

## Center Macromolecular Structure Analysis: 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, deep profiles, 3D, surfaces, structures and defects and phase separations
- Particle analysis in the range from 1  $\mu\text{m}$  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  
Dr. Mikhail Malanin  
E-Mail: malanin@ipfdd.de  
P +49 (0)351 4658 342

Raman and particle analysis  
including microplastics analytic  
Dr. Dieter Fischer  
E-mail: fisch@ipfdd.de  
P +49 (0)351 4658 268

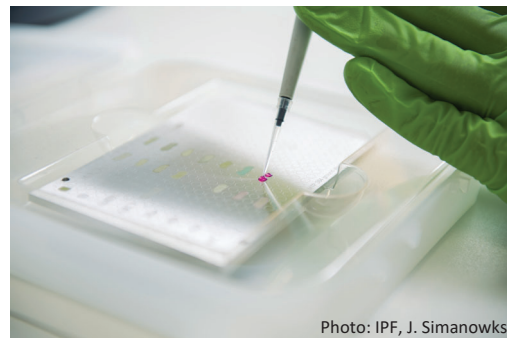


Photo: IPF, J. Simanowski



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### NMR spectroscopy

- $^1\text{H}$ ,  $^{13}\text{C}$ ,  $^{19}\text{F}$  and hetero-nuclear NMR spectroscopy for structure characterization of soluble polymers and small substances (1D and 2D NMR methods)
- $^1\text{H}$  and  $^{13}\text{C}$  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  
Dr. Hartmut Komber  
E-mail: komber@ipfdd.de  
P +49 (0)351 4658 343

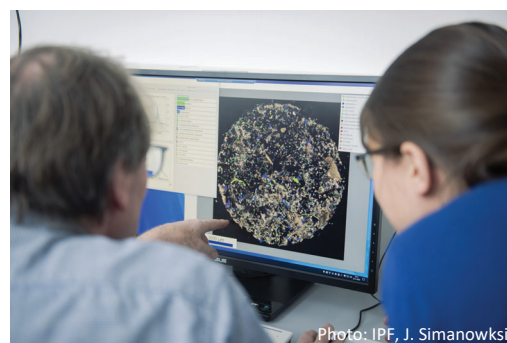
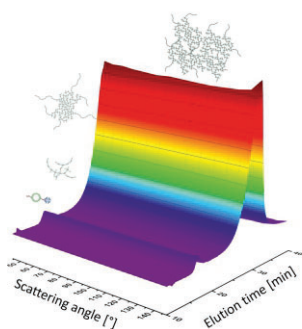


Photo: IPF, J. Simanowski



AF4-MALLS of complex bioconjugate architectures.

### Optical characterization of thin films

- Spectroscopic ellipsometry for determination of film thickness, optical dispersion, and anisotropy of absorbing and transparent polymer films thickness 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

Dr. Eva Bittrich  
E-mail: bittrich-eva@ipfdd.de  
P +49 (0)351 4658 343

### Thermal analysis

- Thermogravimetric investigations of thermal and thermo-oxidative degradation of polymers, analysis of volatile compounds by coupled FTIR spectroscopy and GC-MS
- 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

Dr. Susanne Boye  
E-mail: boye@ipfdd.de  
P +49 (0)351 4658 648

### 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 – 106 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  
Prof. Dr. Alben Lederer  
E-mail: lederer@ipfdd.de  
P +49 (0)351 4658 356

## Contact

### Leibniz-Institut für Polymerforschung Dresden e.V.

Center Macromolecular Structure Analysis

Prof. Dr. Alben Lederer  
E-Mail: lederer@ipfdd.de  
P +49 (0)351 4658 491  
F +49 (0)351 4658 565

Hohe Straße 6 . 01069 Dresden . Germany  
[www.ipfdd.de](http://www.ipfdd.de)