 300