

Polymer analytics: Methods

Optical spectroscopy

- FTIR and Raman spectroscopy for qualitative and quantitative polymer analysis
- FTIR and Raman microscopy for characterization of contaminations/inclusions as well as analysis of heterogeneities
- Confocal Raman microscopy for analysis of polymers, materials, depth profiles, 3D, surfaces, structures and defects and phase separations
- Particle analysis in the range from 1 μm up to a few mm
- Raman imaging
- In-situ and temperature dependent Raman microscopy
- Surface enhanced Raman spectroscopy (SERS)
- Nano-IR system for IR spectroscopy at nanoscale (AFM-IR)

FTIR spectroscopy
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Raman and particle analysis
including microplastics analysis
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NMR spectroscopy

- ^1H , ^{13}C , ^{19}F and hetero-nuclear NMR spectroscopy for structure characterization of soluble polymers and small molecules (1D and 2D NMR methods)
- ^1H and ^{13}C HRMAS NMR spectroscopy for the characterization of swellable substances (1D and 2D NMR methods)

Elemental analysis

- Elemental analysis for C, H, N and S

NMR spectroscopy and elemental analysis
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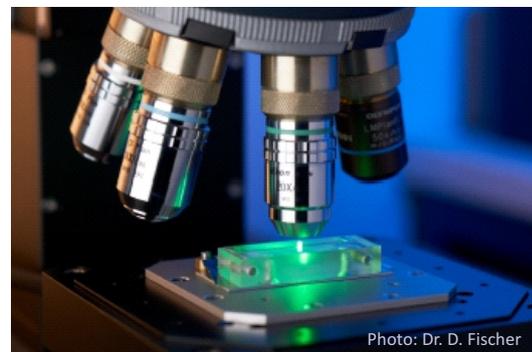


Photo: Dr. D. Fischer

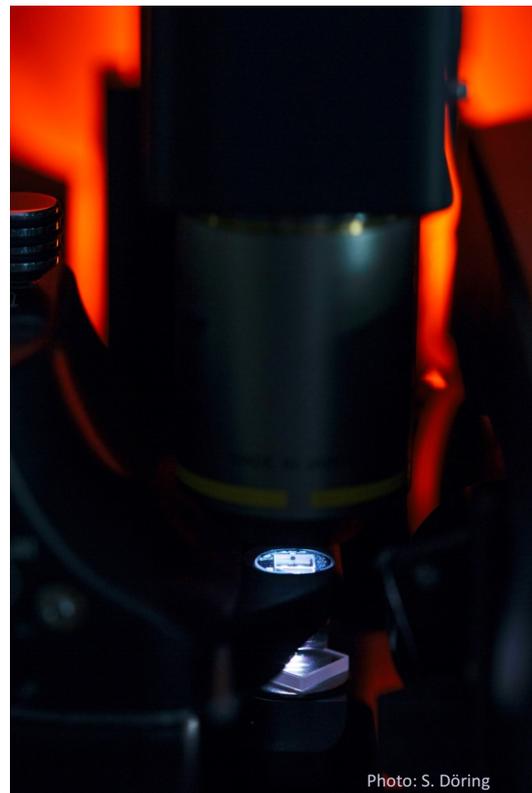
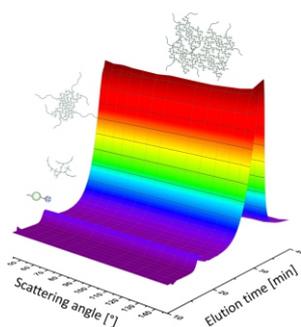


Photo: S. Döring



Angle-dependent light scattering signals of a biohybrid system separated by asymmetrical flow field flow fractionation

Optical characterization of thin films

- Spectroscopic ellipsometry for determination of film thickness, optical dispersion, and anisotropy of absorbing and transparent polymer films with thicknesses of 1-1000 nm
- Müller matrix microscopy for analysis of optically biaxial layers in transmission, in dry state or microfluidic cell
- Quartz crystal microbalance in combination with spectroscopic ellipsometry for simultaneous characterization of optical and mechanical properties

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Thermal analysis

- Thermogravimetric investigations of thermal and thermo-oxidative degradation of polymers, analysis of volatile compounds by coupled FTIR spectroscopy
- Dynamic differential calorimetry for the investigation of melting, crystallization and glass transition behavior as well as solid-solid phase transitions and cross-linking reactions in polymers

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Chromatography, fractionation and light scattering

- High and ambient temperature size exclusion chromatography (SEC) for determination of molar mass distributions in organic and aqueous media
- Light scattering and viscosity detection, in batch or on-line for absolute determination of molar masses as well as dimensions, conformations, thermodynamic parameters of macromolecules, nanoparticles and conjugates
- Asymmetrical flow field flow fractionation (AF4) and thermal field flow fractionation (thFFF) for the separation and characterization of polymers and macromolecules in the range of $10 - 10^6$ kg/mol
- Gas chromatography: classical, head-space and pyrolysis GC coupled with mass spectrometry for qualitative determination of volatile compounds

Matrix-assisted laser desorption ionization mass spectrometry (MALDI-TOF-MS)

- Determination of molar masses and their distributions, characterization of cyclic and linear structures and monomer units with special start and end groups
- Analysis of reaction mechanisms of synthetic polymers and bio-macromolecules
- Coupling of MALDI with chromatographic techniques for the characterization of molecular and chemical heterogeneities in homo and block copolymers

Chromatography, fractionation, light scattering and MALDI-TOF-MS

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