Qualitative Characterization of Multi-walled Carbon Nanotube thin films by GISAXS and SAXS

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Abstract
For optimization of biochemical processes (e.g. for biological and medical applications) under shear flow we investigate the complex interaction between macromolecules and fluid flow. In previous work we selected the multi-walled carbon nanotube (MWCNT) as model macromolecule. In this study first the morphology (i.e. structure and orientation) of the MWCNTs is determined without shear flow.

MWCNT thin films are close packed areas of upright standing MWCNTs. The MWCNTs thin films are produced using a conventional tube furnace aerosol-assisted chemical vapor deposition technique in cooperation with the Institute of Polymer Composites (TUHH).

Scanning electron microscope (SEM) images are the common way to get a qualitative view on the morphology of MWCNT thin films. The disadvantage of SEM is that it is impossible to take SEM images of in-situ measurements. Grazing-incidence small-angle X-ray scattering (GISAXS) and Small-angle X-ray scattering (SAXS) on the other hand enable in-situ measurements.

In cooperation with the Deutsches Elektronen Synchrotron (DESY, Hamburg) we participated in measurements at beamline P03 and BW4 (HASYLAB) to perform GISAXS and SAXS measurements. To determine if either GISAXs or SAXS is more practical in use and to optimize the setup both techniques are tested and compared with the SEM images.

After the successful GISAXS and SAXS measurements without shear flow measurements of the flow field are planned in the near future. The flow field is measured based on micro Particle Image Velocimetry (micro PIV) at the Institute of Multiphase Flows (TUHH). The results based on morphology (GISAXS and SAXS; DESY) and flow field (IMS; TUHH) give a better understanding of the complex interaction between fluid and structure. These model experiments with MWCNTs allow for extending the research to the structure determination of protein thin films under shear flow and to understand their catalytic activity.

Search:
- High-speed camera

Provide:
- SEM images of MWCNT thin films
- GISAXS and SAXS experience