Institute of Hydrochemistry
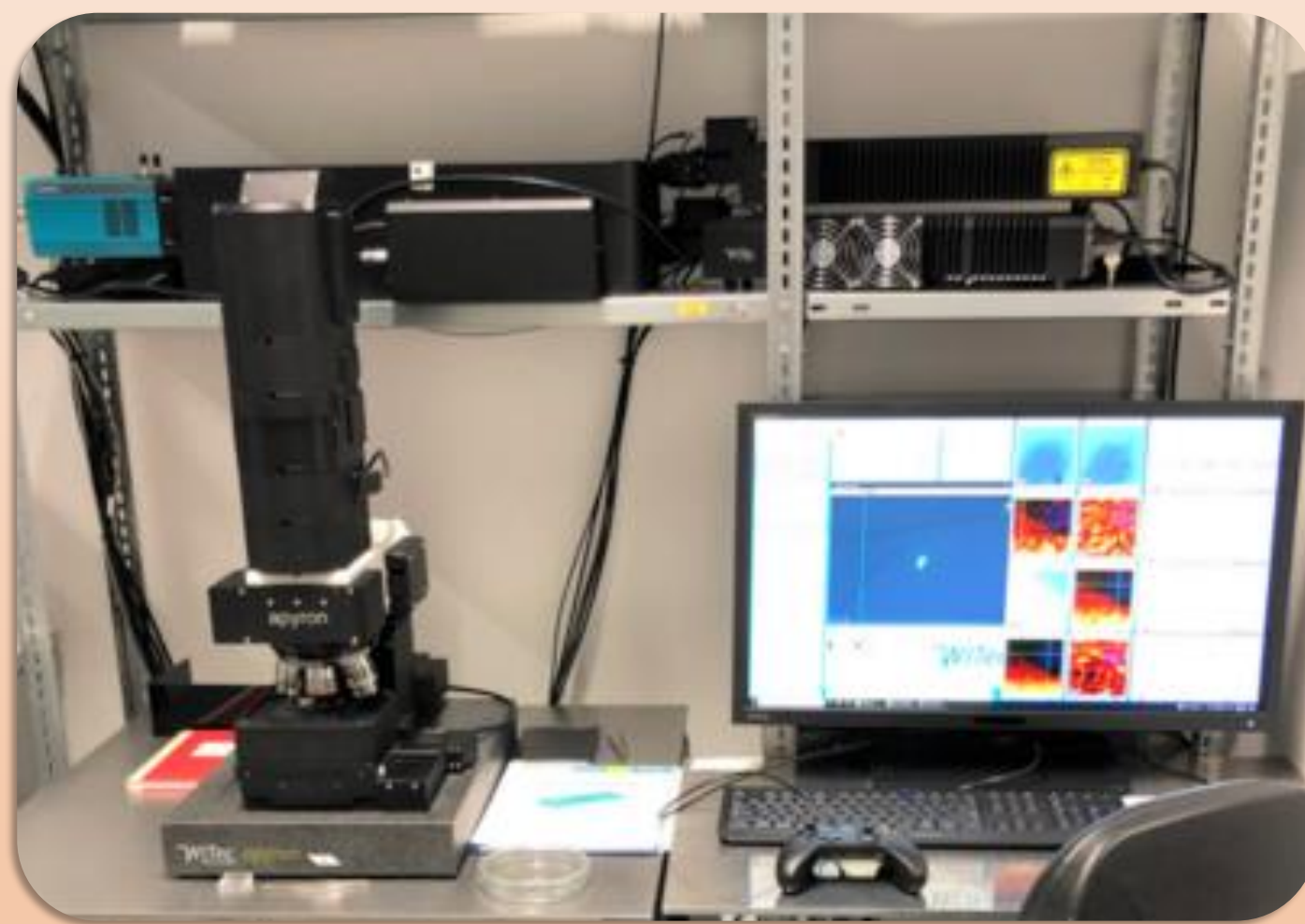Chair of Analytical Chemistry and Water Chemistry (Prof. Dr. Martin Elsner)

# Raman & SEM Group: Research Topics

## Raman Microspectroscopy

**Combination of Raman spectroscopy with confocal optical microscopy**

- Non-contact & non-destructive
- Vibrational fingerprint spectra
- Spatial resolution in µm-range
- 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

## Biofilms in Microbial Fuel Cells

Irina Beer

**Goal: *In situ* characterization of biofilms from microbial fuel cells (MFC)**

- Finding possible electron shuttle mechanisms in MFC biofilms for electricity generation
  ⇒ "system of carotenoids"
- Characterization of the biofilm's integrity
- Visualization of the biofilm's structure on the µm-scale via SEM
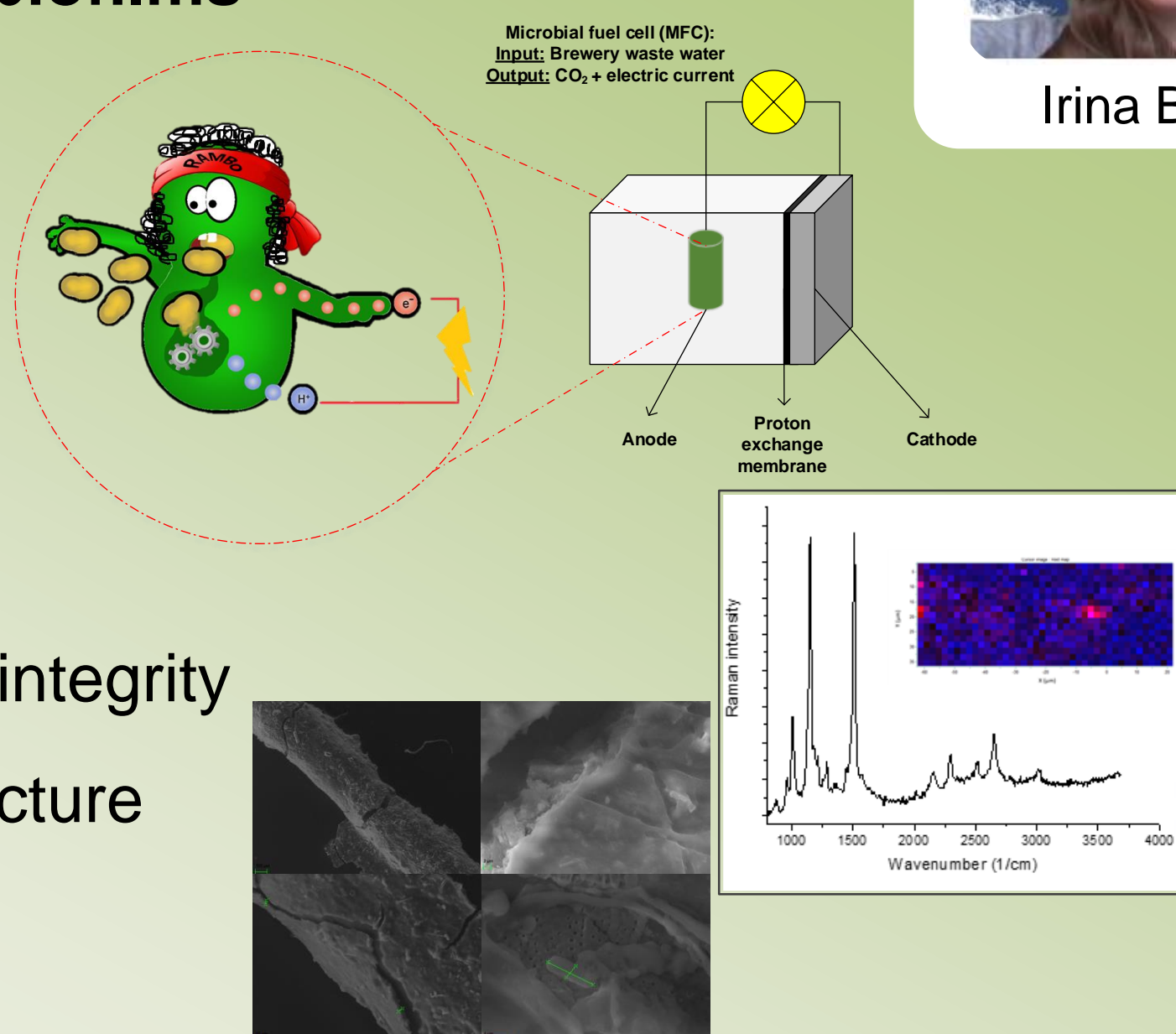
## Automated Analysis of Microplastics

Oliver Jacob

**Goal: Detection, identification and quantification of micro-plastic particles (1 µm–5 mm)**

- Development, validation and testing of an automated Raman-based method
- Image analysis employing *TUM-ParticleTyper*
- Characterization of environmental samples
- 2D & 3D imaging in biota samples
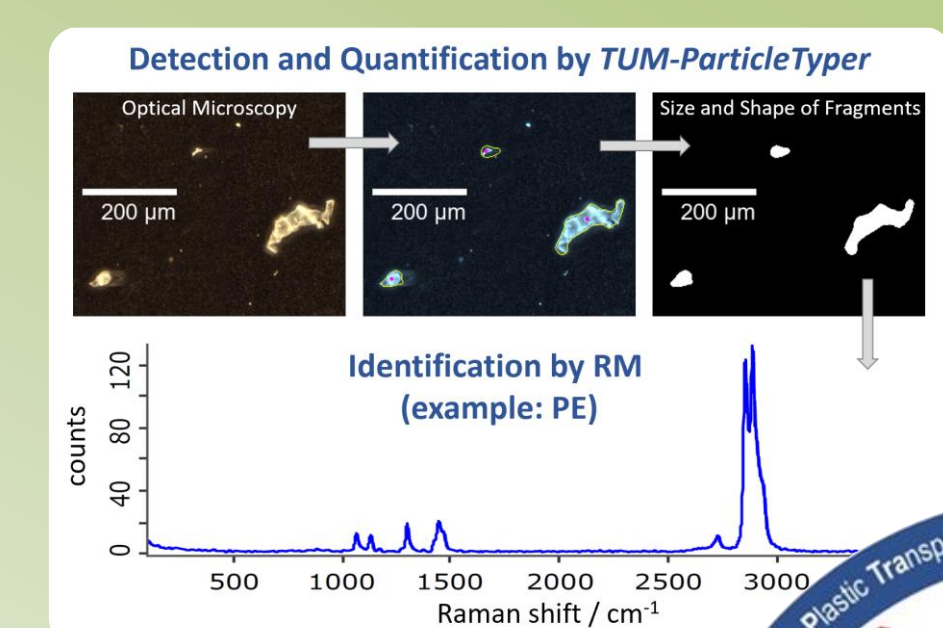
## Biodegradation of Microplastics

Kara Müller

**Goal: Directly track $^{13}C$ from polymer into microbial biomass**

- Reverse and direct stable isotope labeling
- Red-shift due to heavier isotopes
- Analysis of single cells shows phenotypic heterogeneity
- Resonance Raman with chromophoric carotenoids
- Experiments with mono- and multi-species biofilms
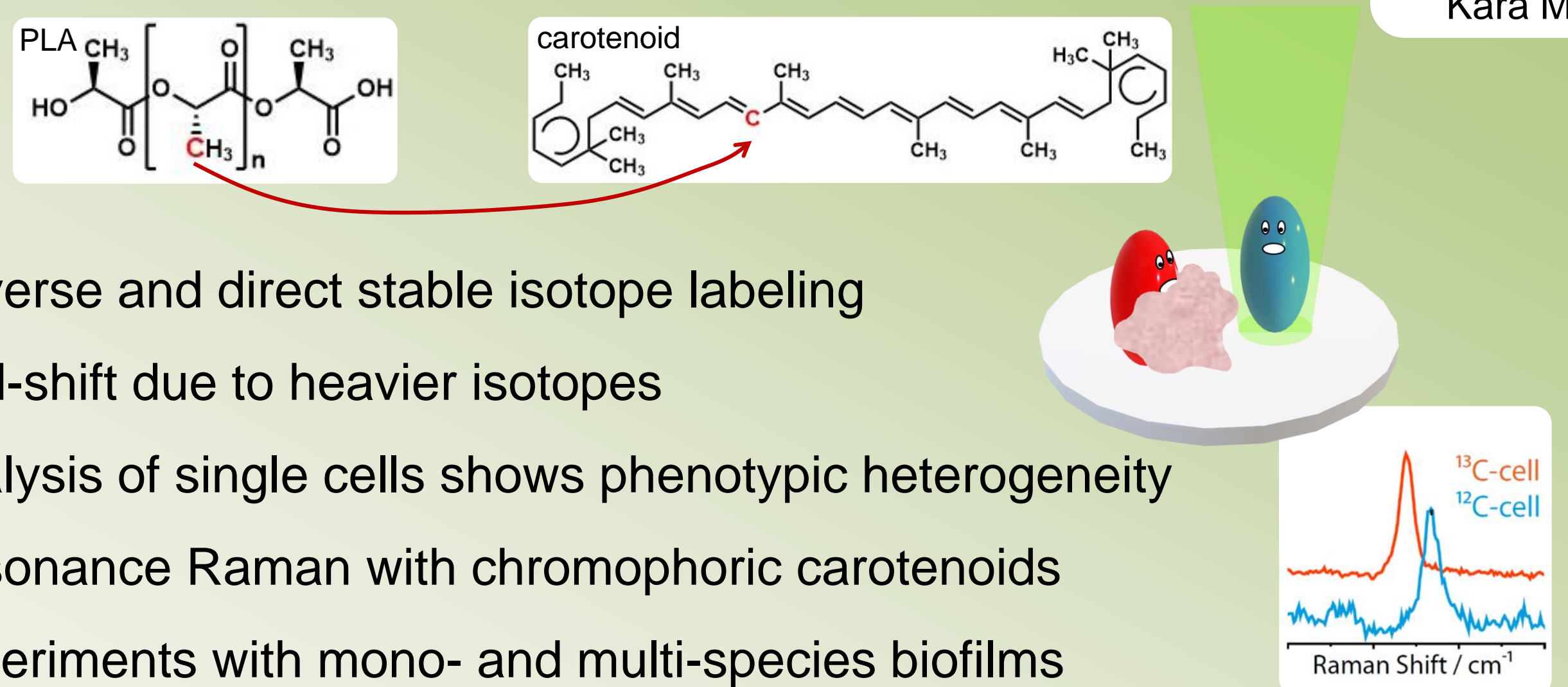
## Online Analysis of Nanoplastics

Maximilian Huber

**Goal: Detection methods for (plastic) particles < 1 µm**

- Online coupling of field flow fractionation (FFF) and Raman microspectroscopy for separation and chemical identification of particles
- Asymmetrical flow (AF4) & centrifugal FFF (CF3)
- Optical trapping of particles in a flow cell enables acquisition of Raman spectra
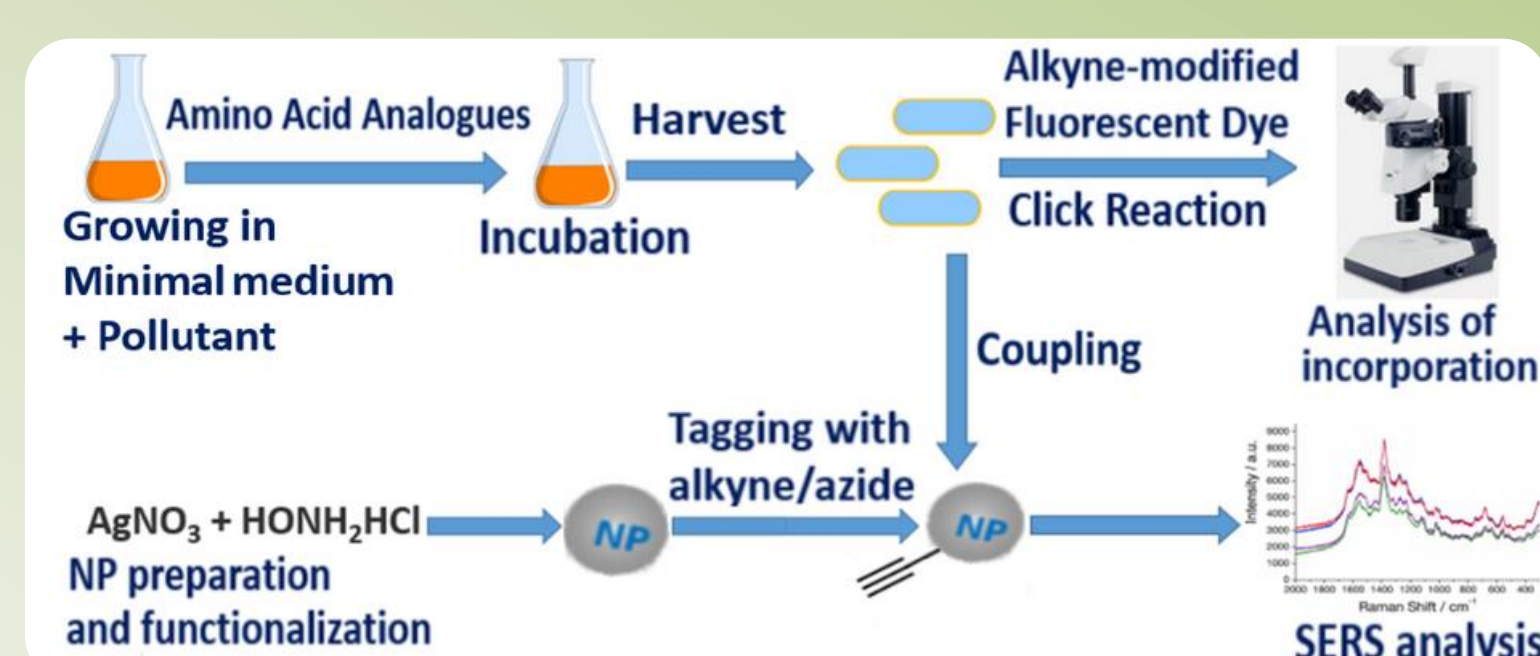- Optimization for real (environmental) samples

## Degradation of Organic Pollutants

Oleksii Morgaienko
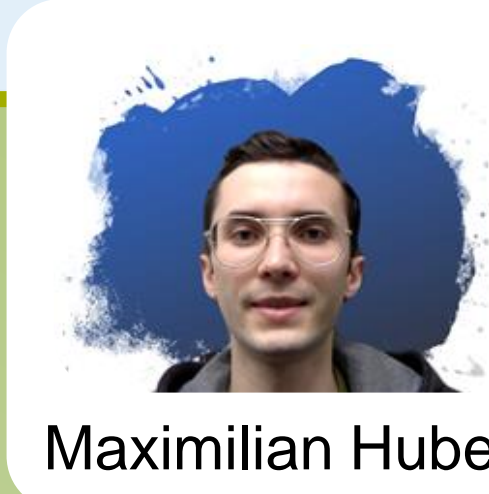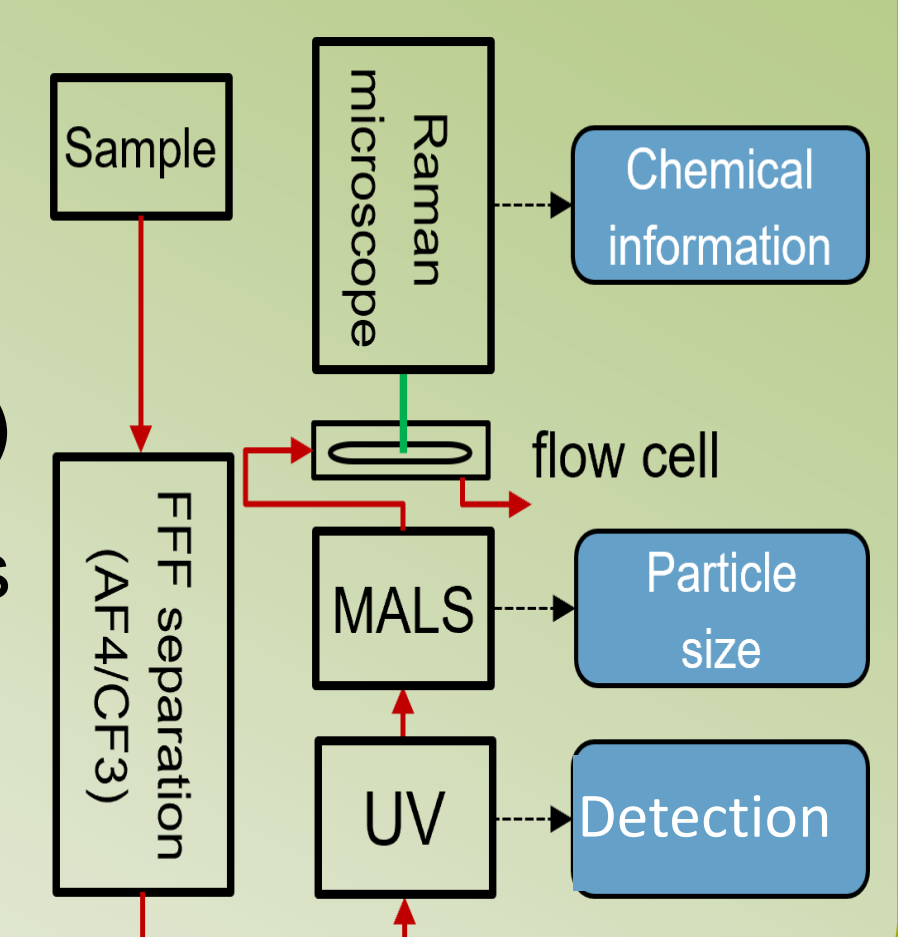
**Goal: Visualize active bacteria responsible for degradation of organic pollutants**

- BONCAT: Bioorthogonal noncanonical amino acid tagging
- SERS: Surface-enhanced Raman scattering
- Coupling BONCAT-SERS
- Visualize and characterize active bacteria

## Metallic Particles in Electrified Drive Systems

Maria Lanzinger

**Goal: Identify particle sources in industrial production by determining structural and elemental composition**

- Laser induced breakdown spectroscopy (LIBS): elemental analysis (qualitative and quantitative)
- Raman spectroscopy: structural information
- Characterization of particles (minerals, metals, polymers) to identify and eliminate particle sources in engines
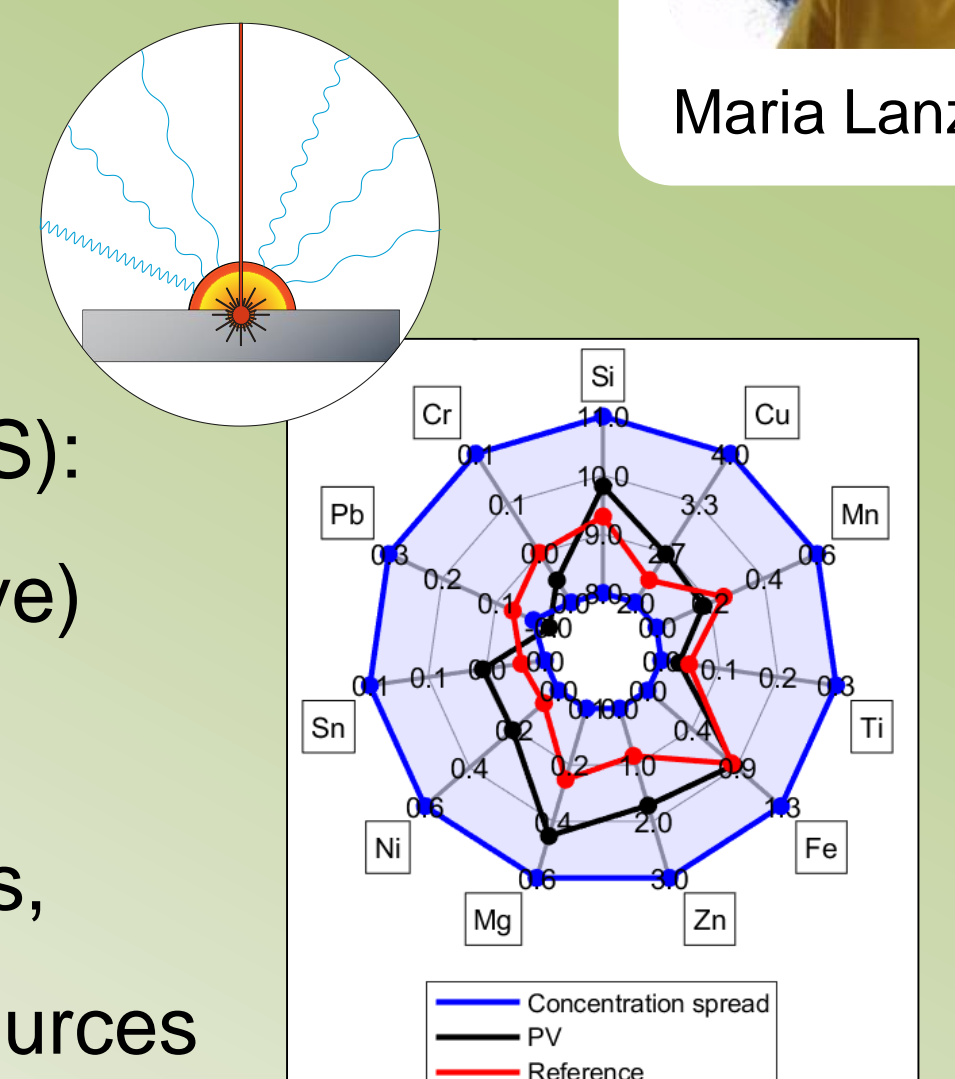
*This work is performed at BMW Group.*

**More information on our team, research topics, equipment and publications at https://www.ch.tum.de/hydrochemistry/raman-sem/**

Alejandro Ramirez Pinero

Julian Weng

Christian Schwaferts

Alexander Thomas

**Contact:**

PD Dr. Natalia P. Ivleva (Head of Raman & SEM Group)

E-Mail: natalia.ivleva@tum.de

Tel.: +49 (0) 89 289 54 507

Lichtenbergstraße 4, D-85748 Garching (Lab: CH 32214)