Raman & SEM Group (PD Dr. N. P. Ivleva)

Institute of Water Chemistry
Chair of Analytical Chemistry and Water Chemistry
TUM School of Natural Sciences, Department of Chemistry
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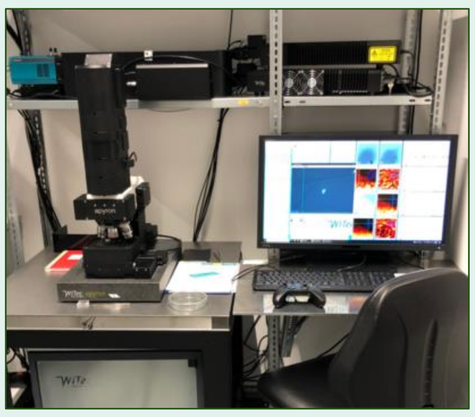
Analytical Methods

Raman Microspectroscopy

Combination of Raman Spectroscopy with Optical Microscopy



- Non-contact & non-destructive
- Vibrational fingerprint spectra
- Spatial resolution in µm-range: single-cells/-particles
- Chemical 2D & 3D imaging
- No interference of water

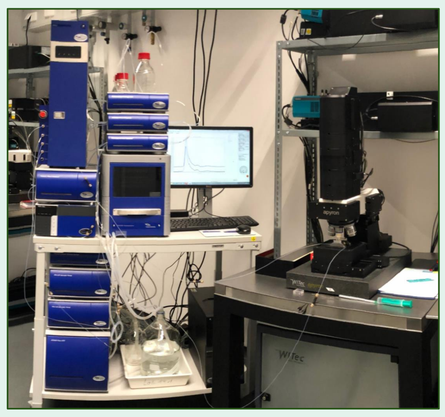
Scanning Electron Microscopy

Field emission SEM with Variable Pressure and Cryo Options

- Spatial resolution in nm-range
- Elemental composition based on characteristic X-rays (EDX)
- Analysis of non-conducting, water-containing and sensitive samples

Field Flow Fractionation

Flow-based Fractionation of nm-sized Particles

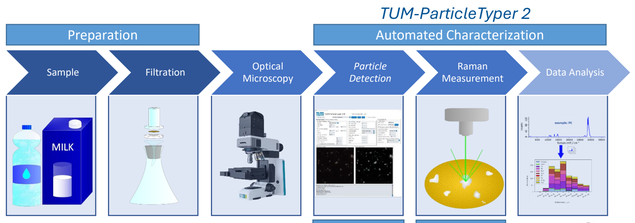


- Size fractionation based on separation force fields and diffusion properties of particles
- Asymmetrical flow field flow fractionation (AF4)
- Centrifugal field flow fractionation (CF3)

Research Topics

Analysis of Plastic Particles in Water and Food

- Problem: Missing of established methods for the quantification and identification of small plastic particles in real samples to assess health risks
- Goal: Analysis of water and milk samples down to 0.5 µm with *TUM-ParticleTyper 2 Software*. Analysis of nanoplastic particles in real matrixes with online coupling of field flow fractionation (FFF) and Raman microspectroscopy.



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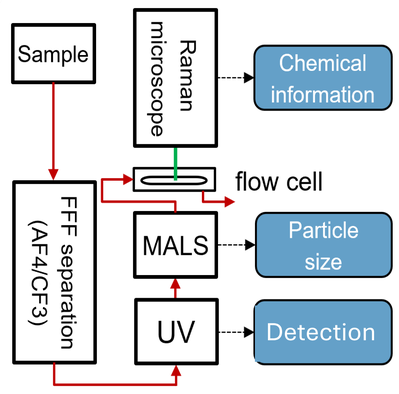
Analysis of Nanoplastic Particles

- Online coupling of field flow fractionation (FFF) and Raman microspectroscopy for separation and chemical identification of particles (<5 µm)
- Optical trapping of particles in a flow cell enables acquisition of Raman spectra
- Optimization for real (environmental) samples
- Quantification of nanoplastics using Nanoparticle Tracking Analysis (NTA)
- Morphological characterization using SEM



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Microplastic Particles in Alpine Region

- Problem: Despite significant laboratory advancements, a gap remains in practical and commercial applications for analysis of micro/nanoplastics
- Aim: Establishing and advancing reliable analytical tools and methods for precise measurement and surveillance of micro/nanoplastics in the environment
- Workflow: 1. Sample Collection and Preparation
  2. Laboratory Analysis and Data Evaluation
  3. Knowledge Transfer to Local Industry and Authorities

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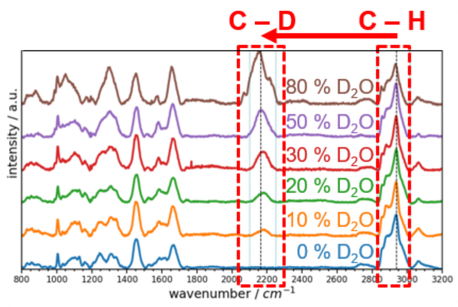
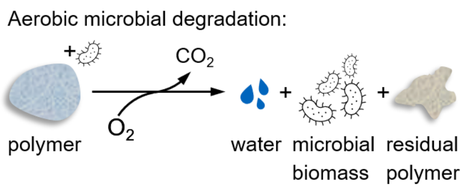
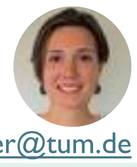
Biodegradability of Microplastic Particles

- Method development to monitor conversion of microplastics into final degradation products (CO_2, H_2O and microbial biomass)
- Trace heavier stable isotopes from labelled polymer into microbial biomass with Stable Isotope Raman Microspectroscopy



Mean Raman spectra of 50 *S. koreensis* cells incubated with different ratios of D_2O as reference spectra for deuterated cells.





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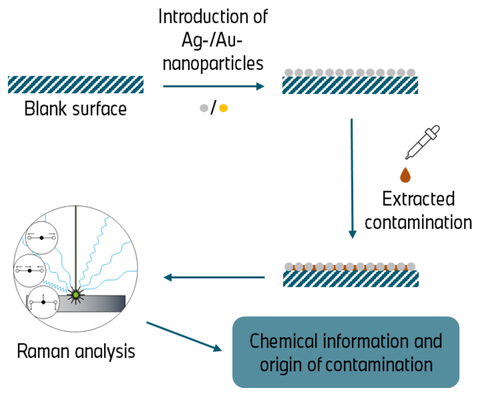
SERS-analysis of filmic contaminations

- Problem: Residue of organic substances, e.g. lubricants, on workpieces can interfere with the technical cleanliness by leading to the arise of weld spatter or reduced adhesion ability
- Aim: Establishment of an analytical method based on surface–enhanced Raman spectroscopy (SERS) for the sensitive detection and identification of thin filmic contaminants



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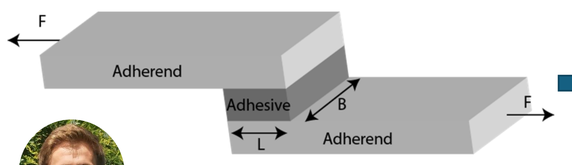
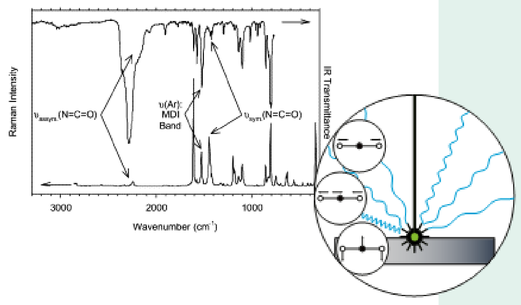
Nondestructive analysis of adhesives

Replacement of destructive lap-shear test due to high cost and low sustainability

- Tracking of polymerisation process via Raman and IR spectroscopy under varying environmental conditions
- Combination of spectroscopic data with destructive analysis to develop prediction models for the strength of adhesives





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https://www.ch.tum.de/hydrochemistry/raman-sem

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